2021

Characteristics of Rural STEM Clubs and Implications for Students with Disabilities

Karin M. Fisher
Georgia Southern University, kfisher@georgiasouthern.edu

Peggy Shannon-Baker
Georgia Southern University, pshannonbaker@georgiasouthern.edu

Kelly Brooksher
Georgia Southern University, kbrooksher@georgiasouthern.edu

Kania Greer
Georgia Southern University, kagreer@georgiasouthern.edu

Characteristics of Rural STEM Clubs and Implications for Students with Disabilities

Karin M. Fisher, PhD.
Peggy Shannon-Baker, PhD.
Kelly Brooksher, EdD.
Kania Greer, EdD.

Georgia Southern University

Abstract

There are many benefits for students to participate in extracurricular science, technology, engineering, and mathematics (STEM) activities or clubs. It is also known that students with disabilities (SWD) do not participate as much as their peers without disabilities (SWOD). However, there is a lack of research on SWD and their participation in STEM clubs. This sequential explanatory mixed method study explored teachers' perceptions of the types and characteristics of STEM clubs and their participants, and their professional development (PD) to work with SWD in their clubs. Findings suggest a variety of STEM clubs are offered with an average of 20 students each but most participants did not know how many SWD were in their clubs. None had PD to work with SWD in informal environments. A discussion of findings include accommodations STEM club sponsors can use with SWD.

Keywords: STEM, students with disabilities, clubs, extracurricular Activities, rural, teachers, mixed methods

Characteristics of Rural STEM Clubs and Implications for Students with Disabilities

Science, technology, engineering and mathematics (STEM) education is not limited to the formal P-12 classroom. In fact, children spend a little more than 1,200 hours (180 days by 7 hours a day) in school which is only 20% of their waking hours. All children are natural scientists at birth, as they discover and explore, trying to make sense of their worlds (Bers, 2008). Since children are learning all the time, informal learning programs like school based extracurricular activities, have the capability to engage, inspire, and stimulate interest by letting them experiment with STEM ideas in real-world situations. Extracurricular STEM programs "are increasingly recognized as playing a valuable role in improving...STEM education" (Afterschool Alliance, 2015, p. 9).

Due to the ever-increasing demands of class time, many students without disabilities (SWOD) having their interest in STEM met after school through clubs and other extracurricular activities (Afterschool Alliance, 2015). Research is prevalent on the positive impact of extracurricular activities on student development (e.g., Darling et al., 2005; Fredericks & Eccles, 2006; McGuire & McDonnell, 2008; Shulruf et al., 2008). Several studies indicated inquiry-based afterschool STEM programs have similar gains (Lauer et al., 2006; Makitalo-Siegl et al., 2011). In 2009, the National Research Council published a report that examined informal STEM learning settings, like STEM clubs, and found learners experience excitement, interest, and motivation about STEM subjects and begin to think of themselves as science learners. Additionally, Cutucache

and colleagues (2018) found an increase in STEM content knowledge in participants of an afterschool STEM club. Indeed, students make gains when they participate in STEM clubs, however, fewer SWD participate in extracurricular activities than their peers without disabilities (U.S. Department of Education, 2013; Kleinert et al, 2007).

Coster and colleagues (2012) found in their study that 62% of parents of SWD indicated their child never participated in teams, clubs, and organizations in their schools or communities. This is surprising given the specific directions for IEP teams to consider SWD participation in non-academic activities by the Individual with Disabilities Education Act (IDEA; 2004). In fact, Power and colleagues (2005) reviewed the Individual Education Programs (IEPs) of almost 400 SWDs and found only 11% included information related to extracurricular involvement.

Researchers also found barriers to traditional STEM education for SWD to include low expectations, limited exposure to prerequisite courses, and lack of role models and access to individualized supports (Alston et al., 2002; Lee, 2011; Rule et al., 2009). Another study by Eriksson and colleagues (2007) found lower participation rates of SWD in unstructured STEM related activities compared to their peers. Research also indicates students in rural areas have additional barriers related to participation in STEM clubs.

Rural schools are often challenged when it comes to offering a variety of after-school activities and in preparing students to become STEM literate (Schafft & Jackson, 2011). Rural school districts often lack access to specialists, have few discretionary resources, and students tend to be geographically isolated (Feinberg et al., 2005). In addition, many rural students face transportation issues, have trouble accessing technological advances (Spencer, 2017), have limited access to advanced coursework in mathematics and science (National Science Board, 2014), and face economic barriers that impact educational opportunities for future employment (Lapan et al., 2007). For example, students in small rural schools are less likely than their urban counterparts to take algebra in the 8th Grade (Spielhagen, 2006) or calculus in high school (Kena et al., 2016).

According to the National Center of Education Statistics (NCES; 2015), rural students are substantially less likely to attend college compared to their urban, or suburban counterparts. With these barriers, the potential lack of involvement and support of SWD in afterschool activities could further increase the achievement gap between SWOD and SWD in STEM content areas. The Afterschool Alliance (2016) found there is a strong demand for more quality afterschool and summer learning programs for rural children. However, Hott and colleagues (2019) found teachers in rural districts have difficulty accessing needed Professional Development (PD) and that lack of access may impact quality and quantity of STEM clubs.

There is a distinct lack of research on the types and characteristics of extracurricular STEM activities and the characteristics of the participants in rural areas and what PD teachers/sponsors have received to work with SWD in their clubs. The rationale for the current study is to identify extracurricular STEM clubs in two rural districts and study the recruitment, retention, and PD/knowledge of working with SWD by the teacher/sponsor to add to the literature base of SWD and STEM clubs. The following research questions (RQ) guided this exploratory study:

RQ1: What types of STEM extracurricular activities are offered in the two rural districts?

RQ2: What are the characteristics of the clubs and their participants?

RQ3: What professional development has the teacher/sponsor had to work with SWD?

Method

The study focused on two rural counties in the Southeast United States (U.S.) where a convenience sample of 16 teachers/sponsors completed a survey and 69% (n =11) participated in follow-up interviews. According to the National Center of Educational Statistics (2019) the locale of district 1 is rural: distant and district 2 is rural: fringe.

Table 1.
District Locale

District in study	Type	Miles from urban area	Population
1	Rural: Distant	5-25	>50,000
2	Rural: Fringe	2.5-10	2500-50000

As noted in Table 1, rural: distant is defined as rural territory that is between 5 and 25 miles from an urbanized area (populations greater than 50,000) and between 2.5 and 10 miles from an urban cluster (populations between 2,500-50,000). Rural: fringe is defined as rural territory less than 5 miles from an urbanized area and less than 2.5 miles from an urban cluster. Next, the researchers used National Center for Education Statistics (NCES; 2019) data to define the locale for each school that had a sponsor participate in the study. Table 2 describes each school.

Table 2.
School Locale Definitions

School	Number of Participants	Locale	Number of Students (17-18)
Elementary School 1	3	Suburb: Large	669
Elementary School 2	1	Rural: Distant	452
Elementary School 3	1	Rural: Distant	384
Elementary School 4	1	Rural: Fringe	1,225
Middle School 1	1	Rural: Fringe	710
Middle School 2	1	Rural: Fringe	1,775
Middle School 3	1	Rural: Distant	812
Middle/High School	1	Rural: Distant	441

High School 1	2	Suburb: Large	2,722
High School 2	1	Town: Distant	1,640
High School 3	1	Rural: Distant	563

Schools

Elementary school 1 is a large suburban school with 669 students in the 2019-2020 academic year. White students represent 67% of the student population, 13% are black, 10% are Hispanic, and 6% are multi-racial. Economically disadvantaged students represent 13% of the population and 8% have disabilities. The researchers included this school in the study even though it is located in a suburban area because it is located in a predominantly rural county.

Elementary school 2 is a rural school with 452 students. White students represent 69% of its population, 22% are black, and 5% are multi-racial. Economically disadvantaged students make up 37% of its population and 17% are identified as having a disability.

Elementary school 3 is a rural school with 384 students in the 2019-2020 school year. Its student population is 59% white, 26% black, 8% Hispanic and 7% multi-racial. Over 50% of this school's students are from low income families. Students with disabilities represent 13% of its student population and 4% are English Language Learners.

Elementary school 4 is a large rural school with 1,225 students in the 2019-2020 school year. White students make up 79% of its population, 7% are Hispanic, 6% are black, and 5% are multi-racial. Only 3% of its students are economically disadvantaged and 8% are identified as having a disability.

Middle school 1 is a rural school with 710 students. Black students represent 65% of its population, 21% is white and 10% is multiracial. Economically disadvantaged students represent 54% of the population and 19% are identified as having a disability. Additionally, 5% are English language learners.

Middle school 2 is a rural school with 1,775 students. White students represent 67% of its population, 14% are black students, 10% are Hispanic, and 5% are multiracial. Economically disadvantaged students represent 9% of its student population and 10% are identified as having a disability.

Middle school 3 is a rural school with 812 students in 2019-2020. White students represent 80% of its population, 11% are black, and 4% are multiracial. Economically disadvantaged students represent 22% of its student population and 15% are identified as having a disability.

One of the schools represented in our population was a combination middle and high school (grades 6-12) representing 441 students. White students represent 58% of the student population while 32% are black. Hispanic students represent 6% of the population. Economically disadvantaged students represent 35% and 12% have disabilities.

High school 1 is a large suburban school with 2,272 students. White students make up 64% of its population and 16% are black. Hispanic students represent 10% and 6% are considered multiracial. Only 7% are economically disadvantaged and 9% have a disability. This high school has a 91% graduation rate. The participants from this school were included in our study because this suburban high school is located in a rural county.

High school 2 has 1,640 students in the 2019-2020 school year. Black students represent 49% of the population, 38% are white, and 8% are Hispanic. Economically disadvantaged students represent 34% of the population and 14% are identified as a SWD. This high school was included in our study because it is located in a rural county.

High school 3 is a small rural school with 563 students. White students represent 67% of the population while 24% are black. Hispanic students represent 3% and 26% are considered economically disadvantaged. Students with disabilities make up 16% of the population.

Participants

Of the 27 potential teachers on the initial list, 18 teacher/sponsors responded and 16 completed the survey for a response rate of 59%. Table 3 displays the demographics of the 16 survey participants. The participants were half male and half female. They were predominantly white (94%). Most of the participants (38%) represented elementary schools and 25% of the participants in the survey did not state what school they represented. The surveys were sent at the beginning of April and all 16 responses were received by the end of May.

Of the 16 participants in the survey, 14 (88%) identified where their clubs meet and represent 11 different schools. As seen in Table 2, 73% (n = 8) of the schools were identified as being in rural areas. However, 42% (n = 6) of the 14 participants who answered the question on the survey did not teach at schools identified as rural because the two schools from suburban areas had multiple teachers participate in the survey.

Table 3.
Descriptive Statistics of Survey Participants

	N = 16	% of N
Gender		
Male	8	50%
Female	8	50%
Ethnicity		
Caucasian	15	94%
Hispanic	1	6%
District		
District 1	9	56%

District 2	7	44%
School Level		
Elementary	6	38%
Middle	1	6%
Middle/High combined	1	6%
High	4	25%
No response	4	25%

The researchers used a sequential explanatory mixed methods design (Creswell & Plano Clark, 2017). The design typically begins with a quantitative phase followed by a qualitative phase used to help explain, extend, and/or complexify the findings from the quantitative phase (Griffin, 2012; Plano Clark & Ivankova, 2016). These designs also typically use the findings or sample from the quantitative phase to identify participants for the qualitative phase (Creswell & Plano Clark, 2017). Multimethod and mixed methods research approaches have been shown to enhance the interpretations of and provide a richer picture of special education processes (e.g., Collins et al., 2006; Hott et al., 2019). Data were collected in two phases for this study: Phase I entailed an online survey of teachers/coaches who lead STEM extracurricular activities, and Phase II consisted of individual semi-structured interviews with survey participants.

Phase I: Quantitative Survey Implementation and Analysis Procedures

The survey sent to teachers/sponsors was modified from a previous study about after school STEM activities in another southeast state (Fisher, 2016). The purpose of that research study was to identify the types of afterschool STEM activities, inclusion of SWD in STEM activities, types of SWD, number of SWD who participated in the activities and then compared district STEM offerings with standardized 8th grade science scores of SWD. The results of that study were that most districts do not track the number of SWD in their STEM clubs, the largest category of SWD who do participate were students with learning disabilities (SLDs), and there was a small positive correlation between the number of STEM clubs offered in a district and the results of the 8th Grade standardized science scores for SWD.

Two experts in the field of STEM education reviewed the questionnaire for clarity, coverage, face, content, and construct validity. The survey was revised based on their feedback and approved by the Institutional Review Board (IRB). The survey consisted of 19 questions and is available in Appendix A. In order to increase the response rate, the length of the survey was purposefully kept short (Dillman, 2000; Mavletova, 2013). The overall survey focus was to determine the types of STEM extracurricular activities offered, the characteristics of the clubs and their participants, and the knowledge/PD of the teacher/sponsor to work with SWDs.

The first section contained questions aimed at collecting basic information about the clubs and teacher/sponsors, such as the types of clubs offered, which club(s) the participant coached, and their experiences leading clubs. The third section contained questions about the number of

students who participated in the club, their age ranges, and information about any SWDs known to the teacher/sponsor in the club (e.g., type of disabilities, number of students). The survey also asked if the teacher/sponsor ever received PD to work with SWD in extracurricular activities, as well as their experiences recruiting SWD. The questionnaire consisted of several short answer response questions for expansion of initial answers. The survey was prepared in Qualtrics and shared via email with an anonymized link.

Descriptive statistics were used to evaluate the results of the survey. The researchers independently coded the open-ended responses. Lastly, the results were analyzed qualitatively by the school level (e.g., elementary, middle, high school) of the participants.

Results

Phase I

Survey question 5 asked about the type of STEM club sponsored by the participants and multiple clubs could be selected. Respondents selected 30 different clubs which means most participants sponsor multiple STEM clubs. Indeed, each participant led an average of 2 clubs. Robotics was the most common selected (23%) with STEM Club and Coding Club coming in second at 16% each. Several other types of clubs were offered such as Science Club, Engineering Club, and Tech Clubs. See Table 4 for a list of specific STEM clubs by district.

Table 4.
Clubs Reported at Schools by Participants

SQ	Type	District 1	District 2	Total
What type(s) of STEM* clubs do you sponsor or coach (select all that apply)?	Robotics	3 (43%)	4 (57%)	7
	SECME**	3 (100%)	0 (0%)	3
	Science Club	0 (0%)	2 (100%)	2
	STEM Club	3 (60%)	2 (40%)	5
	Coding Club	1 (20%)	4 (80%)	5
	Engineering Club	0 (0%)	1 (100%)	1
	Other	3 (43%)	4 (57%)	7
	Total	**13 (43%)**	**17 (57%)**	**30**

*STEM Clubs are all encompassing for science, technology, engineering, and math type clubs. The name of the club may be STEM or it may be Robotics but it is still a STEM club.
**SECME was founded as the Southeastern Consortium of Minorities in Engineering but now most commonly just goes by SECME.

Participants also selected other STEM clubs offered at their schools. The following clubs were selected: Robotics, SECME, Science Olympiad, Science Club, STEM Club, Coding Club, Math-letics, Engineering Club, Math Olympiad, and Video Game Club. Robotics and Science Olympiad had the highest results with 17% of the participants selecting those clubs. Participants were asked how long they served as teacher/sponsors of extracurricular STEM activities. The results were that 75% of the participants only sponsored clubs from 1-3 years. See Table 4 for

the number of students whose teacher/sponsors stated regularly participate in their STEM clubs. Indeed, over 40% of the teacher/sponsors had clubs with a regular attendance rate of over 20 students.

Table 5.
How Many Students Regularly Participate

Number of students	*n*	%
6-10	2	13%
10-15	4	25%
15-20	3	19%
20+	7	44%

When asked how many students in their clubs had disabilities, 14 of the 16 respondents who selected yes and unknown as seen in Table 6. Most (n = 6, 43%) selected they didn't know how many had disabilities. When asked if they had received any PD to work with SWDs in extracurricular settings, only three participants (19%) stated yes. Two teachers responded to our request for the type of PD. One wrote a "workshop" and the other stated "I have taken PD in the past for developmentally delayed children".

Table 6.
Survey Question Results on SWD Participation and PD

Survey Question	*N*	Unknown	Yes	No
Are students with disabilities participating in your clubs?	16	6 (43%)	8 (35%)*	2 (13%)
Have you received PD to work with SWDs in informal learning environments?	16		3 (19%)	13 (81%)

*There were varying numbers reported by teachers: three said at least 1, two stated more than 5, with one participating selecting 2, 3, and 5.

As noted in Table 7, three (21%) selected one SWD and two (14%) stated more than five SWDs participated in their clubs. One participant each selected two, three, and five SWDs participated in their clubs.

Table 7.
Survey Question Results on Number of Participating SWDs

Survey Question	*N*	1	2	3	4	5	5+	Unknown
How many SWDs participate in your clubs?	14	3 (21%)	1 (7%)	1 (7%)	0	1 (7%)	2 (14%)	6 (38%)

When asked what types of disabilities were represented in their clubs, the respondents could select more than one category of disabilities. As noted in Table 8, the most frequent response (n = 8) was emotional behavior disorder (EBD). The next most frequent response was SLD (n = 7). Three respondents selected autism spectrum disorders (ASD) and one participant each (not

necessarily the same participant) selected developmental delay (DD), physical disability, and hearing impaired (HI).

Table 8.
Survey Question Results of Type of Disabilities in Clubs

		$N = 12$					
Survey Question	*N*	EBD	SLD	ASD	DD	Physical	HI
What type of disabilities were represented in your clubs?	12	8 (67%)	7 (58%)	3 (25%)	1 (8%)	1 (8%)	1 (8%)

Respondents were asked if they thought SWD participated less than their nondisabled peers and 14 answered the question as shown in Table 9. Five (31%) responded yes, seven (44%) said maybe, and two selected no. When asked if they had access to the IEPs of SWDs, only 12 of the 16 participants responded to the question. Most of the participants ($n = 9$, 56%) stated yes, one said no, and two selected other. Both respondents who stated "other" wrote they only have access if the student is also in one of their classes during the school day.

Table 9.
Survey Responses on Participation of SWDs and Access to IEPs.

Survey Question	*N*	Maybe/Other	Yes	No
Do SWDs participate less than their peers?	14	7 (44%)	5 (31%)	2 (14%)
Do you have access to SWDs IEPs?	12	2 (17%)	9 (75%)	1 (8%)

Teacher/sponsors were almost evenly split on the survey with slightly more than half (56%, $n = 9$) indicating they actively recruit SWD. Interesting to note is that teachers/sponsors indicated on the survey they have access to IEP information for students in their clubs. Indeed, 75% of the respondents ($n = 9$) said yes, they did have access to this information. However, in the follow up interviews only two of the 11 teacher/sponsors (18%) said they had IEP access but only because the SWDs were in their classes during the school day.

Phase II: Interview Procedures and Analysis

In the Phase I survey, participants were asked if they would be interested in participating in a follow-up interview. The purpose of the interviews was to provide additional information, clarifications, and details regarding the survey data as a whole and their individual experiences as a teacher sponsor for STEM clubs. The researchers designed the semi-structured interview protocol (Appendix B) which contained 15 questions. The initial set of questions focused on basic information about the STEM clubs to contextualize their own experiences and allow the teachers to feel comfortable with the interviewer(s). The protocol also included questions about the number of students in the club with IEPs, as well as the teacher/sponsors' PD regarding working with SWDs in an informal learning environment, like clubs. Questions asked included participant recruiting practices and requirements of SWDs. The protocol ended with general

questions asking the teacher/sponsor to share anything else that would be helpful and if they had questions about the research.

The research team traveled in pairs to conduct the interviews where one team member generally led the interview, and both took notes. The interviews were conducted with the teacher/sponsors at their own school at a time and date that best fit their schedules. The interviews were audio recorded, and later transcribed verbatim.

After reading the transcripts, all members of the research team independently completed open coding resulting in three themes: (a) recruitment, (b) retention, and (c) knowledge/PD. One person from the research team then collated the coded passages to check for interrater reliability of the interviews. There was a strong internal consistency among researchers in the coding of interviews. Each interview participant received a $25 gift card. Member checking was conducted by two volunteer participants. A draft of the results was sent to the members and their feedback was incorporated. Member checking participants each received an additional $25 gift card. Both stated the draft manuscript is representative of what they experienced in terms of the survey and follow up interviews.

After the three themes were determined, the researchers operationally defined them. Recruitment was operationally defined as the act of enlisting new students to join an extracurricular STEM club. Retention was defined as the continued engagement of students in an extracurricular STEM club. Professional development was defined as activities formally organized to improve the requisite knowledge, skills, pedagogies, and effectiveness of the teacher sponsoring STEM clubs. Lastly, knowledge was operationally defined as facts, information, procedures and pedagogies related to the strengths and needs of SWD and their participation in STEM clubs. Knowledge includes information about types of SWD, which students were identified as having a disability, and what is included in IEPs including accommodations. To test the operational definitions, an expert in the area of SWD and STEM was asked to review the definitions for clarity and agreed the definitions operationally define each variable.

The instruments used to measure recruitment, retention, and PD/knowledge are the survey open-ended questions and the transcripts from the interviews. The method used to measure the constructs were visual checks and colored highlighters. Four different researchers independently highlighted the transcripts, researcher interview notes, and written responses on the surveys for the three themes. Next the marked-up transcripts were compared to determine consensus of color coding of the three different themes. Differences were discussed and resolved when all researchers agreed on the data found in the transcripts, notes, and survey data.

Results Phase II

Recruitment. The types of clubs offered and the teacher/sponsors who run them can affect the recruitment of SWD into clubs at all levels. In addition, perceived or real barriers to recruitment practices can have an impact on whether students enroll in clubs. For the most part, high school clubs met in the afternoon while many elementary and middle schools' clubs met in the mornings. When asked if they actively recruit SWD on the survey, 56 percent ($n = 9$) said yes.

Of those, three teacher/sponsors were at the high school level, one at the middle school level, and five were elementary school club coaches or teacher sponsors.

Teachers/sponsors in the high school indicated "every student who enrolls in the club participates" and they "work closely with the special education teachers" when it comes to student participation. Typically, high school teachers/sponsors reported being "pretty relaxed about how [they] recruit" and that they have an "open house" at the beginning of the year. Otherwise, it is up to students "to be interested" enough to pursue joining the club.

Middle school teachers/sponsors indicated they "don't often have to recruit" because students want to get into the STEM Clubs and they "come to me". However, the teacher/sponsors said some "general announcements" are made to the school. One teacher did mention they recruit through "word of mouth" but they feel you have to "show them interest and ask [SWD]" to join, pointing out "you don't know what they [can] handle until you try them."

For elementary school teachers/sponsors, recruitment usually involves sending fliers home and students sign up "on interest." Most respondents said they did not think about "actively recruiting SWD," but can see how it would be a benefit stating "just because they have a disability doesn't mean they can't participate" and that for some students "[who] may not connect academically…[this] gives them some passions to kind [of] [want to] come to school."

During the interviews, all grade level teacher/sponsors indicated SWD may have barriers to joining that other students do not have or have to the same degree. Response examples include "transportation" and "parents who aren't comfortable signing up their child." More responses included "their disability will be a hindrance," and "club meeting times" conflicted with remediation courses for SWD when clubs met during the school day.

Retention. Once SWDs join a club, keeping them becomes a priority especially for those clubs participating in STEM competitions. Being aware of what keeps SWD involved and their barriers to continued participation are important when thinking about how to retain SWD in the clubs/organizations. When asked on the survey if respondents ($N = 16$) felt SWD participated less than their peers five said yes, two said no, and seven said maybe. One common thread among all teachers/sponsors was a lack of awareness of accommodations for SWD participating in STEM activities.

During the interviews, high school teacher/sponsors stated the level of "competition is pretty high," and they speculate that many SWD feel they cannot compete because of a "[lack of] confidence," "feeling like the club is unapproachable," and/or lack of "advocacy skills" at this level since many struggle socially and academically. However, these teachers/sponsors also attempt to "differentiate and help them understand the material." Another teacher/sponsor felt SWD are drawn to "fine arts" programs like chorus where students can participate without the competitive academic pressures often associated with STEM Clubs. Many of the high school teacher/sponsors acknowledged not really understanding why SWD do not participate more and speculated that "[lack of] confidence," "feeling like the club is unapproachable," and/or lack of "advocacy skills" could be barriers to students continuing to participate in these clubs.

For middle school teachers/sponsors, only one respondent said he/she felt SWD participate less than their peers while two others said maybe. One of the main retention issues mentioned during the interviews was SWD struggling in reading or mathematics. Some middle school teachers/sponsors found it easier to be "familiar with all the special ed teachers". Additionally they stated they find out "what students need". However, other teachers/sponsors felt students "lose interest or [the club] is not what they thought it was going to be." Some teachers/sponsors stated the students may process things more slowly and that makes "[them] uncomfortable".

At the elementary level, five respondents felt SWD participated less than their peers, one respondent felt SWD did participate more than their peers, and one selected maybe on the survey. When interviewed, elementary teachers/sponsors expressed a willingness to speak to "other teachers" about students so they can provide needed support. In some instances, however, teacher/sponsors stated coming to an afterschool program is a "privilege" (for students) and this could make it difficult for SWD (especially EBD). Many teachers/sponsors stated transportation is one of the largest barriers to SWD retention in clubs. Lastly, teacher/sponsors felt SWD may "feel intimidated" being in clubs with students who they see as smarter and more able.

Knowledge/PD. Teachers/sponsors have knowledge of working with SWD in general and that SWD have specific IEP accommodations to make material accessible to them. Indeed, nine survey participants (56%) said they had access to IEPs. However, none of the teacher/sponsors interviewed knew the IEP accommodations or information on students who joined their clubs unless that student was already in their classroom. In fact, in many cases the teacher/sponsors were only speculating on the number of SWD's in their clubs, because they were not officially informed by the special education case manager or parent. Most of the elementary teachers/sponsors expressed a willingness and an effort to go and speak with classroom teachers if they knew a student needed special modifications. Most of the middle and high school teachers/sponsors in the study "figured out what they need" "on the job".

Knowledge/Development. On the survey, 13 of the 16 respondents indicated they have not received any PD to work with SWD in informal learning environments. Three respondents, one at each level (elementary, middle, and high) selected yes, they have received some PD to work with SWD in their clubs. Conversely, during the interviews all teachers/sponsors (n = 11) indicated there was a lack of information and PD on how to work with SWD in informal settings. Many even went so far as to say it was all "on the job training" and that "you learn as you go through". Teacher/sponsors indicated they had workshops and college classes on disabilities, but none of the teacher/sponsors interviewed were aware that IDEA required IEPs address extracurricular needs or that accommodations were required in extracurricular settings as a related service. However, all the teachers/sponsors indicated they would "meet the students where they are" and help them as they could regardless of any formal training to do so. All admitted to understanding basic accommodations, but several admitted they "don't face the same problems that traditional classroom teachers face" and most of what is learned is learned "informally".

Discussion

The purpose of this study was to answer the following research questions:

RQ1: What types of STEM extracurricular activities are offered in the two rural districts?

RQ2: What are the characteristics of the clubs and their participants?

RQ3: What professional development has the teacher/sponsor had to work with SWD?

Results showed SWDs in rural areas do have access to STEM clubs (see Table 4), however, the variety of these clubs, within the rural schools and districts, are often limited due to lack of resources (Afterschool Alliance, 2016; Afterschool Alliance, 2014). The STEM clubs were reported to have many students (see Table 5) and consist mostly of SWOD. These responses are consistent with the research that SWD participated less than SWOD (Coster et al., 2012; Kleinert et al., 2007; Power et al., 2005).

Most of the participants indicated they did not know how many SWDs they had in their clubs. The finding is similar to those of the Fisher (2016) study in another state. It stands to reason if teachers/sponsors do not know which students have disabilities, they would not know how to accommodate them. As a result, districts should set up a mechanism for extracurricular teachers/sponsors to have access to information on disability status and IEP's of SWD who participate in their clubs.

Many SWD often need instructional support with subject matter and based on club schedules, lack of support could impact SWD participation even if they were interested. Support during the school day includes specially designed instruction in a content area or in behavior/social skills. It is well known SWDs often struggle in STEM content areas (i.e., Basham & Marino, 2013; McFarland et al., 2017; National Science Foundation, 2019). That struggle and lack of support could impact SWD participation and retention in extracurricular STEM activities. However, the teachers/sponsors who facilitate the clubs in this study appear to accept everyone in their clubs and ensure each student has an opportunity to succeed.

STEM Club sponsors reported retaining SWD was difficult due to the lack of knowledge of who are SWDs, as well as what accommodations they should be making for them. While it is hoped students would advocate for themselves in these situations, it often falls on the club teacher/sponsor to ensure all students have equal access to the materials. For example, a student with dyslexia can benefit by having instructions read to them. A student with autism or general anxiety disorder may need competition-based projects broken down into checklists. If these accommodations are offered during the school day, they need to be offered in school sponsored clubs as well (IDEA, 2004). However, the results of this study show that most of the teachers/sponsors are not aware of the needed accommodations in order to make them.

Implications for practice include adding specific accommodations to include in the IEP that teachers/coaches could use are read-aloud, breaking down large assignments into smaller chunks, and checking for understanding. For STEM competitions, accommodations could include the use of headphones and a sensory area where students with sensory impairments can find a quiet place to regroup (Fisher, 2019). The use of a buddy system or peer tutors could also be used for SWD to be included in afterschool activities and STEM competitions. Districts should also consider incentivizing special education teachers to support club sponsors.

Additionally, participants indicated a lack of PD offered on SWD in extracurricular environments (see Table 6). The teacher/sponsors took required courses in their college programs. Indeed, teacher preparation programs often require general educators to take one or more special education courses (Mader, 2017; Tait & Purdie, 2000). These introductory courses, however, are often considered ineffective for new teachers to educate SWD within their classes (Young, 2011), let alone their clubs.

Professional development could include how to best provide accommodations for SWDs in informal learning environments. Offering an opportunity for these teachers/sponsors to be successful in mentoring and coaching SWDs in non-academic environments may allow students to feel more successful within classrooms, especially in STEM content areas. As one teacher said, "these are my kids who can persevere and problem solve and think through…they kind of have to do that in the academic setting…where my gifted learners are the first ones to shut down because they didn't get it right the first time."

The last implication for practice is for STEM club sponsors to specifically identify and recruit SWDs into their clubs. The STEM workforce needs more diverse workers because these students are known to think outside of the box and can help fuel innovation in our ever changing society. If sponsors specifically recruit SWD into their clubs, the sponsor, school, and/or district could apply for grants specified in the Every Student Succeeds Act (ESSA). Grants under ESSA are for marginalized students like SWD and can help the sponsor, school, and district fund more of these STEM based extracurricular programs.

Limitations

The limitations of the study include teacher perceptions, sample size, accessibility to information, and timing of the study.

Teacher perceptions. First, the teacher surveys and interviews used in this research were self-reported teacher perceptions. Participants may have over- or under-represented their knowledge. The information is speculative of the teacher/sponsors' knowledge and recollection of SWD participation in extracurricular STEM activities. Findings indicated most club teachers/sponsors did not have an actual list of SWD in their clubs. Without a list of identified SWD, this allowed for a great deal of subjectivity on the part of the club teacher/sponsors. During interviews, it was apparent teachers/sponsors most often guessed about disability categories. The discrepancy of knowledge of the IEP is also a limitation in the study. In the survey, most of the participants (56%) stated they had access to the IEPs of the SWDs in their clubs but in the follow up interviews, none of the participants stated they had access.

Sample size. The second limitation of the study is the sample size. As with all survey research, it was difficult to determine if a representative sample was obtained. Of the 27 teacher/sponsors gathered from websites and names generated by local school principals, 16 completed the survey. Additionally, a convenience sample was used and nonresponse error was not calculated. The qualitative analysis was intended to clarify and support the survey results and lends credibility to the findings. Although there was representation from elementary, middle, and high

school teachers/sponsors in both districts, it is plausible responses may not be indicative of true population norms.

Accessibility to information. A third limitation was the lack of STEM clubs and activities listed on school websites. Schools' websites varied greatly in the amount of information presented. Some contained a list of clubs with teacher/sponsors' names and contact information while others had no clubs listed at all. As a result, the population of the number of STEM club teachers/sponsors was not determined. Furthermore, the researchers' agreement with each district stated the principal at each school would be contacted first. This is important because not all principals responded to our requests to conduct research at their school. Indeed, 29% (n = 5) of the principals in district one and 1% (n = 1) of the principals in district 2 did not respond to our email requests.

Timing of the study. Researchers attempted to gather a representative sample of STEM club sponsors in the two participating rural school systems. Permission was asked of principals and the surveys were sent electronically to teacher/sponsors near the end of the school year (April). The timing of the surveys may have limited teacher/sponsor ability to devote time to completing surveys. While the survey response rate (56%) was positive, perhaps a different time of the year would have had a better response rate.

Future Research

Just as the findings presented here, there are several areas in which future research may provide a better understanding. These include recruitment and retention of SWD and PD of teacher/sponsors supporting SWD in clubs. With recruitment and retention, data needs to be collected in more areas to gain a better understanding. As reported, recruitment and retention data are all teacher/sponsor perceptions. Further research could investigate SWD and/or their parents' perceptions regarding level of comfort and barriers.

Additionally, since many teachers/sponsors did not know whether students in their clubs had or did not have disabilities, research could be conducted on the knowledge of club teachers/sponsors and the implementation of a system to notify the teacher/sponsors of the individual needs of SWD. The research on IEPs conducted by Power and colleagues (2005) could be replicated where IEPs are analyzed for information about extracurricular activities as well as the impact and of PD on the IEP requirements for club teachers/sponsors. Further research could also focus on accommodations of SWD who participate in afterschool clubs and how they compare to accommodations used during the school day.

In this study, teacher/sponsors speculated comfort levels of SWD dropped when the rigor increased impacting the retention of SWD. Actual student data would confirm or dispute teacher/sponsor perceptions reported in this study. Additionally, future research would be able to determine the attrition of SWD from STEM clubs versus barriers of the disability impacting their performance. Student interviews or surveys may also be able to uncover why students leave STEM clubs. Additionally, student interviews would also reveal why SWD potentially select other clubs instead of STEM clubs.

Another facet of research would be to investigate the PD needs and support of rural teacher/sponsors sponsoring STEM clubs. Research on the impact of access to and implementation of IEP accommodations on the participation of SWD in their clubs should be investigated. The study by Hott and colleagues (2019) could be replicated using STEM teachers/coaches. If teacher/sponsors received and understood the accommodations set forth in academic environments, SWD may participate more in STEM clubs. Additionally, PD could impact the recruitment and retention of SWD in STEM clubs. To gain a deeper understanding of the effects of SWD's participation in STEM-related clubs, research should be broadened to gain a more cohesive picture of the impacts of recruitment, retention, and knowledge of teachers who sponsor the clubs. Future research should include an expansion of this study to look at a broader spectrum of schools and districts to see how a rural setting compares with other settings across the U.S.

References

Afterschool Alliance. (2016). *America after 3pm special report: The growing importance of Afterschool in Rural Communities,* 1-49.

Afterschool Alliance. (2015). *Defining youth outcomes for STEM learning afterschool*, 1-35.

Afterschool Alliance. (2014). *America after 3pm: Afterschool programs in demand.* Washington, DC.

Alston, R., Bell, T., & Hampton, J. (2002). Learning disability and career entry into the sciences: A critical analysis of attitudinal factors. *Journal of Career Development, 28*(4), 263-275.

Basham, J. D., & Marino, M. T. (2013). Understanding STEM education and supporting students through Universal Design for Learning. *Teaching Exceptional Children. 45*(4), 8-15.

Bers, M. U. (2008). *Blocks, robots and computers: Learning about technology in early childhood.* Columbia University Teacher's College Press, New York, NY.

Collins, K. M. T., Onwuegbuzie, A. J., & Sutton, I. L. (2006). A model incorporating the rationale and purpose for conducting mixed-methods research in special education and beyond. *Learning Disabilities – A Contemporary Journal*, 4(1), 67-100.

Coster, W., Law, M., Debell, G., Liljenquist, K., Kao, Y. C., Khetani, M., & Teplicky, R. (2013). School participation supports and barriers of students with and without disabilities. *Child: Care, Health and Development, 39*(4), 535-543.

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). Thousand Oaks, CA: Sage.

Cutucache, C., Boham, T., Luhr, J, Sommers, A., Stevenson, N., Sointu, E., & Tapprich, W. (2018). NE STEM 4U afterschool intervention leads to gains in STEM content knowledge for middle school youth. *Cogent Education, 5*(1), 1-12.

Darling, N., Caldwell, L. L., & Smith, R. (2005). Participation in school-based extracurricular activities and adolescent adjustment. *Journal of Leisure Research, 37*, 51-76.

Dillman, D. A. (2000). *Mail and internet surveys: The tailored design method.* New York: John Wiley and Sons.

Eriksson, L., Welander, J., & Granlund, M. (2007). Participation in everyday school activities for children with and without disabilities. *Journal of Developmental and Physical Disabilities, 19*(5), 485-502.

Feinberg, T., Nuijens, K., & Canter, A. (2005). Workload vs. case- load: There's more to school psychology than numbers. *NASP Communiqué*, 33.

Fisher, K. (2019). ESSA, students with disabilities, and robotics. *Technology and Engineering Teacher,* 28-32.

Fisher, K. (2016). The relationship between extracurricular STEM activities and performance on the Florida science assessment. *Electronic Theses and dissertations,* 5076.

Fredericks, A. J., & Eccles, S. J. (2006). Is extracurricular participation associated with beneficial outcomes? Concurrent and longitudinal relations. *Development Psychology, 42*(4), 698-713.

Griffin, K. A. (2012). Learning to mentor: A mixed methods study of the nature and influence of Black professors' socialization into their roles as mentors. *Journal of the Professoriate*, 6(2), 27-58. Retrieved from https://works.bepress.com/kimberly_griffin/5/download/

Hott, B. L., Dibbs, R. A., Naizer, G., Raymond, L., Reid, C. C., & Martin, A. (2019). Practitioner perceptions of algebra strategy and intervention use to support students with mathematics difficulty or disability in rural Texas. *Rural Special Education Quarterly, 38*(1), 3-14. DOI: 10.1177/8756870518795494

Individuals with Disability Education Act, 34 C.F.R. § 300.117 (2004).

Kena, G., Hussar, W., McFarland, J., de Brey, C., Musu-Gillette, L., Wang, X., . . . Barmer, A. (2016). *The condition of education 2016* (NCES 2016-144). Washington, DC: National Center for Education Statistics.

Kleinert, H. L., Miracle, S. A., & Sheppard-Jones, K. (2007). Including students with moderate and severe disabilities in extracurricular and community activities: Steps to Success. *Intellectual and Developmental Disabilities, 45*(1), 33-38.

Lapan, R., Aoyagi, M., & Kayson, M. (2007). Helping rural adolescents make successful postsecondary transitions: A longitudinal study. *Professional School Counseling*, 10, 266-272. doi:10.5330/prsc.10.3.u6j3j64h48p27w25

Lauer, P. A., Akiba, M., Wilkerson, S. B., Apthorp, H. S., Snow, D., & Martin-Glenn, M. L. (2006). Out-of-school time programs: A metanalysis of effects for at-risk students. *Review of Educational Research, 76,* 275-313.

Lee, A. (2011). Postsecondary science, engineering, and mathematics (STEM) enrollment comparisons for students with and without disabilities. *Career Development for Exceptional Individuals, 34*(2), 72-82.

Mader, J. (2017). How teacher training hinders special-needs students. *The Atlantic.* Retrieved from https://www.theatlantic.com/education/archive/2017/03/how-teacher-training-hinders-special-needs-students/518286/

Makitalo-Siegl, K., Kohnle, C., & Fischer, F. (2011). Computer-supported collaborative inquiry learning and classroom scripts: Effects on helping-seeking processes and learning outcomes. *Learning and Instruction, 21*(2), 257-266.

Mavletova, A. (2013). Data quality in PC and mobile web surveys. *Social Science Computer Review, 31*(6), 725-743.

McGuire, J., & McDonnell, J. (2008). Relationships between recreation levels of self-determination for adolescents and young adults with disabilities. *Career Development for Exceptional Individuals, 31,* 154-163.

McFarland, J., Hussar, B., de Brey, C., Snyder, T., Wang, X., Wilkinson-Flicker, S., Gebrekristos, S., Zhang, J., Rathbun, A., Barmer, A., Bullock Mann, F., & Hinz, S. (2017). *The condition of education 2017.* (NCES 2017-144). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2017/2017144.pdf

National Center for Education Statistics. (2015). *Percentage of persons ages 18-29 enrolled in colleges or universities, by age group, 4-category local, and sex* [data file]. Retrieved from https://nces.ed.gov/surveys/ruraled/tables/b.3.b.-1.asp

National Science Board. (2014, February). *Science and engineering indicators 2014* (NAB 14-01). Arlington, VA: Author.

National Science Foundation (2019). *Women, minorities, and persons with disabilities in science and engineering: 2019.* Special Report (NSF 13-304). Arlington, VA. Retrieved from http://www.nsf.gov/statistics/wmpd

National Research Council (2009). *Learning science in informal environments: People, places, and pursuits.* Washington, DC: National Academies Press.

Plano Clark, V. L., & Ivankova, N. V. (2016). *Mixed methods research: A guide to the field*. Thousand Oaks, CA: SAGE.

Power, K. M., Gil-Kashiwabara, E., Geenan, S. J., Powers, L., Balandran, J., & Palmer, C. (2005). Mandates and effective transition planning practices reflected in IEPs. *Career Development for Exceptional Individuals, 28*, 47-59.

Rule, A., Stefanich, G., Hadelhuhn, C., & Peiffer, B. (2009). *A working conference on students with disabilities in STEM coursework and career.* Iowa City: College of Education, University of Iowa.

Schafft, K. A., & Jackson, A. Y. (Eds.). (2011). *Rural education for the twenty-first century: Identity, place, and community in a globalized world.* University Park: Pennsylvania State University.

Shulruf, B., Tumen, S., & Tolley, H. (2008). Extracurricular activities in school, do they matter? *Children and Youth Services Review, 30*(4), 418-426.

Spencer, K. (2017, January 22). *Not all towns are created equal, digitally: How a Colorado school district struggles to give its students a technology boost* (The Hechinger Report). New York, NY: Teachers College at Columbia University. Retrieved from http://hechingerreport.org/not-all-towns-are- created-equal-digitally/

Spielhagen, F. R. (2006). Closing the achievement gap in math: Considering eighth grade algebra for all students. *American Secondary Education, 34*(3), 29-41.

Tait, K., & Purdie, N. (2000). Attitudes toward disability: Teacher education for inclusive environments in an Australian university. *International Journal of Disability, Development and Education, 47*(1), 25-38.

U.S. Department of Education, Office for Civil Rights. (2013). *Students with disabilities in extracurricular athletics.* Retrieved from www2.ed.gov/about/offices/list/ocr/letters/colleague-201301-504.pdf

Young, K. S. (2011). Institutional separation in schools of education: Understanding the functions of space in general and special education teacher preparation. *Teaching and Teacher Education, 27*(2), 483-493.

About the Authors

Karin M. Fisher, PhD, is an assistant professor of special education at Georgia Southern University. Her research interests include students with disabilities, STEM education, extracurricular activities, and special education law. In addition, Fisher serves as President Elect of the Georgia Council for Exceptional Children (CEC) and President of the Early Career Special Interest Group of the Teacher Education Division of CEC.

Peggy Shannon-Baker, PhD, is an assistant professor in the Department of Curriculum, Foundations and Reading and affiliate faculty member of the Women's, Gender, and Sexuality Studies Program at Georgia Southern University. Shannon-Baker's research bridges two areas: critical, international approaches to teacher education and the use of social justice-informed arts-based, qualitative, and mixed methods research approaches.

Kelly S. Brooksher, EdD, is an Assistant Professor in the Department of Elementary and Special Education at Georgia Southern University. Brooksher has been in education for over two decades, and she has taught general and special education. She has also been a school administrator. Her research interests include: co-teaching, grading and assessment, and higher-order thinking strategies.

Kania Greer, EdD, is the Coordinator for the Institute for Interdisciplinary STEM Education in the College of Education at Georgia Southern University. Greer has worked with Students with Disabilities as a Vocational Rehabilitation Counselor and in informal education settings such as camps. Her research interests include science communication and the intersection of formal and informal STEM education.

*Appendix A**

SURVEY

Are you a sponsor of a school-based extracurricular STEM club? The definition of club sponsor is an individual that provides support to the club and is the adult responsible for the students involved in the club. STEM Clubs include any extracurricular activity that is based on improving science, technology, engineering, and/or math skills. Examples include Robotics, Science Olympiad, Coding Club, etc.

- Yes
- No
- Other _____

How many years have you been a coach for extracurricular STEM activities?

- 1-3 years
- 4-6 years
- 7-10 years
- 10 + years

In which district does your club meet?

- District 1
- District 2
- District 3
- Other _____

What is the name of the school where your club meets?

_____

What type(s) of STEM clubs do you sponsor or coach (select all that apply)?

- Robotics
- Modeling and Simulation Club
- SECME
- Science Olympiad
- Science club
- STEM Club
- Math Counts
- Coding Club
- Science bowl
- Math-letics
- Engineering club
- Math Olympiad
- Video Game Club
- Other _____

What other type(s) of STEM clubs are offered at the school where you meet (select all that apply)?

- Robotics
- Modeling and Simulation Club
- SECME
- Science Olympiad
- Science club
- STEM Club
- Math Counts
- Coding Club
- Science bowl
- Math-letics
- Engineering club
- Math Olympiad
- Video Game Club
- Other _____
- None

How many students regularly participate in your STEM club? If you coach more than one club, please provide the average number of participants in both clubs.

- 0-5
- 6-10
- 10-15
- 15-20
- 20 or more

What is the age range of students in your club? (select all that apply)

- 5-7
- 8-10
- 11-13
- 14-16
- 17 and older</u>
- Unknown</u>

Have you received any professional development or training to work with students with disabilities in an extracurricular environment?

- Yes
- No
- Other

If yes, what kind of professional development or training have you received to work with students with disabilities in an extracurricular environment? Please provide as much information as possible.

_____

Do any of your student participants have disabilities?

- Yes
- No
- Unknown

If known, how many of your student participants have disabilities?

- 0</u>
- 1
- 2
- 3
- 4
- 5
- More than 5
- unknown

What kind of disabilities do they have? (select all that apply)

Autism
Learning Disabilities
Speech Language Impairment
Emotional Behavioral Disorder
Developmental Delay
Physical Disability
Visually Impaired
Hearing Impaired
Other _____

Do you think students with disabilities participate less in your club than students without disabilities?

- Yes
- Maybe
- No

If yes, why do you think they do not participate as much as their peers?

_____

Do you have access to the individual education programs (IEPs) for any students with disabilities who are participating in your club?

- Yes
- No
- Other _____

Do you actively recruit students with disabilities?

- Yes
- No

Choose one or more races that you consider yourself to be:

White
Black or African American
American Indian or Alaska Native
Asian
Native Hawaiian or Pacific Islander
Other _____

What is your sex?

- Male
- Female
- Other _____

Appendix B

Qualitative Interview Questions

Interviewee [pseudonym]:

Interviewer(s):

Date: _____ Time: _____ Place: _____
[pseudonym]

Consent and Introduction:

- Introduce interviewer(s)
- The purpose of the study:
    - The purpose of our study is to learn more about the STEM extracurricular activities/clubs being offered at schools in the area, and how these activities/clubs include students with disabilities.
- The purpose of the interview:
    - The purpose of the interview is to help us follow-up with more details after the survey you took online with us. The survey was anonymous, but the interview will give us a better understanding of your STEM club(s) and activities.
- The general plan and expected length of the interview:
    - We have some basic questions about the STEM activities/clubs at your school.
    - The interview should take about 20-30 minutes.
- Plan for using the results from the interview:
    - We plan to analyze all the interviews and surveys together to help us get a better sense of the STEM activities/clubs in the area.
    - Do you want us to share the final report with you?
- Any follow-up after the interview:
    - We may follow-up via email if we have any questions. You can also ask for more information later.
- We want to get your permission to audio record the interview so that we have the best notes to use later. Is that ok? (If not, can we just take written notes?)

Interview questions

- What STEM clubs or activities are offered at your school?
    - What grade levels do these cover?
- Do you sponsor/coach an extracurricular STEM club?

    - What type of STEM club(s) do you coach?
    - Where does your club meet and how often?
    - How many students come to your meetings on average?

- Do any of the students in your club(s) have IEPs? Are you aware of and follow their accommodations?
    - If so, do you know what kind of disabilities they have?
- What kind of professional development have you had to work with students with disabilities (SWD) in an informal learning environment?
- How do you recruit students typically to your club(s)?
    - Do you recruit SWD in particular?
- Do you feel prepared to recruit and retain SWD in your club?
    - If not, what do you think you need? What would help you recruit and retain SWD in your club?

General final questions

- Is there anything else we should know to help you recruit and retain SWD in your club?
- Is there anyone else we should contact to participate in our study?
- Do you have any questions for me/us?

Don't forget to thank them and give them the gift card or ask for how to send them the gift card.