

AN EXPLORATION PROJECT: THE PROCESS OF BUILDING A TECHNOLOGY
EMBEDDED STEAM LEARNING COMMUNITY THROUGH MOBILE GROUP
APPLICATIONS

by

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ABSTRACT

Early exposure to science, technology, engineering, and mathematics (STEM) has a profound effect on long-term educational and societal outcomes (Brenneman, 2011; Dejarnette, 2012; Lamb, Akmal, & Petrie, 2015). Today, we are living in an era of rapid technological and digital innovation. Group messaging applications on smartphones have enabled increased social interaction and communication. In recent years, there has been widespread excitement around the potential for technology to transform learning (Escueta, 2017). New technologies offer exciting opportunities to enhance home-school explorations, family engagement, and a child's learning in early childhood (Snell, 2018). As investments in educational technology continue to grow, the possibilities to explore and maximize the potential of digital learning platforms, are endless. There is an apparent gap in the availability of STEAM-based resources for parents living in more rural areas such as Pitt County. This is due to lack of time, infrastructure, and a platform on which a network of STEAM-based parent communication can be facilitated. Technological innovations, such as Microsoft Teams, the Band Application, or the GroupMe Application, can be utilized to strengthen the STEAM learning community amongst parents with children aged 2-5 years, in Pitt County.

The goal of this project is to (1) identify and explore mobile group applications for parents who have participated in previous two Early Childhood STEAM workshops; (2) create a survey/questionnaire to explore the parents' perceptions and opinions toward the possibility of this technology-embedded learning community; (3) set the foundation for this technology based parent community to grow in the future. By utilizing this form of group messaging, parents will be able to share ideas and communicate updates with the research team, and one another. This will also serve as a means to evaluate and document parents' progress with STEAM implementation in their home. Today, group messaging applications on smartphones have enabled increased social interaction and communication. Findings from this study reveal that most parents find group-messaging applications, in particular, the Band Application, user-friendly and easily accessible. If managed properly, this innovation can be utilized to strengthen the STEAM learning community amongst parents with children aged 2-5 years, in Pitt County, North Carolina.

LITERATURE REVIEW

Extensive literature reviews enabled the research team to understand the growing role of STEAM in today's world. Furthermore, the benefits of implementing STEAM in early childhood are brought to light through numerous studies. With the focus of this research study being on designing a technology-based parent STEAM platform, previous and ongoing studies on the use of group-messaging applications in various settings, were reviewed to gauge their success and challenges. While numerous articles are available for STEAM and technology programs as two independent topics, research based on the union of the two to form a cohesive parent program is lacking severely.

Growth of STEAM Today

Early exposure to science, technology, engineering, and mathematics (STEM) has an essential effect on long-term educational and societal outcomes (Brenneman, 2011; Dejarnette, 2012; Lamb, Akmal, & Petrie, 2015). However, many STEM enrichment programs are initiated in the school system, especially during middle and high school in the United States (Robinson, Dailey, Hughes, & Cotabish, 2014), but little has been done for young children or parents before kindergarten classrooms (Dejarnette, 2012). Recently the abbreviation STEM has adopted the letter A, which represents the designating arts to promote creativity in STEM education. Creativity and innovation are pieces that were lacking in the original STEM plan. Educators should incorporate open-ended, creative activities into an integrated STEAM curriculum during early childhood.

Parents have been identified as children's first teachers and they play a critical role in shaping children's early STEAM exploration. "Some adults have the misconception that real STEM learning only happens inside classrooms, which may leave teachers feeling isolated and unsupported. But when adults recognize that even very young children are capable of meaningfully engaging in STEM inquiries anytime, anywhere, they can extend that STEM learning in multiple aspects of children's lives. As with learning a new language, children become *fluent* in STEM habits and more knowledgeable about STEM topics when they are *immersed* in them. The more opportunities they have to explore STEM—at museums, at libraries, and at home—the more fluent they will become" (McClure, et al. 2017).

However, many adults (e.g., early childhood teachers and parents) lack sufficient confidence and competencies to teach science, engineering, technology, arts, and mathematics in their classrooms or at home (McClure, et al. 2017). Many adults have low self-efficacy related to their abilities to support children’s STEAM education (Spaepen, 2017). Their low self-efficacy could be a hindrance in delivering effective instructional support in early childhood STEAM learning reducing children’s curiosity and STEAM exploration. There is little research focused on equipping parents with the tools to foster a vibrant STEAM education at home. In addition, there is currently no early childhood STEAM curriculum/program that facilitates home-environment STEAM instructional support and interaction for parents. The call of the hour is to design a technology-embedded program which establishes a virtual network of like-minded parents who are interested in integrating STEAM in early childhood.

Benefits of a Technology- Based Parent Learning Community

To promote long-term, sustainable implementation of STEAM exploration in the home-environment, a virtual platform seems to be the most feasible and practical option. Group-messaging approach has been used to sustain and form the learning community in some public-school systems and healthcare intervention programs (Barhoumi, 2015; Rathbone & Prescott, 2017; Cheng et al., 2018). In particular, the importance of parent involvement in children’s educational process has been recognized by many studies. “However, barriers of time, schedules, and resources have put limits on effective parent involvement. To address these problems, telecommunications technology has been applied to increase parent-teacher interaction” (Bauch, 1998).

Benefits of using technology-based group messaging applications include: (1) increased social interaction and communication; (2) parents who join the group messaging platform engage in more learning activities with their children; (3) and the development of a vibrant learning community (Hurwitz, Lauricella, Hanson, Raden, & Wartella, 2015).

Existing Technology-Based Learning Communities

Similar applications of technology are being used in numerous settings today. In one particular study, the use of the mobile application GroupMe was explored in the higher education context. Findings from this study indicated that GroupMe platform “afforded students opportunities to

engage in productive course-relevant conversations and provided additional ways for learners to exhibit online social presence through tool features” (Gronseth & Hebert 2018). Another prior research study experimented with the use of WhatsApp to engage young professionals in mobile communities, in effort to establish a social/professional network. Findings from this study indicated that “participants in the moderated WhatsApp groups had significantly higher knowledge and exhibited fewer feelings of professional isolation compared with the control group” who were not invited to any group application (Ajuwon, et al. 2019). This reinforces the idea that parents who will be actively engaged in an early childhood virtual group will feel more motivated and encouraged to expand the exploration of STEAM with their child at home.

Lack of Literature for this Subject

Technology has revolutionized networking and has provided opportunities to expand learning even outside of the classroom. However, very little has been done to develop a technology-embedded learning community to promote early childhood STEM learning at home for parents in the non-school setting. Extensive literature reviews yielded very few studies focusing on the development of such a program. In addition, since applications like Band and Microsoft Teams are relatively new, research studies utilizing these tools are scarce, if at all available. The purpose of this project is to demonstrate the Process of Building a Technology Embedded STEAM Learning Community through Mobile Group Applications, with a hope to bridge that gap to some extent.

PROJECT BACKGROUND

There is a considerable amount of evidence which demonstrates the lack of STEAM programs or resources for parents with young children in Eastern North Carolina. In 2018, the idea of introducing a STEAM-based intervention for such parents was conceived by a faculty member and research team at East Carolina University's Human Development and Family Science Department. The primary stage of this intervention comprised of extensive literature reviews, child observation assessments, and outreach efforts. These steps were essential to understand the prevalence and context of the lack of early childhood STEAM education in Pitt County, North Carolina. Findings from these initial steps guided the development of the program. In Fall of 2018, a Pilot Workshop was launched. This 5-week series of workshops was tailored for parents living in Pitt County, North Carolina who had at least one child in the age group of 2-5 years old. The program was hosted in conjunction with the Martin-Pitt Partnership for Children, in Greenville, North Carolina.



Figure 1.0 – STEAM Workshop Schedule

The pilot workshop focused on educating ten parent participants regarding implementation of STEAM concepts at their home. Workshop topics were geared towards strengthening their understanding of STEAM, the benefits of STEAM, ideas on how to overcome common challenges they may encounter, as well as providing unique ideas and promoting collaboration with other parents in the area. Encouraged by the success of the pilot workshop, the research team conducted a second Spring Workshop for 20 more parents in 2019. The concept of STEAM was new to many and it was evident that the workshops were effective in kindling parents to brainstorm ways to propel their child's STEAM exploration at the home-level. The workshops

intended to simply plant the seed for early childhood STEAM education in parents of Pitt County. Interviews with each parent participant were conducted prior to the 5-week session to gauge their preliminary understanding of STEAM education. Interviews were also conducted at the completion of the 5 weeks. Comparing results from pre- and post-workshop interviews really enabled us to understand the effectiveness of the workshops. Parent responses were transcribed and thoroughly analyzed for several months to recognize patterns and discrepancies in their evolved understand of STEAM, their success with implementing concepts at the home level, and to assess what they were seeking from the community.

Data analysis brought to the forefront the alarming scarcity of resources and even the lack of efforts to cultivate an environment of early childhood STEAM education in Pitt County. Parents from the workshops shared a common desire for a long-term, sustainable STEAM community. Some parents suggested more workshops, others suggested creating monthly STEAM idea videos, and some wanted to simply share ideas with other parents and build a stronger STEAM parent network. This is what sparked the research team to pioneer the development of a technology-based STEAM Parent Community through the use of a group-messaging platform.

The creation of such a program involved multiple trials of different group applications to determine which would be ideal for the parents participating. Thus, the purpose of this research study is aimed to examine parental perceptions and opinion of using free mobile group apps to engage in an early childhood STEAM (Science, Technology, Engineer, Arts, and Math) learning community and further examine their preferences, convenience, and usability of free apps.

RESEARCH QUESTIONS

- A. How can a sustainable long-term STEAM community be created for Pitt County parents with children aged 2-5?
- B. What should the content and design of a survey targeting parent preferences/perceptions entail?
- C. What mobile group application would be best for facilitating a STEAM learning community with parents of children aged 2-5?
- D. What are parents' preferences, experiences, and challenges in using mobile group applications to engage in a STEAM learning community?

METHODS

The technology-embedded STEAM Parent Community is an idea conceived from the feedback received by parents from previously conducted Parent STEAM Workshops. Qualitative analysis of the interview transcriptions revealed that parents were looking for a sustainable community to foster a more vibrant STEAM environment for their child at home. Parent excerpts from post-workshop interviews included below re-affirm this:

“which would be like a website or even if they had handouts or something where it just had those ideas, just so people can see how simple it really is, you know, if there was a place you could go and just have activities already kind of laid out for you.”

- Post Workshop II Interviewee 0305

“I just so happened to look on their website, but you don't really know about things, and parents look for stuff like that to do with their kids, because in Greenville there's not a lot. You know, he's 3, he's not going to go to, you know, Atomic Laser place or something like that. I want him to be in stuff and engaged, and I don't know anything what's happening at ECU, I don't know if ECU has things, programs, I just feel like it's just limited as far as communication in what's out there. So we resort to going to other places because we know they have things, but I think that's a big thing, just get the word out and let people know, hey, this is what's going on, and, you know, I think a lot more people would be interested in it, you know?”

– Post Workshop II Interviewee 1216

“I think it was great and I wish, that y'all would be able to continue doing it too. I understand, you know, resources, funding and everything else, and time of course, but I think it's a beneficial thing and I'd love to see it more widespread too, not just to where it's you know, a small group once a week and everything else, I'd love to see it more, integrated. I'd love to see it more as a larger-scale even, and even consistent throughout the year. I mean you look at summers, you look at falls, you know, winters and springs and all that stuff too, there's so many different ways to tie in everything into whatever season it may be.”

– Post Workshop II Interviewee 1022

While conducting a series of workshops and distributing STEAM Handbooks were very effective methods in the initial stage of this intervention, the research team recognized the long-term challenges associated with this. Financial constraints, conflicting parent schedules, childcare liability during workshops, and the overall dynamic nature of this project, were all factors that made the research team realize that in-person programs didn't seem like a feasible, long-term option. To provide parents with a consistent and stable community, it seemed more practical to design a technology-based platform, by which parents and the research team could always stay connected. Launching such a program, would equip parents with a consistent channel to share ideas, encourage one another, ask questions, and communicate updates with the research team, as well as with one another regarding their child's STEAM exploration. This would also serve as a means to evaluate and document parents' progress with STEAM implementation in their home.

The next stage was to determine which group-messaging platform would be most ideal for the purpose of our project. With the rise in technological inventions, the list of group application options is simply non-exhaustive. Extensive research was conducted to explore different group-messaging applications. Literature reviews shed light on the usability of some of the most popular applications for similar endeavors. Direct messaging was initially considered as an option due to its familiarity, but it was soon discovered that exchange of videos and multimedia was a challenging process, especially for larger files.

Founded in 2010, the GroupMe application has established itself as a leading group messaging platform. Groups can easily be created, pictures and videos can be shared, and direct messaging with participants of the group is also a feature. An added function of the application is that it automatically downloads all media into one folder of the user's gallery. This would enable parents to easily access ideas and documents shared by other parent participants of the group.

Microsoft Teams, primarily utilized in professional settings, is another well-established platform. Teams promotes a vibrant community by allowing the exchange of not just messages, but documents, multimedia, screen sharing, and even coordinates scheduled meetings. It's easy sharing ability and accessibility made it a strong candidate for our STEAM community application search.

While numerous other options are available, the research team decided to explore the Band Application. This is a relatively new platform, but its initial reviews are noteworthy. The multi-faceted features and appealing layout of this program is what drew our attention to it. The Band Application was created with the vision of eliminating long email threads, scattered messages, and disconnected features. This one platform presents opportunities to exchange messages, post photos/videos/documents, share calendars with important reminders, and overall easy sharing.

Understanding parent preferences remained a steadfast goal of our project. Since the program was intended to create a vibrant early childhood STEAM Parent Community, hearing parents voice their thoughts, opinions, and challenges was critical to the process of our program development.

To facilitate this, a survey was designed using the Qualtrics Program. This tool was selected because of its ease, usability, and its ability to initiate data analysis based on survey results. With limited time for this project, it was essential for us to choose a tool that would enhance and expedite the survey creation and data analysis process.

The survey aimed to provide parents in the community with the opportunity to explore all three of the selected group applications and evaluate their usability and effectiveness. The next step was to determine the range and type of questions to include in the survey in order to garner the needed data, but also keep its length reasonable for parents.

In parallel, the research team set up these three applications on their personal devices and created “mock” STEAM Communities on each platform. This was done so that tutorial videos could be created for each application. Watching a detailed video with realistic STEAM content would enable parents to gain a clearer insight of each application. These three videos were then embedded into the survey.

After setting up the communities for each of the three platforms, amongst the research team itself, the script-writing process began. The script was revised several times to keep the length under 2 minutes and still be effective in shedding light on the different features of each application.

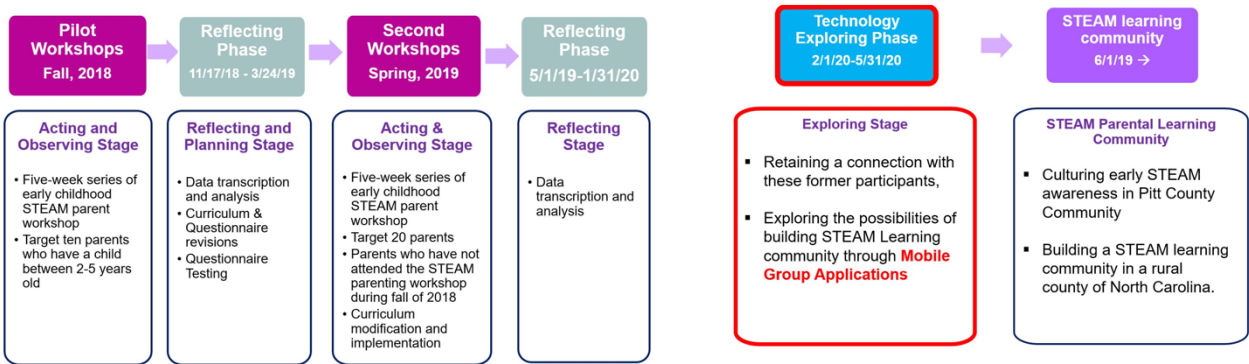


Figure 2.0 – Timeline of Project Development

Participants

The research team focused on parents with at least one child aged 2-5 years old, residing in North Carolina. The survey was sent out to as many NC parents as possible. Many of those who were emailed the survey were the thirty parents from the Pilot and Spring STEAM Workshops. This research is ongoing, but as of now, 32 parents have responded to the survey. Demographic questions of the survey indicate that responses were primarily from females who had not attended either of the workshops, but had heard of STEAM before. Thirty-one of the thirty-two respondents indicated that they had at least one child between the age 2-5, and had completed at least high school education themselves.

RESULTS

The three mobile-group applications shortlisted were determined after assessing numerous group applications and after referring to literature reviews highlighting which applications have worked successfully for such endeavors. After completing multiple revisions of the script, application tutorial videos were created using a screen recorder for: GroupMe, Band, and Microsoft Teams. Parents were able to take a virtual tour of each application, with the focus being on their unique features and sharing functions. These videos were converted to simple YouTube links, which were then embedded into the Qualtrics Survey.

Please see Appendix B for tutorial video scripts.

The Qualtrics Survey was thoroughly reviewed on several occasions, before it was published and released to parents. The survey was created to address all facets of the project. It opens with demographic questions to better understand the focus group parent population. This set of questions is then followed by questions assessing parents' overall use of technology and group-messaging applications. The research team would use the responses to these questions to gauge parents' familiarity and access to technology. The conclusion of the survey focuses on introducing parents to the three group-messaging applications selected by the research team. These questions would allow parents to evaluate each application and provide in-depth feedback on what they liked and disliked for each. Parents were given the opportunity to share their opinions on the development of such a technology-embedded STEAM parent community. While the majority of questions were either in multiple choice format or set up as matrix tables, some questions were left open-ended to elicit a thoughtful response from parents. The research team designed this so that parents would have an avenue to articulate their exact needs, preferences, and feedback for this pilot, technology-based STEAM parent community.

Please see Appendix A for complete survey.

The final Qualtrics survey was then published and sent out to numerous NC parents with children between the age 2-5. Along with this, an online consent form was attached in the email to share basic information about the purpose the study and to assure confidentiality of their responses. Parents from the Pilot and Spring STEAM Workshops were emailed the survey

specifically, as they were the fundamental, building blocks of this initiative. Other parents from across the state were also contacted.

Within two weeks of releasing the survey, around 32 parent responses were received. The research team reviewed preliminary data analysis reports generated by Qualtrics. Extensive data analysis will be conducted in the Summer of 2020 after a wider pool of parents have responded to the survey.

Preliminary data collected from the survey indicates the following:

Q19 - 12. Do you have a device to use apps (e.g., I-Pad, smart phone, tablet, computer) in your household?

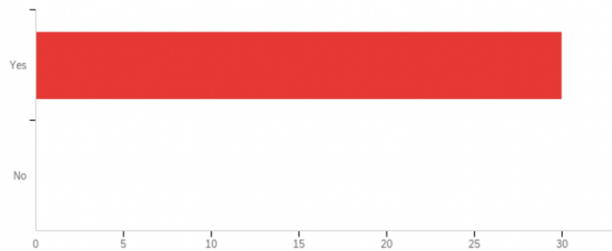


Figure 3.0 – Device Use Question from Survey

Q22 - 15. Group messaging apps are designed for getting in touch with several people and are a useful communication tool to engage with a group of people who might have similar interests. Group messaging apps can also be a good way to share information, and to inform a learning community. Have you used group messaging apps in the past, like Facebook Messenger, GroupMe, WhatsApp, WeChat, or Microsoft Teams?

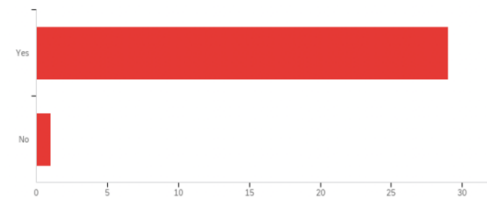


Figure 3.1 – Group App Question

All parents reported having at least one technological device by which they can join group-applications. 29 of the 30 parents even have prior experience with using group-messaging applications. Parents shared that their experience with group-applications has mostly been with: Facebook, Microsoft Teams, WhatsApp, GroupMe, and Zoom. This reveals that launching a technology-based community would be accessible for many interested parents in the county.

When asked about what information/ STEAM Content they were hoping to obtain through this learning community, common themes that emerged include:

1. *“Activities to do with children at home along with learning objectives/outcomes.”*
2. *“Things to do with items already in the home and how to keep a child engaged/trying a new activity.”*
3. *“STEAM activities to do with your child- preferably in picture format with text about supplies and directions.”*

Most parents associated a virtual STEAM parent community with a positive outcome. They acknowledged that with the changing times and growth of technology, such a platform would be beneficial to connect and communicate with other like-minded parents. Management of such a platform seemed to be a recurrent concern. Parents are seeking confirmation that the application doesn't become an added responsibility for them or that it doesn't get misused in any way. Their primary hope is for the program is that it provides creative activities for them to try at home with limited, basic supplies.

Q34 - 34. Overall, how satisfied were you with the usability of the Band Application?

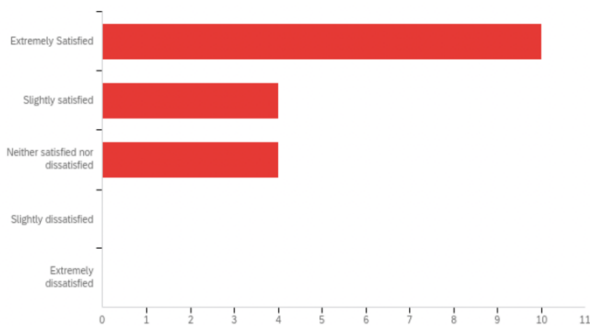


Figure 4.0- Band App Satisfaction

Q35 - 35. Overall, how satisfied were you with the usability of the GroupMe Application?

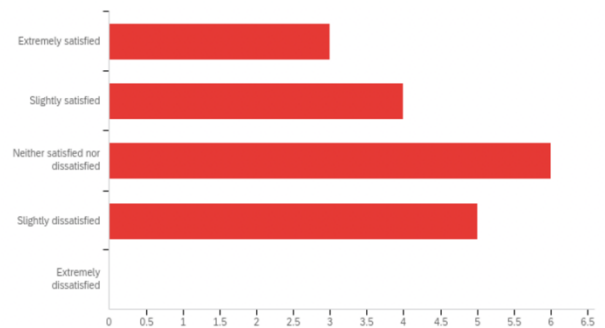


Figure 4.1- GroupMe App Satisfaction

Q36 - 36. Overall, how satisfied were you with the usability of the Microsoft Teams?

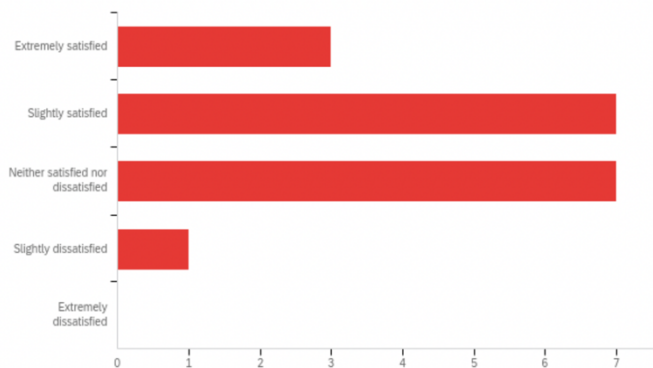


Figure 4.2- Microsoft Teams App Satisfaction

When considering parent responses to the three Group Applications themselves, it became evident that a significant number of parents were most satisfied with the Band Application as compared to GroupMe or Microsoft Teams. The Band Application review didn't yield any negative feedback or dissatisfaction. GroupMe had a number of satisfied parents, but a greater proportion of parents seemed dissatisfied with its features and overall usability. Microsoft

Teams' review saw a pretty even distribution, with parents being neither extremely satisfied nor dissatisfied with.

Analysis of these preliminary results revealed that the Band Application would be most user-friendly and useful to establish a STEAM Parent network in Pitt County. Many parents appreciated its features and found it straightforward use.

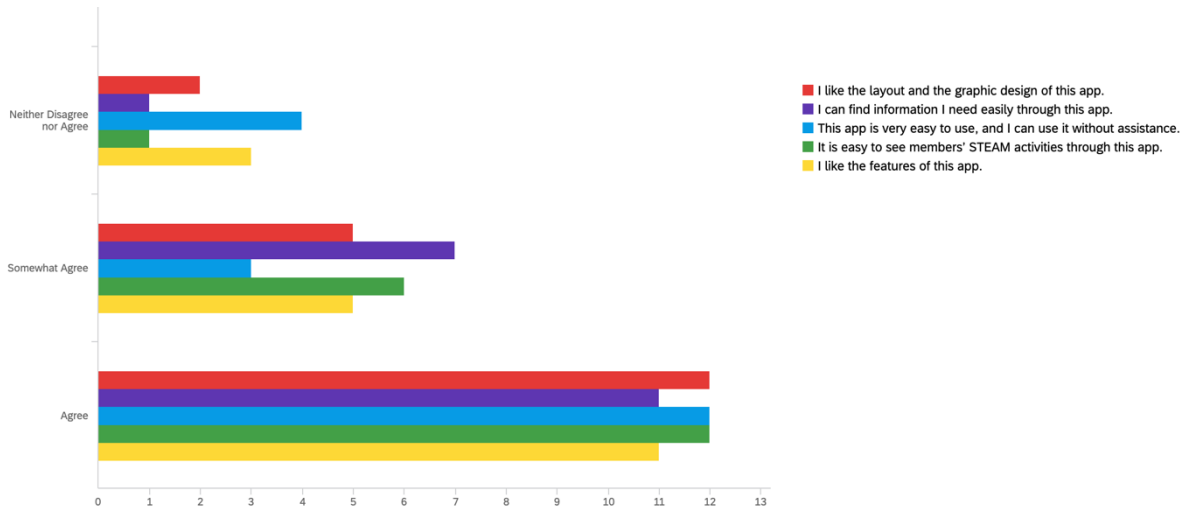


Figure 5.0 from Qualtrics Survey Data Report – Band Application Review

DISCUSSION & FUTURE APPLICATION

As discovered through initial stage literature reviews, implementing STEAM concepts and promoting their exploration amongst kids age 2-5 before entering school, has proven to be extremely beneficial for their long-term education and development. Families often have the misconception that real STEAM learning only occurs within classrooms. But when parents recognize that even very young children are capable of meaningfully engaging in STEAM inquiries, they can extend their STEAM exploration in multiple avenues. The more opportunities and activities that young children will have to explore STEAM—at museums, at events, and even at home—the more prepared they will be. Considering the lack of existing initiatives to facilitate early childhood STEAM exploration in Pitt County, the idea of launching a technology-embedded parent community is a novel approach.

This pilot research project can serve as a pioneer initiative to fulfill the needs to increase STEAM awareness in early childhood in our community. We hope to have ignited a vibrant discussion amongst the community and researchers to further strengthen and expand this program in our Eastern North Carolina, especially in rural counties such as Pitt County and Martin County in North Carolina. This community-engaged research holds great promise since it helps a great number of parents understand early childhood STEAM, as an engaging process of inquiry. The program will create rich experiences and creative ideas for them to foster a more vibrant environment at home.

While survey findings do reflect parents' excitement with the potential of such a group-messaging platform for STEAM, they did also express certain concerns and challenges. The research team will study these further before developing a final program.

Improvements and adaptations can be made to this research moving forward. Due to the time constraint, the Qualtrics Survey wasn't sent for expert revision. This may have led to certain aspects being overlooked. It's also important to consider that this study was focused on parents in North Carolina. Most that responded live in suburban or rural areas of the state. Parents residing in different states or even in more urban cities may have different preferences.

All in all, the guidance and feedback that has emerged from this pilot research study can be used to develop a long-term, sustainable, early-childhood STEAM parent community in Pitt County and other similar contexts.

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APPENDIX A—Parent Qualtrics Survey

Building a Technology Embedded STEAM Learning Community through Mobile Group Applications

1. Gender of Respondent

- Female
- Male

2. Which of the following best describes your age? Please select one:

- 18-25
- 26-35
- 36-45
- 46-55
- 56-66
- Above 66

3. What is your race/ethnic background?

- Caucasian/ White/European American
- African American/ Black
- Hispanic/Latin American
- American Indian or Alaska Native (AIAN)
- Native Hawaiian or Other Pacific Islander (NHOPI)
- Asian American
- Multiracial? (describe) _____
- Others (Describe) _____

4. What is your **current** marital status?

- Single/Never Married
- Married
- Divorced
- Separated
- Widowed
- Other: _____

5. How many children do you have and their ages?

- | Number of children | Their ages |
|---------------------------------|---|
| <input type="radio"/> 0 | <input type="radio"/> none |
| <input type="radio"/> 1 | <input type="radio"/> ___ years old |
| <input type="radio"/> 2 | <input type="radio"/> ___ years old; years old |
| <input type="radio"/> 3 | <input type="radio"/> years old; years old; years old |
| <input type="radio"/> 4 or more | <input type="radio"/> years old; years old; years old; and others |

6. What is the highest level of education you have completed?

- Some High School courses
- High school Diploma
- Technical/Vocational Training
- Some College courses
- Associate's Degree
- Bachelor's Degree
- Some Graduate degree courses or credits
- Master's Degree
- Doctoral Degree

7. If you earned an associate's degree or higher, what was your area of study (Major)? _____

8. Which best describes your current employment situation?

- Working - Full Time (at least 32 hours per week)
- Working - Part Time
- On leave but still employed
- Going to School
- Freelance/Independent
- Unemployed
- Other (specify): _____

9. I have heard of STEM/ STEAM education

- Yes
- No

10. I attended/participated early childhood STEM/STEAM parenting workshop earlier.

- Yes
- No

11. If you have attended STEAM/STEAM parenting workshop with ECU research team earlier, please let us know which workshop have you attended:

- Pilot STEAM Parenting Workshop during Fall 2018 (10/19/18-11/16/18)
- STEAM Parenting workshop during Spring 2019 (3/25/19-4/30/19)
- I don't remember

12. Do you have a device to use apps (e.g., I-Pad, smart phone, tablet, computer) in your household?

- Yes
- No

If No, please go to **Q17**.

13. How many electronic devices with apps do you have in your household (e.g., phone, tablet, computer)?

- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more

14. What is the operating system of your device(s)? (select all that apply)

- Apple
- Android
- Windows
- Other _____

15. Group messaging apps are designed for getting in touch with several people and are a useful communication tool to engage with a group of people who might have similar interests. Group messaging apps can also be a good way to share information, and to inform a learning community. Have you used group messaging apps in the past, like Facebook Messenger, GroupMe, WhatsApp, WeChat, or Microsoft Teams?

- Yes
- No

If no, please go to **Q 17**

16. What app(s) have you used to communicate in groups?

17. How often do you use Group messaging apps, such as a phone, tablet, or computer?

- Very often (20 hours or more per week)
- Often (15-20 hours per week)
- Sometimes (10-15 hours per week)
- Hardly ever (less than 10 hours per week)
- Never

	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree
18. I believe that using a mobile group application during or after STEAM parenting workshops might be a good idea to help develop a virtual STEAM learning community.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I might feel more comfortable asking STEAM questions with other group members through a mobile group application rather than asking questions during STEAM workshops.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I believe that I will learn more ideas about how to incorporate STEAM activities at home through a mobile group application.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. I would feel more encouraged to do STEAM activities with my child/children when seeing posts and examples from other parents in our group.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree
22. In the near future, if there is a free virtual STEAM learning community for parents using mobile group applications, I would love to join it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. I prefer to receive notifications through mobile group applications related to new resources toward STEAM learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. I prefer to receive documents/articles through mobile group applications related to STEAM learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<p>25. I prefer to receive videos through mobile group applications to learn more about promoting STEAM learning for young children.</p>	○	○	○	○	○
<p>26. I prefer to receive activity ideas through mobile group applications to implement STEAM activities with my child/children at home.</p>	○	○	○	○	○

Q 27. In the near future, if there is a free virtual STEAM learning community for parents using a mobile group application, what information/ STEAM Content would you like to obtain through this learning community?

Q 28. What is your opinion of using mobile applications to promote a virtual STEAM learning community amongst parents?

Q 29. What is your opinion of using mobile applications at home to enhance your understanding of STEAM education at home with your child/children?

Please review the given apps, by answering following questions.

Q 30. Please rate the following statements for the **Band Application** from "Disagree" to "Agree"

	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree
I like the layout and the graphic design of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can find information I need easily through this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This app is very easy to use, and I can use it without assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to see members' STEAM activities through this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like the features of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q 31. Please rate the following statements for the **GroupMe Application** regarding from "Disagree" to "Agree"

	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree
I like the layout and the graphic design of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can find information I need easily through this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This app is very easy to use, and I can use it without assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to see members' STEAM activities through this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like the features of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q 32. Please rate the following statements for the **Microsoft Teams** regarding from "Disagree" to "Agree"

	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree
I like the layout and the graphic design of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can find information I need easily through this App.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This app is very easy to use, and I can use it without assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to see members' STEAM activities through this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like the features of this app.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q 33. After using the three Apps, which app did you find most beneficial and easiest to use?

- Band Application
- GroupMe Application
- Microsoft Teams

Q 34. Overall, how satisfied were you with the usability of the Band Application?

- Extremely dissatisfied
- Slightly dissatisfied
- Neither satisfied nor dissatisfied
- Slightly satisfied
- Extremely satisfied

Q 35. Overall, how satisfied were you with the usability of the GroupMe Application?

- Extremely dissatisfied
- Slightly dissatisfied
- Neither satisfied nor dissatisfied
- Slightly satisfied
- Extremely satisfied

Q 36. Overall, how satisfied were you with the usability of the Microsoft Teams?

- Extremely dissatisfied
- Slightly dissatisfied
- Neither satisfied nor dissatisfied
- Slightly satisfied
- Extremely satisfied

Q 37. If you could only recommend **one** group messaging app for other parents to develop the virtual STEAM learning community, which app (Band Application, GroupMe Application, Microsoft Teams) would you recommend to a friend? Why?

Q 38. Please state any other thoughts or concerns you have regarding the three apps.

Q 39. How long **each day** do you spend on STEAM related concepts with your child?

- <1 hour
- 1-2 hours
- 2-3 hours
- 3-4 hours
- 4 + hours

Q 40. How often per week do you and your child work on STEAM-related activities?

- Everyday
- Every other day
- 3 days per week
- 2 days per week
- 1 day per week
- Less than 1 day per week

APPENDIX B— Tutorial Video Script

Script for Application Video Tutorials

BAND:

Welcome to the BAND app.

As you open the app, you are prompted to choose which “band” you would like to interact in. You are then taken to a home page in the selected band. You will see the layout like this. On top of the page, you will see the members in this private group, you can invite anyone to join the learning group.

Here, you will see recent posts from other members. You can also post your comments, share the documents, files like our workshop handbook and articles about STEAM, events, photos, and STEAM activity videos and more.

Band members can like, comment, and interact with items in the newsfeed.

On the bottom of the screen, there is a chat option where members can share ideas and activities with the learning community, photo albums, calendars, search for other members to interact with, and adjust their personal settings. In the chatroom, you have option to join or create a private chatroom or public chatroom and create specific topic to interact in. For example, STEAM activities at home, new STEAM ideas, community resources, and more.

In the upper right-hand corner, members can make posts or search the entire band.

In addition to the mobile app, BAND also has a desktop version with all of the same capabilities.

GroupMe:

Welcome to the GroupMe app.

As you open the app, you will be prompted to choose which group you would like to interact in. You will see the layout like this. You are then taken to the selected group’s message.

Here, you can scroll through all of the group's messages, as well as write your own messages.

Here, members can collaborate and share ideas, useful STEAM videos from YouTube, or your own video and pictures in the learning community. Members can like selected posts by clicking the heart on the right side of the post.

By clicking the group's photo in the right-hand corner, members can view members in this group, add members, view a gallery of photos, calendar, Vote in polls, Look through popular posts, and adjust their personal settings.

Members can post photos of their activities, locations, gifs, events, and polls with the learning community by tapping the plus sign on the text bar.

Microsoft Teams:

Welcome to the Microsoft Teams app.

As you open the app, you will be shown a page with all the teams you are part of. You are then able to choose which team you would like to interact in. You are then taken to the team's general page, which has a tab for posts and a tab for files and the tab for more. You will see the layout like this. For the tab for posts, you will see the post from your group members, then you can click thumb up, red heart, big smile, smile, shock, sad or angry face to other peers' post. You can also create your new post and upload or share your pictures, videos or other documents with other team members. Team members are able to like, reply, and interact with posts here. This allows members of the learning community to share ideas and information with each other.

For the tab for files, you can see the files which group members have uploaded earlier from the post. These files can be organized by folder with different categories so members can find the files, like Word document, PDF files, videos or pictures. Files can also be categorized by topics, such as STEAM activities at home, new STEAM ideas, community resources, and more.

On the right top corner of page, you will see people plus icon where you can create a team, browse teams, or join a team. Across the bottom of the page, you see a tab for recent activity, tab for chat, tab for Teams, tab for assignments and tab for Calendar. For a tab for recent activity, you can see the team activity from other group members or your recent activity. Chat tab can be used with groups or individual. When you click the tab of “Teams,” it will show all teams you have created or joined. In addition to the mobile app, Microsoft teams also has a desktop version with all of the same capabilities.