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STEM educational activities and the role of the parent in the home education of high school students

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ABSTRACT

This qualitative case study examined the homeschool STEM educational activities and the role of the parent in those activities. Twenty-nine homeschooling parents from within a purposefully selected homeschool cooperative learning group in a southern community in the United States participated in the study. Data were collected using an open-ended questionnaire, which was then followed up with observations, interviews, and collection of documents. Analysis of the data pointed to an eclectic mix of STEM educational activities including both curricular activities such as online courses, tutors, and self-study, as well as curriculum extensions such as field trips and local STEM clubs and teams. Parents in this case study depended heavily on community resources available to them to provide these educational activities for their students. Parents played multiple roles in their child's education including the role of facilitator, the role of counsellor, and the role of presenter or lecturer.

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Introduction

While homeschooling seems to have come into the national spotlight relatively recently, the modern homeschool movement actually has roots in the 1970s when parents began exercising their freedom to educate their children at home (Isenberg 2007). During the earlier days of the homeschool movement in the United States, parents often cited conflict between their personal religious beliefs and the public school programmes as the primary motivating factor for homeschooling (Cooper and Sureau 2007). During the 1970s and 1980s, however, homeschooling was seen as a violation of mandatory attendance laws and, thereby, considered a form of truancy (Cooper and Sureau 2007). Parents who chose to keep children at home often did so quietly, choosing not to participate in formal education opportunities. Beginning in the 1980s, homeschool advocates began working at state and national levels to uphold legal rights for parents to homeschool their children (Isenberg 2007). By the mid-1990s, all states had adopted laws and regulations, which safeguarded the right of parents to homeschool their children (Isenberg 2007).

The National Center for Educational Statistics in 2011 estimated the number of homeschooled children in the United States to be approximately 1.77 million, which is an increase

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from the estimated 1.5 million in 2007 (Noel, Stark and Redford 2015). This growth in homeschooling has resulted in a wider variety of homeschooling families with diverse background characteristics and an expansion in the reasons parents choose to homeschool (Hanna 2012; Isenberg 2007; Noel, Stark and Redford 2015). The Department of Education (Noel, Stark and Redford 2015) reported the top three reasons for parents to homeschool:

- 1. A concern about the environment of institutional schools.
- 2. A desire to provide moral instruction.
- 3. A dissatisfaction with academic instruction at other schools.

Homeschooling research has also shown that as the number of homeschooled students has increased and the motivations to homeschool have diversified, parents have also diversified their instructional methods and activities, incorporating such resources as tutors, cooperative learning groups, and community resources (e.g. libraries, museums) (Boschee and Boschee 2011; Hanna 2012; Muldowney 2011).

Problem statement and purpose

The increase in homeschooling as a school choice, as well as the diversification of homeschooling families and instructional methods, has the potential to impact communities and their educational systems (Murphy 2014). However, homeschooling research on the curriculum and educational choices of parents remains scarce, particularly in the area of science, technology, engineering, and mathematics (STEM) education (Kunzman and Gaither 2013). Most homeschooling research has focused on evaluating the effectiveness and relevance of homeschooling (Jamaludin, Alias, and DeWitt 2015). Limited research into the curriculum practices of the homeschooling community shows that parents use a variety of educational activities, which they choose based on their instructional goals for their students (Anthony and Burroughs 2012; Boschee and Boschee 2011; Hanna 2012). These parents often use a variety of community networks, resources, and learning groups to meet the educational needs of their students (Anthony 2015; Bachman and Dierking 2011).

Diversity in resources and approaches to homeschooling also point to a need for research focused on the parents as teachers. Research on parents as teachers is needed in terms of the exploration of daily activities to gain a more complete perspective on the practices and curriculum of this school reform effort, specifically in the area of STEM education. While parents may be considered the "teachers" for their students, research demonstrates their role to be more akin to advisors or managers who find and use a variety of resources for their children instead of actually delivering instruction themselves (Hanna 2012). Parents often cite the need to promote children's interest in STEM areas (Jones et al. 2015), but exactly how parents act as teachers or facilitators and use teaching and learning strategies to provide valuable STEM education opportunities remains largely undocumented in the homeschooling community.

The purpose of this case study was to investigate the homeschool STEM educational activities of high school students. This case study sought to capture information of the STEM educational activities currently used by a select group of homeschooling parents or guardians in a community in the southern United States. This research focused on the parental viewpoint as teacher of their child and what role the parent or guardian played in activities associated with delivering instruction, coordinating educational activities, choosing curriculum, and working with the child as their student on a typical school day, specifically in the area of STEM education. The following two research questions guided the study:

- 1. What educational activities do parents or guardians choose for their high school students in STEM education?
- 2. What is the role of the parent or guardian in the STEM activities?

Homeschool literature review

Research studies on homeschooling highlight different aspects of homeschooling methods, curriculum, and the role of the parent in homeschooling. This existent literature provides a framework for this study and further provides a platform for continuing research into the homeschooling environment. The following literature review demonstrates research into homeschooling educational activities and the role of the parent. Overall, the studies demonstrate variety in the instructional methods used by homeschooling parents, as well as a focus on the use of networking and community resources to provide educational opportunities for students (Bachman 2011; Boschee and Boschee 2011; Hanna 2012).

General curricular practices of homeschooling

Hanna (2012) conducted a longitudinal study of 225 homeschool families over a period of 10 years, using a combination of phone and computer interviews with questionnaire data, which has been cited widely in homeschooling literature. The administered questionnaires captured the demographics of the families, their methods, materials, curricular choices, and the motivation for the families to homeschool. Data were gathered from the same families at two separate times, 10 years apart, as long as they were still engaged in home-based education practices. The section of Hanna's (2012) research that focused on the methods and curricular choices of homeschool families is of particular interest to the purpose of the research questions proposed in this study. The questionnaire included a large range of aspects relating to curriculum and instruction including the use of prepared curriculum sources, the use of community resources and programmes (local school districts, libraries, etc.), and the use of technology and online materials in the homeschooling process.

The data from the second set of interviews and questionnaires indicated a significant amount of growth in the categories in terms of the percentage of parents who were using different methods and resources. Two factors for this general increase and diversification of methods were: (a) an increased use of technologies, and (b) an increased concept of networking within the homeschool community. More specifically, the areas that showed an increase in use by parents by at least 20% were: (a) the use of prepared curriculum, (b) the use of textbooks from local schools, (c) the use of the public library, and (d) the use of consulting teachers or specialists.

This study demonstrates the diversity of methods and resources often found in a homeschooling setting, and also indicates that parents were willing to change or adapt their homeschooling methods as new resources and technologies become available. This study provided an overview of the general methods or activities that homeschooling parents reported using including the use of textbooks, technology, and outside resources such as libraries and tutors (Hanna 2012).

Boschee and Boschee (2011) administered a survey to parents to determine parent motivation to homeschool and to examine what types of curriculum and assessment were prevalent within the homeschooling community. The findings of the survey provided insight into daily activities of homeschool students. The majority of homeschool parents (72.5%) reported using published curricula as a primary source of information, and 44.9% of parents reported following the South Dakota curriculum standards. The majority of parents reported that their students spent an average of four (42%) to six (23.2%) hours per day in formal education. Parents also reported using the following as resources in their homeschooling: the Internet (76.8%), the public library (85.5%), and field trips (73.9%) (Boschee and Boschee 2011).

In looking at parents who have chosen to homeschool children with special needs, Parsons and Lewis (2010) concluded that most parents did not follow the National Curriculum, even though the description of activities they provided were very similar to the academic subjects listed in the National Curriculum. Instead, parents opted for a more flexible approach to homeschooling, which relied somewhat on the pre-planning of subjects and instruction but also incorporated children's preferences and accommodations (Parsons and Lewis 2010).

Homeschool teaching methods and styles

Besides simply purchasing curriculum, many parents often employed an eclectic mix of teaching methods or homeschooling styles, using multiple resources, spaces, and community access to provide educational opportunities for their children (Kraftl 2013; McKeon 2007; Seibert 2002). Research has attempted to classify the types of teaching methods and styles found in the homeschool community (Clements 2002; McKeon 2007). Some parents have used a textbook-based teaching style or online learning environments, which mimic a more traditional approach in recreating a "school-like" atmosphere at home. Other homeschooling parents have chosen no guiding curriculum, instead choosing to allow students to pursue whatever interests them, a method often called "unschooling" (Clements 2002; Seibert 2002).

While large survey and questionnaire type studies have attempted to identify general trends in homeschooling methods (Boschee and Boschee 2011; Hanna 2012), smaller case study approaches have looked more specifically at parents' teaching methods. Direct instruction, one-on-one instruction and self-study are some of the primary teaching methods seen in case studies of homeschooling families (Anthony and Burroughs 2012; Cardinale 2013; Clements 2002; Swanson 1996). Clements (2002) conducted a case study of three families. The findings indicated that parents used a combination of self-study, computer-based work, seatwork, and guided self-study with individualised help as teaching methods for instructing their students. Findings from Anthony and Burroughs (2012) identified similar methods, as they found that approximately 70% of a homeschool student's instructional day was spent reading and parents tended to use more traditional curriculum and teaching activities.

Swanson (1996) investigated what homeschooling methods might look like on a daily basis by using interviews with 39 different families. Findings concluded that parents used several different methods of instruction. Some parents stated that they had a more traditional, school-like setting in their home, while others emphasized the use of one-on-one instruction and independent study, especially for older students. Most parents stated that they chose strategies based on the needs and learning styles of the children, a common approach seen across homeschooling case studies (Bachman 2011; Clements 2002; Swanson 1996).

International studies have yielded specific teaching strategies such as direct instruction or self-study. Parents in case studies in the United Kingdom also took advantage of the freedom and flexibility of the homeschooling environment. In conversations with homeschooling parents in the United Kingdom, Winstanley (2009) and Kraftl (2013) both found that parents saw learning in the homeschool setting to be flexible and designed to meet the needs of students. McKeon (2007), using surveys and interviews, found that parents played an active role in developing homeschooling methods around the experiences, interests, and abilities of their children. For example, with gifted students, the instruction could be individualized and challenging (Winstanley 2009).

Parents were also able to use the natural patterns and relaxed schedule of the day to provide avenues for children to pursue interests and immerse children in educational experiences that often transcended specific times and location but were rather a natural part of all their activities (Kraftl 2013). Kraftl's (2013) in-depth interviews with 30 homeschooling parents demonstrated that parents often used locations and movements, such as a trip to the grocery store or a walk outside, as an educational opportunity to promote learning. Parents allowed children the freedom to direct the learning and flow of activities (Kraftl 2013).

Homeschooling resources and community involvement

The types of educational experiences homeschooling families engage in are driven by factors such as location, access to resources, and community connections (Bachman and Dierking 2011; Kraftl 2013). Homeschooling does not occur in isolation but rather takes place within an increasingly connected and diversified community. In surveys, parents reported the use of multiple types of resources, including the Internet, local libraries and museums, community members, and tutors, as ways to enhance their homeschooling methods (Boschee and Boschee 2011; Carpenter and Gann 2015; Hanna 2012).

Kraftl (2013) focused on the need to expand what constitutes learning spaces in education, specifically within a homeschool environment. He stated that for homeschoolers, "learning at home" could actually mean constructing knowledge in a variety of spaces and locations where learning opportunities arise and parents take advantage of those opportunities. Field trips to local museums, libraries, or even walks outside were spaces where learning occurred within a homeschool environment (Hanna 2012; Kraftl 2013).

One method of homeschooling that relies heavily on community connections and resources is the use of a homeschool cooperative (co-op), which is a group of parents who gather to collectively teach courses (Anthony 2015; Muldowney 2011). These courses can range from typical school subjects, such as maths or science courses, to electives and athletics. Many times the teachers in these groups are other homeschooling mothers or community members (Muldowney 2011). While the co-op is used as a way to expose students to different curricula and people, parents often also provide classes at home to supplement the curriculum offered by the co-op (Muldowney 2011). However, to many parents the co-op is an integral part of the homeschooling process and helps parents overcome the inability to teach all courses or provide extracurricular activities for their children (Anthony 2015).

Besides the use of resources and community involvement to assist in the teaching and learning practices of homeschool, homeschooling parents also rely heavily on a network for advice and support throughout the homeschooling process (Hanna 2012; Lois 2006; Ortloff 2006). Parents use other homeschool parents to learn how to homeschool, to discuss curriculum and teaching practices, and as sources of encouragement when they may be struggling with homeschooling (Lois 2006; Ortloff 2006). The importance of a network for homeschooling has been stressed multiple times in the research (Hanna 2012; Lois 2006;

Ortloff 2006), and its importance in the teaching and learning activities, as well as the general support systems of homeschooling parents, cannot be overlooked.

Homeschooling methods and STEM education

When looking specifically at homeschooling methods in STEM education, the focus of this study, the research shows similar findings to what has previously been stated. Parents tend to use an eclectic mix of styles and resources designed around meeting the needs of the students (Bachman and Dierking 2011; Jones et al. 2015). Outside the traditional school setting, homeschooling families tend to foster lifelong learning in STEM education and find creative ways to promote their child's interest, what could be considered an "informal" approach to STEM education (Bachman 2011; Bachman and Dierking 2011).

Bachman (2011) highlighted that most STEM activity in the homeschool environment is family-led and often guided by the parents' goals and values, while also taking into account the child's interests. Bachman (2011) investigated homeschooling STEM activities and used an ethnographic methodology, including video, audio records, field notes, and artifacts. Data analysis revealed that a parent's approach to STEM education is dynamic and evolves based on children's interests and available resources. These findings are similar to other research in the homeschooling area (Hanna 2012; Parsons and Lewis 2010). Parents in the study actively sought outside resources to enhance their student's STEM education such as free-choice learning activities at local museums and libraries, web-based materials, and other community resources such as science clubs (Bachman 2011). The flexibility in schedule and approach to homeschooling allowed parents to provide freedom for students to engage with materials and other opportunities that may be problematic within a traditional, confined, school setting (Bachman 2011; Bachman and Dierking 2011).

Specifically examining successful mathematics homeschooling practices, Cardinale (2013) stated that parents set the learning foundation first, and then, to be successful, students were able to build on that foundation through such things as mastery learning and challenging curriculum (Cardinale 2013). This discovery is similar to the findings of Bachman (2011), in that parents usually guide the learning process in science education as well.

For parents and students who homeschool, the concepts of in- and out-of-school learning in STEM education are often blurred, and the movement between the two types of learning is fluid and changing constantly (Jones et al. 2015). Observations of homeschooling families engaged in STEM educational activities have shown families use a "school-like" approach and then transition seamlessly to a more informal approach. This approach allows students to pursue interests in specific content knowledge or through different investigations (Bachman 2011). Jones et al. (2015) similarly reported that homeschool activities in engineering education could be seen as an informal pathway of education, reliant on activities, resources, and events that students engage in outside of a formal setting. In homeschool engineering education, these activities ranged from participation in scouts and LEGO leagues to magazines and Internet activities (Jones et al. 2015).

The role of the parent in homeschooling

In the homeschool setting, the parent assumes the role of the teacher in terms of their children's education. This places parents in a unique position of fulfilling both their parental responsibilities and also meeting the requirements necessary for teaching. In fact,

homeschooling mothers often view these two roles – teacher and parent – as being intricately related (Lois 2006, 2010). Despite the tension that occurs as parents attempt to navigate the responsibilities of both of these roles, homeschooling parents perceive that they are capable of creating the necessary environment and fulfilling the role of teacher for their child effectively (Green and Hoover-Dempsey 2007; Port 1989; van Schalkwyk and Bouwer 2011).

Although parents fulfil the role of teacher to their students, the definition of teacher may have a different meaning within a homeschool environment than in a traditional classroom. While teachers in classrooms are oftentimes the ones delivering the instruction themselves, parents as teachers in the homeschool setting are sometimes seen more as facilitators, purchasing curriculum for their students, finding tutors or co-op groups, or learning alongside their children (Bachman and Dierking 2011; Carpenter and Gann 2015; Kraftl 2013).

Most parents learn to homeschool individually and experimentally, oftentimes having to reframe conceptions from a traditional classroom setting that are not applicable to the homeschool setting, and learning from and in relation to other parents (Ortloff 2006). This corresponds with the conclusions from Kraftl (2013) whose conversations with parents showed parents moving from a more traditional style of homeschooling to a more child-led form as they experimented with methods and relied on a relationship between the learner (child) and the educator (parent).

Despite the resources and support parents draw from family and community members, fulfilling the role of both parent and teacher brings a unique set of challenges (Lois 2006; Shepherd 2010). Parents often experience insecurity, emotional strain, and anxiety in providing education for their students (Lois 2006, 2010). Specifically in STEM education, parents express concerns about knowing what their children need and providing the necessary resources (Jones et al. 2015). Research even shows that oftentimes homeschooling parents may have believed they were acting in the best interest of their child in terms of schooling when in actuality they had been unaware of the child's needs (van Schalkwyk and Bouwer 2011).

The role of the parent as the teacher is intricately connected to their role as a parent. Oftentimes parents struggle with some of the aspects of being a teacher (Lois 2006). Specifically, parents have been seen to struggle with meeting the needs of their learners and knowing what their children need in terms of resources in the education they provide (Jones et al. 2015; van Schalkwyk and Bouwer 2011). However, parents often indicate they were able to overcome challenges and felt confident in fulfilling this role for their child (Lois 2006; Ortloff 2006; Shepherd 2010). Homeschooling parents can be seen as intricately involved in their child's education but often in a non-standard and sometimes misunderstood way (Green and Hoover-Dempsey 2007).

Methodology

This research was conducted using a qualitative case study approach to describe the homeschooling practices of a small sample of families. In case study research, the researcher gathers data from within a bounded system in order to produce detailed, rich descriptions of the specific context of the system (Creswell 2014; Yin 2013). The data gathered during this study fits directly within a case study approach by focusing on a purposefully selected group of homeschooling parents and the educational activities those parents used within their homeschooling environment. This qualitative case study used multiple data sources to provide a thorough answer to the research questions and to provide avenues for comparison (Creswell 2013). This research study was conducted in two phases. Participants were recruited from within a purposefully selected, local, homeschool, cooperative learning group (co-op) with which the researcher had been associated over two years. This group consisted of a group of parents who met together weekly during the school year to provide courses and support for homeschooling students. Although the primary researcher had never participated in homeschooling, the association with this community over two years preceding this study provided the rapport and access the researcher needed to conduct this study. The researcher then recruited participants in this group who were the designated teachers for their high school students, either by providing instruction or coordinating the educational activities of students. Participants were required to have at least one student taking a high school level course, and their students could not be attending a traditional public or private secondary school for any courses. Online courses or courses taken on a university campus were not included as traditional secondary school courses.

In the first phase of the study, the director of the group sent an email to the entire group containing a link to an open-ended, online questionnaire. Participants could volunteer to respond to the questionnaire, which asked them questions on their teaching style, methods and activities in STEM education. At the conclusion of the questionnaire, participants had the ability to volunteer for the second phase of the study. Overall, 29 participants responded to the questionnaire. The second phase of the case study consisted of follow-up observations, semi-structured interviews, and document collection from 10 homeschooling parents who volunteered to participate.

Data collection and analysis was conducted simultaneously in this research (Merriam and Tisdale 2016). Data were analysed to identify patterns, trends, and themes embedded throughout the data. Answers to the open-ended guestionnaires, observation field notes, verbatim interview transcripts, and collected documents provided written data sources for the coding process (Stake 2010). Data were coded in Dedoose to look for themes and categories. Initially, themes had been found based on the review of relevant literature. These themes include an eclectic mix of homeschooling styles and activities (Boschee and Boschee 2011; Hanna 2012; McKeon 2007), a reliance on a homeschool network and outside resources for learning opportunities (Bachman 2011; Hanna 2012; Kraftl 2013; Muldowney 2011), and the role of the parent as facilitator or manager of education (Bachman and Dierking 2011; Carpenter and Gann 2015; Ortloff 2006). The data from this study were used to further develop and expand on these themes. The categories and sub-categories, which are described in detail later in this paper, were drawn from triangulating data from the questionnaires, interviews, observations, and artifacts. Although many activities appeared in the data for this research, only those that appeared consistently and could be triangulated across multiple forms of data are included in the data presentation. Along with this triangulation, member checks were conducted with the participants in which the participants provided validity for the themes and categories drawn from the data analysis (Stake 2010).

Context of the participants

All participants for this study were recruited from within the same homeschool learning co-op group, which was located in a southern community in the United States. This

purposeful recruitment helped provide the bounded system necessary for a case study. This co-op was a group of homeschooling families who gathered once a week for approximately 20 weeks during the school year to provide courses and activities for students. The group was composed of approximately 70 to 80 families who met at a local community centre. Parents or other community members would volunteer to provide specific courses for students to enrol in. Besides foundational courses, other activities and classes were offered such as journaling, robotics, and gardening. The courses varied depending on the expertise of parents who volunteered. Members were allowed to enrol their students in whatever courses or activities they chose; some students may have only taken one course at the co-op, while others might have been enrolled in five or six courses.

From the co-op, 29 parents and guardians completed the open-ended questionnaire. The 29 participants collectively represented 35 high school students. The open-ended questionnaire allowed participants to volunteer for follow-up procedures, and 10 of the 29 participants volunteered. All 10 of these participants were the mothers of their students and were involved in the co-op for at least one STEM related course. Each mother had one to two high school level students. Cara, Anna, Susan, Alisa, Casey, and Dottie (pseudonyms) all had two high school students at home, while Glenda, Cheryl, Lacy, and Deb (pseudonyms) had one high school student.

Presentation of findings

In the process of data analysis, categories discovered in the literature review (e.g. eclectic mix of homeschooling styles and activities, a reliance on a network and outside resources, the role of the parent as facilitator or manager) were expanded upon with the data from this study. While these three categories still provide the basis for the presentation of findings, they have been updated and revised to the following three major categories. First is the eclectic mix of typical educational activities, which includes both the variety seen in curricular activities as well as activities that are extensions of the curriculum. The second category continues to be the reliance on community resources. The third category pertains to the role of the parent as having three main priorities: parent as facilitator, parent as counsellor, and parent as teacher. Each of these categories is described individually in the following sections.

Eclectic mix of typical STEM educational activities

This category includes the educational activities that parents chose for their students in STEM education. Two main themes or types of activities emerged during data analysis including curricular activities and curricular extensions. Each of these themes and the types of activities that were identified are discussed next.

Variety of curricular activities

Variety of curricular activities refers to the methods and activities parents used with their students as they covered specific curriculum or material from a course in which the student was enrolled. In terms of STEM courses, of the 10 parents who chose to participate in follow-up procedures, each had students enrolled in both a science and a maths course, and three had students who were also taking a computer-programming course. Within each

course, whether maths, science, or computer-programming, the parent had a primary method or course delivery mechanism through which their student received instruction for the course. These methods included online delivery of courses, classes taken through the co-op, tutors, and self-study, where the student primarily completed the course material on their own. These methods were reported in observations, interviews, and documented in the open-ended questionnaire answers.

Along with having a primary course delivery mechanism or instructional method, students also participated in a variety of activities within that method to assist them with learning the required content of each course. Many of these activities were similar to those found in a more traditional school environment. As they took charge of their own learning, students read textbooks and completed assignments or practice problems over the material. Parents also indicated that they used videos with their students, that either came with the curriculum they purchased or that they found online as an instructional activity. Students also participated in other activities, such as labs and experiments, and used manipulatives or other hands-on activities to assist with instructional needs.

Curriculum extensions

Besides activities that went along with specific curriculum or courses, many parents also provided curriculum extensions for their students in the area of STEM education. These curriculum extension activities came in primarily two forms, STEM activities that the family participated in together and STEM clubs and teams in the community in which parents enrolled their students. The family activities included field trips to different locations such as museums or marine sites. Cheryl mentioned that her family attended a professional fair at a local college where the students got to see and participate in activities associated with specific professions that related to science and engineering such as putting together cars using robotic arms. Along with field trips that specifically related to STEM education, parents also stated that they engaged students in everyday STEM related activities that were not necessarily tied to a specific course. Some examples of these included building computers, working on the family car, researching plants growing in their backyards, gardening, or looking at the mineral build-up on an old washing machine.

Besides family-oriented activities, many parents also enrolled their students in local clubs or groups that related to aspects of STEM education. In the open-ended questionnaire, parents listed examples of these groups, which included science clubs, library teen technology groups, STEM related summer camps, and 4-H Forestry. The co-op learning group provided a unique opportunity for students to participate in a robotics team and competition throughout the year, and many participants stated that their students were involved with this team. Parents found the experiences that students gained through involvement in these types of STEM clubs and teams to be a valuable experience. As Casey stated in her interview about robotics, "It's [robotics] being able to do some hands on project where you see the math and the engineering come together to make a thing that does something, some task, has been beyond words helpful."

Reliance on community resources

As can be seen in the sections above related to the curricular activities and extensions of STEM education, homeschooling parents in this study relied heavily on community resources

to provide instruction and engage their students in STEM learning opportunities. Although this is easily seen in the examples given in the previous sections, the extent to which parents rely on a network and resources to assist them in the homeschooling process warrants a separate discussion as well. Since this research was conducted within a homeschool co-op learning group, the obvious and primary example of a network of community members is the co-op itself. Every participant had their student enrolled in at least one co-op course, which was taught by another parent or member of the community, and many parents enrolled their children in multiple courses through the co-op.

Besides the use of the co-op, two other examples of parents' reliance on community resources were the use of tutors to provide instruction and the use of community establishments, such as libraries, to provide access to resources such as clubs and teams. As already previously discussed, many parents employed private STEM tutors for their children. These tutors were either members of the community or other homeschooling parents. Parents also relied on local colleges to provide their students access to STEM courses. A number of parents indicated that their high school students were enrolled in early college courses or dual enrolment at local colleges in the area and, as mentioned previously, parents also used community resources, such as the library, to provide access to science and technology clubs.

Role of the parent

Throughout data analysis, evidence demonstrated that homeschooling parents take on many different roles in the education of their students. While these roles are fluid and could vary from parent to parent, three main themes emerged, identifying the main type of roles fulfilled by the parents. These include: parent as manager or facilitator, parent as counsellor, and parent as presenter/lecturer. Each of these types of roles is discussed in further detail in the following sections.

Parent as manager or facilitator

The theme of parent as manager or facilitator demonstrates how parents oversee their children's education through such duties as grading, making daily schedules, and ensuring students are staying on task and completing assignments. In observations, parents were also witnessed acting as facilitators as they went over schedules and assignment lists with their students. When asked in interviews about the role they play in their children's education, many parents articulated that they see themselves as the facilitator rather than teacher. In an interview with Anna, she claimed, "I'm the facilitator.... I am going to guide them to the areas they need to go." Cara explained, "It's not a teacher. It's more, you guys have the tools and you know what to do.... I will make sure you are doing everything." Deb explained her role by saying, "I'm more of a mentor....I'm not truly a teacher because for her to be educated she needs to learn to educate herself." To these parents, the role of facilitator or manager requires them to know what their child should be completing in terms of instruction and assignments and then ensure that those items are completed. They are also the ones who grade tests and keep accurate records of grades and school days, which is a requirement of the state.

Parent as counsellor

Besides their role as facilitator, parents also serve the role of counsellor or guidance counsellor to their students. In this role, parents are responsible for determining the academic needs of their children, both in terms of graduation requirements for the state and individual learning needs, and finding the resources available to meet those needs, similar to the work of a traditional school counsellor. For example, Susan and Dottie enrolled their children in courses offered by local colleges to meet both academic requirements mandated by the state and the individual learning needs of their students, and Casey attended to her son's diagnosed learning disorder by finding curriculum that accommodated his needs. In addition, parents also reported taking notice of specific learning needs and styles of their students and then finding the appropriate resources to assist them. In her interview, Anna explained her choices based on her sons' learning styles: "They like to experience it more than just hear it. It just goes with their learning style and gives them a chance to be more social." Dottie explained how she chose activities: "Well, resources become available to me, and I made the decision based on what would best fit that child and their learning styles." Alisa also articulated about her daughters' learning styles: "They see it. They will surely see it. . . . I think my kids are mostly visual learners, so they'll get it to their heads early."

Each of these quotes serves as evidence of a parent who understands the learning style of her student and then uses that knowledge to make decisions about academic instruction, thereby fulfilling the role of counsellor.

Parent as presenter/lecturer

The final role parents were seen to play in this research study was the role of lecturer or presenter of information. In this role, the parent is the primary source of instruction for his/ her student, presenting information through traditional methods such as lecturing or reading material out loud. In the open-ended questionnaire, parents listed items, such as "direct teaching", as a main example of how they are involved in their students' education. In observations, examples of direct teaching by parents included Susan delivering a maths lecture to an entire group of students at the co-op, which included her son, and Alisa teaching her daughter through the use of an experiment. Cara also mentioned in her interview that she is the physical science teacher/lecturer at the co-op.

Discussion

This case study focused on a small, purposefully selected community of homeschool parents. While conclusions can be drawn from this study, it is important to note that the participants may not be representative of all homeschooling parents. Rather, the results discussed below provide a glimpse into a select homeschooling community and the activities used by parents within that community. In this case study, parents were seen to use an eclectic mix of STEM educational activities for their students based on the academic needs of the students and the resources available within the community. Parents usually provided their students with a primary instructional delivery method for their STEM related courses, which included courses offered through the local co-op, online courses, courses delivered through tutors, and courses that were primarily self-study.

As well as activities that were directly related to a specific course or topic, many parents also had their students participate in STEM activities that were extensions of the curriculum. These activities mainly revolved around STEM clubs and teams in the community such as the BEST robotics team for homeschool students and activities the family participates in together such as field trips to museums or presentations at local universities. In all of these

activities, parents relied heavily on resources within the community offered through outlets such as local universities, the co-op, or access to tutors.

While this research represented a case study approach and the results are not meant to generalize to other homeschooling communities, these results do align with other homeschooling literature. Other homeschooling research indicates that parents use a wide variety of educational activities for their students including activities such as textbook readings and online courses (Anthony and Burroughs 2012; Hanna 2012), which is similar to what was found in this case study. In STEM education literature, parents have been reported to rely heavily on community resources including libraries, museums, and community clubs (Bachman 2011; Bachman and Dierking 2011). The importance of a learning cooperative as a group to provide support for parents choosing to homeschool their students has also been emphasised in previous homeschool literature as a primary resource for parents (Anthony 2015). This study had similar findings as parents were seen to engage students using community resources and resources provided through a cooperative learning group.

As the persons primarily responsible for their children's education, parents within this case study were seen to have three primary roles in relation to the STEM educational activities of students. First, parents acted as the manager or facilitator of their students' education. This included activities such as grading papers, maintaining records, providing a daily schedule for their students, and keeping students on task as they worked to complete activities. This role is similar to other homeschool literature, which found parents to act as facilitators of their students' education (Bachman and Dierking 2011; Carpenter and Gann 2015). The literature emphasises that parents usually want their students to take charge of the learning process with parents being facilitators. This research also indicated that parents might also fill the role of counsellor to their students as well as being involved in the direct instruction of the student. Parents took into account the academic needs of their students and then used that to make decisions on courses taken and activities used within a course; similar to the direction a guidance counsellor on a traditional secondary school campus might offer students.

Implications and recommendations

In case study research, the goal of the results is to provide detailed descriptions of the context of the research setting (Yin 2013). This means that the results of this case study as presented below may not be applicable to all homeschooling parents and families that are represented by different communities. However, this research does have some implications for both those families who are choosing to homeschool their children and for people outside of the homeschool community. For families who are already homeschooling or will begin homeschooling, this study offers some examples of STEM activities that parents could choose to incorporate into the curriculum. This study also examined the importance of a network and community resources for homeschool parents, which implies that homeschooling families should seek out and become familiar with resources within their specific community. These resources may include local co-op groups and community establishments such as libraries, local colleges, and universities.

This study also carries implications for those outside of the homeschooling community by providing literature on what types of activities constitute homeschooling, specifically in

STEM education. This study demonstrated that while homeschooling is often viewed simply as learning in a home environment, homeschooling students in this study were engaged in activities within their community and in many different types of instructional activities including co-op courses, tutors, and robotics teams.

Because of the limitations based on the size of this study, future studies should continue to investigate the STEM educational activities and educational activities in other subject areas to expand on the results of this research further. Future research can compare and contrast the homeschool educational activities of homeschooling families from different locations and communities with the findings of this study and potentially contribute more to the literature foundation for best practices within this unique educational genre. Also, since this study focused on high school level students, further research should examine homeschooling at different age and grade levels as well as the evolution of homeschooling methods from elementary to high school students in STEM education.

Conclusion

homeschooling research, particularly in the area of STEM curriculum and instructional practices, as well as research that examines the role of the parent in the homeschooling process, remains limited (Bachman and Dierking 2011; Badman 2009; Kunzman and Gaither 2013). The purpose of this research was to examine both the STEM educational activities of high school students and the role the parent played in those activities. Since this case study used a small, purposefully selected group, the results presented may not be representative of other homeschooling parents. However, the data was consistent with findings from other homeschooling research studies. Data for this case study clearly pointed to an eclectic mix of educational activities selected and used by parents of homeschool students and the reliance of parents on community resources to assist with providing educational activities.

This study also indicates that the role of parents as the teacher for their students is a continually evolving role within this specific homeschool community. While some parents in this case study indicated that they did directly teach or present information to their students, many others felt their role was more akin to that of a facilitator, supervisor, or even a counsellor. As this research demonstrates, homeschooling parents in this community fulfil multiple roles and responsibilities in their children's education, and those roles have the ability to change based on needs and circumstances.

Further research is needed to continue expanding on these findings. Given the sample size and location, further research should be done in other communities in the United States and in other countries where homeschooling occurs to provide data, which can be compared and contrasted with these findings. The impact of the homeschooling community cannot be overlooked in further research. The results presented in this case study reflect only the activities of a single community. Further studies should investigate how the participation in a homeschooling community affects the educational activities selected and used by parents.

Disclosure statement

No potential conflict of interest was reported by the authors.

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