Creating a Vibrant STEM Community in an Elementary School

Liesha Sherman

Six years ago, our district embarked on a journey to infuse more STEM and hands-on science experiences for our elementary students. This has been a passionate mission for me as I joined the staff at the onset of these changes and I have seen the difference it has made for so many of our students. When we started, we had a science curriculum that spoon fed science content to our students and did not allow for exploration or inquiry. We had no STEM programming offered outside of our school day. Our administration recognized that in order to develop 21st century skills for our students, we needed to make some shifts in the way we taught science.

As a result we developed a STEM curriculum that has been transformational for our students and teachers. Based on our research and feedback our STEM program makes learning fun, encourages our students to be creative and to be part of their own learning, and creates authentic learning opportunities. Our students have a genuine excitement and enthusiasm for our Science Lab, Makerspace, and before and after school STEM programming. Teachers, administrators, students and parents now value and prioritize STEM. Many of our teachers embrace STEM and feel supported by training and resources. We have had to overcome many challenges. We have had successes and failures. This is an ongoing process, but one that is well worth it. *The key to creating a vibrant STEM community is recognizing that students are the spark, teachers provide the fuel to fan the flames, and administrative support can keep that fire burning bright.*

In order to move toward a STEM infused school, there are a few important keys to success. The first essential element is administrative support. It makes life easier if you have it from the start. If you don't, I have some advice on how to gain administrative support. Any new program proposal I submit includes two critical components: how it will support NYS learning standards in Science, Math, and ELA and how it will directly enhance student learning outcomes. I am also open to suggestions and know that any ideas I come up with are made better by the input provided by my administrators and colleagues.

Earning the trust of my administration has been important in obtaining approval for our new programs. They know that if I propose a new program or idea, I will do everything in my power to make it succeed. That is not to say that everything we have tried is successful, but I always work hard to be proactive, prepared, and organized. I am now given a great deal of responsibility and freedom to try new things and I believe it is because I have proven I will see a program through to completion and take feedback to improve. I have been extremely fortunate with the support of my school district with the investment they made, including purchasing equipment and supplies for Science lab and Makerspace. I believe this investment is in direct correlation to the development of trust I have built. . When I ask for something to support STEM in our building, my administrators know I will follow through and will ensure those materials are taken care of and utilized to their potential. There is no way we would have the abundance of resources we have without administrative support.

Additionally, program promotion to district decision makers is essential. . Some people might accuse me of shameless self promotion of our programs, but I think it is so important to let the right people know exactly what you are doing and how many students you are reaching. There are two ways in which we have accomplished this. First, social media is an important tool. We regularly tweet and tag the district, school administrators and Board of Education members about our STEM programming. This has enabled us to receive a lot of attention and support. I felt supported and encouraged by my Science administrator when she would retweet and comment on STEM lessons that I was teaching. We use Facebook to reach parents and community members. By using social mediaour administrators,board members, parents and local community see the great things that are happening and support our new initiatives. Secondly, I attend almost every school board meeting. As a parent and a teacher in my district I feel it is important to attend these meetings so I have a good sense of what is happening in my district, but this has also allowed me to develop relationships with our board members. During the public comment period I regularly speak at the Board of Education meetings to inform them of our progress and to invite board members and senior administration to attend our STEM programs. I share with them the excitement our students have for our programs like the Science Fair, Cardboard Challenge, and Hour of Code. I feel these two avenues of communication have furthered our STEM mission.

Next, let's talk about the obstacles because of course there are barriers to overcome. The first barrier was teacher confidence in the area of STEM. The second barrier was time needed to develop lessons and time to teach STEM during a busy elementary school day. The third barrier was resources needed to provide a hands on experience as well as the time needed to collect those materials. We have worked to overcome these barriers over the last six years, but they are still challenges. On a recent survey that our teachers took they identified these same obstacles as challenges to teaching STEM in the classroom. Teachers indicated the biggest barriers to STEM education in an elementary school is their knowledge (85%), time (76%), and resources (69%). Only 15 percent felt STEM isn't as important as other subjects. Our teachers indicated they value the importance of STEM programming, but still feel additional training and support with time and resources is necessary. The main ways we have worked to meet these challenges is through a weekly Science lab, a dedicated point person in our building who coordinates and supports STEM education, a Makerspace, and professional development for our teachers.

One of the things that makes our school unique is our Science Lab. Our students come with their teacher to Science lab once a week and have the opportunity to experience hands-on science. Our science curriculum involves both science lab and classroom science instruction. Classroom science instruction consists of an ELA integrated approach with an emphasis on reading non-fiction and writing. Science lab emphasizes hands-on science experiments with exposure to the scientific method and engineering projects that teach the engineering design process. There are so many advantages to this system. We have one set of materials that are used over and over again for all of our students. For example, over 200 students use the 25 microscopes during our life science lessons. Those 25 microscopes are set up and ready for

student use as they enter the lab. Plus, a dedicated science lab teacher is providing the lessons on how to use a microscope so not every elementary teacher in our district needs to be an expert on how to use a microscope. Another example is our third grade engineering project. Our third graders design and build a model of a Maglev train and the goal is to get their train car to levitate above a magnetic track using the properties of repulsion. Teachers are able to come to Science Lab with their class where tracks are already set up, materials are put out so students can build and test their prototype, and there are two teachers there to assist, support, and encourage the students. There are so many examples of messy, hands on labs that require many materials ranging from our matter experiments in fifth grade to our building a dam engineering challenge in fourth grade to teaching our third graders how to use a pan balance.

Science lab enables our students to receive consistent science and engineering instruction every week. Our teachers do not have to use their planning periods to find, manage, and set up materials. In addition, we are able to reuse materials for every class which saves money. We have eight classes at each grade level so we only need one set of materials which each class uses over and over again. Furthermore, teachers who may not feel as confident with science content or who may feel uncomfortable with an engineering challenge take on a co-teacher role. They experience the lab with their students, help students make connections to science learning in the classroom, and have become more comfortable with letting students make mistakes and figure things out for themselves. Science lab can be a messy place and having a separate location and dedicated science lab teacher helps support our classroom teachers with resources as well as reducing the time and work it takes to teach a hands-on science lesson.

As I have mentioned, our Science lab has a full time teacher that co-teaches science lab with the classroom teacher. In addition to this role in the Science lab, this teacher also maintains the Makerspace in our building, organizes before and after school STEM activities, and acts as a STEM resource and mentor for our faculty. I am the lucky teacher with this amazing job. A few examples of the benefits of having a STEM point person in our building include our Makerspace, Cardboard Challenge, and Hour of Code. We have numerous other STEM opportunities as well, but these are three highlights.

Our Makerspace is brand new this year. Over the last six years, I have accumulated many items which now fill our Makerspace including Dash and Dot robots, Ozobots, Cubelets, Legos, and many recyclable building materials. These materials have come from a couple of grants as well as the investment my district has made in STEM. A couple of years ago, I made a budget request to purchase the robots and another year my science administrator requested the purchase of the Legos and our Board of Education allocated money for the purchase of those materials. Last year, I asked my principal if we could set up a Makerspace and he provided me with a space, purchased a STEM sign to hang outside the classroom, and let me promote Makerspace time with my faculty. I have a full teaching load with Science lab so I provided a training class for how to use the Makerspace for teachers with their classes and I maintain a schedule so teachers can sign up their classes to go to the Makerspace. Teachers visit the Makerspace with their classes and allow them to either have free choice time or to do more structured STEM activities with the materials that are available in the Makerspace. I offer a

professional development opportunity in the morning before school called Makerspace 101 where teachers can come and learn how to make the most of their Makerspace time. I offer sessions like “Learning to Code with Dash and Dot - Going Beyond the Go app”, “How to Use Ozobots to Support Your Social Studies Curriculum”, and “Legos for Education.” Teachers stop by for 20 minutes before school starts and I give them a new STEM idea to try with their class. I view my role as making STEM easier and more accessible, providing teachers with support and encouragement, and maximizing the STEM opportunities for our students.

Another way in which I support STEM in our building is by organizing school wide STEM events that take place outside of the school day. We have a number of these throughout the year, but probably my favorite is the Cardboard Challenge inspired by Caine’s Arcade. This is a student driven event. At our Back to School assemblies, I show a video about Caine’s Cardboard Challenge and share the link with teachers who want to show the full video to inspire their students. I play the role of cheerleader to encourage our students to participate by building anything they want out of cardboard. Flyers are sent home and students submit project proposals. In October, we host an extra help night where we have students from the middle and high school science clubs and honor societies come to our school to help students get started. I spent the first month of school collecting tons of cardboard so any student who needs cardboard or tape just needs to ask. At the end of October, students bring their Cardboard project to school in the morning and we display all of the projects in the gym for the day. This past fall was our third annual Cardboard Challenge and we had almost 200 participants. Each class visits the Cardboard Museum throughout the day and interacts with the projects and votes for their favorite using a Google Form on an ipad. There are really cool projects like basketball hoops, pool tables, Skee ball, doghouses, and the Titanic to name a few. In the evening, we host a “Night at the Cardboard Museum” where students and their parents return to school and we reveal the top three winning projects per grade level as determined by the voting. Those students win a field trip to our Center for Advanced Technology at the high school where they visit three different classrooms and have the opportunity to complete a technology or engineering challenge. At the evening event, parents have the chance to see all of the cool projects and take their child’s project home with them. This is a great event which highlights student creativity and hard work. It is completely optional and we have about one-third of our student population participate. All of the students enjoy the museum and voting so it really brings the students together for a community event. In addition, all of the students are so proud of their classmates and cheer for them as the winners are revealed. The time and resources spent on this program are minimal. I put a lot of work into the program planning, setting up, and organizing, but most of the work is done by the children and their families. Plus, this is such a beloved program, many teachers volunteer to help with the project drop off and come to the evening event to show support for their students and to be part of this great event. This is the third year for our two elementary schools and this year an art teacher worked with us to bring the program to our middle school. The projects are primarily done by students at home, with minimal time during the school day being devoted to this program. Basically the 20-30 minutes that the class visits the Cardboard Museum is the extent of teacher participation. However, many teachers do attend the evening program to support their students. This is an event that is loved by our students, our teachers, and our families. Organizing events like this provides

opportunities for our students, involves our parents and families, and does not take time away from instruction in the classroom.

The Hour of Code is another program that highlights STEM in our school while respecting the classroom teacher's time. Our school started participating in the Hour of Code because my Science administrator sent me a link to code.org and asked me to check it out. She thought it was something that I would enjoy teaching to students. I taught myself how to code using the code.org platforms and agreed this was something our students needed to learn. I typed a proposal for my principal outlining how the Hour of Code would support both math and science standards and how I thought we would accomplish bringing the Hour of Code to our school. She agreed with the concept, but didn't want me to teach it and take time away from my Science curriculum so we devised a schedule where teachers would do the Hour of Code on their own with their classes during their regularly scheduled computer lab time. I only helped classes that first year during my planning times. Unfortunately it was not successful. Teachers struggled to help their students and students felt frustrated. Even logging on to the platform was a challenge. The classes I was able to assist had the most success so we decided this was a worthwhile activity and the following year I taught the Hour of Code for a week during their scheduled Science lab and was able to instruct every classroom and support every teacher.

The difference was amazing. The entire school was buzzing about the Hour of Code. That year students kept track of the lines of code they wrote and they were visiting me daily with little scraps of paper with how many lines of code they had written at home. Each morning I would let the entire school know the total lines of code we had written and we ended up with over 20,000 lines of code written in our school that week. Our Assistant Superintendent stopped by to learn to code and was overwhelmed by the excitement of our students. As she and I were talking about the coding and the instructional value of problem solving and critical thinking, we kept getting interrupted by students stopping by to tell me how many lines of code they had completed at home. Our school was hooked and we had the support we needed to continue and grow this program. This year we completed our fifth annual Hour of Code. The difference between success and failure of this program was having a STEM point person who could support classroom teachers in an area where they were not confident and could build excitement among our students and staff for coding.

This is an ongoing journey, but we have identified obstacles to teaching STEM and then we have attempted in a variety of ways to address those challenges in order to provide our students with a robust STEM experience. There are a number of reasons why I believe STEM education is important. STEMengages and excites students about learning that is hard to match elsewhere. Students learn essential collaborative, problem solving, and critical thinking skills. Students see themselves as scientists, engineers, and mathematicians and imagine careers as computer scientists, structural engineers and research scientists. Families participate together and students see how their parents value education. The best examples I can provide for this are a couple of stories from my school. I run a before school Coding Club for fifth graders once a week. Mason, a fifth grader, was so excited to share with me that he learned how to create a pop up on his computer using Java and he tricked his mom into thinking that her computer had

been hacked. It was quite a joke and his mom sure was surprised to learn Mason pulled off a good one on her. The cool part of this is that Mason taught himself how to write computer language simply by being shown where to access information about learning to code on code.org as part of his involvement in our coding club.

An example of student enthusiasm is the number of students who come to me asking if we are going to do the Cardboard Challenge again next year. Our students look forward to it and plan for months. This past year, a group of three students would regularly stop by my classroom each morning with updates about how their cardboard mini-golf project was progressing. They met in the evenings and had a notebook filled with ideas, sketches, lists of materials and plans for how to build this project. It involved a three hole golf course with an eight foot entry way. Each of the three students designed a hole based on a Wonder of the World. On the day of the Cardboard Challenge, they had some issues and their entry way collapsed. One of the students brought his grandfather afterschool before our evening “Night at the Museum” and the two of them spent over an hour making repairs. I loved hearing the grandfather teach his fifth grade grandson how to use a power drill to fix the wooden base they had built to reinforce the cardboard. Those students learned important skills in collaboration, perseverance, and created lasting memories with their friends and families.

My last example came during our recent Science Fair. Two of my fifth grade students designed and built a solar powered backpack that can charge a cell phone. They used a 3D printer to print the solar panel and their invention actually worked. During the Science Fair they had a cell phone plugged in and it was charging using the 3D solar panel they created. Their parents were so impressed with the work the boys had done, they introduced them to a scientist one of the fathers worked with so they could share their invention and the process they went through. Those boys were on cloud nine about meeting this scientist who was so impressed with their invention. The boys also helped their third grade sisters use the 3D technology to build a solar powered mini fan for their science project. These three stories reflect the vibrant STEM community we are building in our school and in my opinion, these experiences are so important to the education of our students.

Literature Review

Beyond my personal experiences a review of literature on Elementary Makerspaces and STEM education supports the importance of providing opportunities to young learners. An integrative STEM approach is supported by Next Generation Science standards and there is evidence standardized test scores either remain unchanged or improve using an integrated STEM approach according to Mark Sanders from Virginia Tech University in his abstract, “Integrative STEM Education as Best Practice” (12/8/2012). Sanders goes on to cite further studies to support that an integrative STEM approach improves student interest, understanding, and abilities more than learning each of these disciplines separately. I would go further to say without a STEM approach, most elementary schools would really only teach science content and math concepts without integrating the two and would mostly ignore technology and engineering concepts until students are in middle or high school. In the dissertation, *Elementary Teachers’ Receptivity to Integrated Science, Technology, Engineering, and Mathematics*

(STEM) Education in the Elementary Grades, Troy Thomas finds elementary teachers are receptive to teaching with an integrated STEM approach. This supports my experiences working with the teachers in my school and district. They are overwhelmingly receptive to teaching with an integrative STEM approach. They need training and support with materials, but once those barriers are overcome, elementary teachers recognize the benefits and would like to find more time for these activities. Lastly, Susan Whittemore offers support for Makerspaces in her abstract, *Makerspaces that Set the Stage for Lifelong Learning.* "When young students embrace their own learning and can envision that they own their future, that confidence will carry them through learning experience after learning experience, into post-secondary education, the workforce, and their communities." These three articles support the STEM approach we have embraced in our school. In the short term, teaching integrated STEM supports science standards and there is evidence standardized test scores stay the same or improve. In the long term, students develop essential life skills and become lifelong learners.

Evidence

There are two measures I can offer as evidence of the success of our STEM programming. The first of these measures is the participation rates by students in our programs. This provides support for the demand for this type of programming. Through tracking of participation rates, we can measure what programs are popular with our students and their families as well as identify areas where we can improve and change to meet the demands of our student population. In addition to participation numbers, we use parent exit survey resultsand anecdotal evidence from students, parents, teachers, and administrators.

Secondly, we administered a survey to our teachers to assess attitudes towards STEM education. We used a STEM Attitude Assessment survey for teachers in my building where the intent was to measure attitude, knowledge and application of STEM. The First 15 questions of the survey were adapted from a survey developed by Chang B Wahono to measure attitudes toward STEM education. The last ten questions on this survey were intended to measure specific attitudes towards our STEM programming at Pinewood. Unfortunately, there is no comparative data available from six years ago when we started to institute these changes. We will be using the current survey as a baseline as we continue to improve our STEM education program. These two measures have been helpful in evaluating our progress and also provided us with important feedback for how we will continue to improve.

Much of our STEM education programs reach all of our student population because those STEM programs take place as part of our school day. Our Hour of Code and Earth Day Celebration are experienced by every student in our school. Our Science lab program is also consistent across our building and every student experiences a hands-on investigative science lab program with an emphasis on engineering principles and the scientific method. We have tracked participation in the Cardboard Challenge and the Science Fair and are continuously working to promote these optional activities to increase participation (see tables 1 and 2). We also offered an Astronomy club for two years which was very well attended with 40 students the first year and 57 students the second year. This program was not offered this year because the instructor was a high school student who graduated and went to college. Our Coding Club

averages 15-20 students each spring and fall and is capped at 20 because of limited resources. We no longer offer our after school STEM classes because this program was unsustainable. The first two years, we were able to find instructors and were able to fill the class with 15-20 students. Attendance began to decrease during the third year and the decision was made to suspend this offering. Some reasons for the decrease include the fee that parents had to pay to have their child attend and the fact there was no transportation provided afterschool. Our Summer STEM Camps vary each year depending on the availability of instructors and students often have a variety of choices of classes they can take. Programs range from half day to full day, week long camps which parents pay for and provide transportation to these camps. We generally have 15-20 students attend each of these summer camps. In general, our STEM programs are considered popular and are well attended. Our evening events tend to be very popular and also appear to be sustainable. We can plan an evening event and many of our teachers will volunteer 30 - 60 minutes of their time to present. Attendance at these types of events range from 40-80 students and their families. This type of programming seems to offer the most return on our investment. We can offer these evening events for free or for a minimal charge, they are well attended, and the feedback from parents is very positive. Our goal is to expose parents and to provide students with the opportunity to participate in STEM activities.

Table 1- Cardboard Challenge

Year of Event	Number of Students attending Extra Help Night	Number of Students Participating from Pinewood
2019	53	153
2018	25	106
2017	20	95

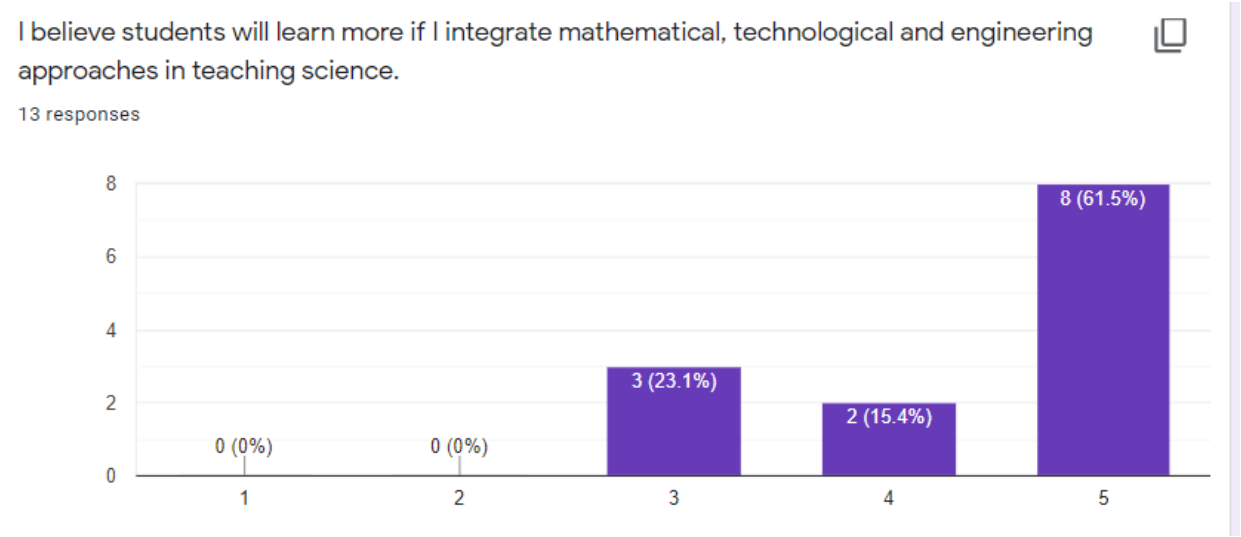
Table 2- Science Fair

Year of Event	Number of Students attending Extra Help Night	Number of Students Participating from Bradt and Pinewood
2020	20	190
2019	14	183
2018	Cancelled due to snowstorm	157
2017	25	154

As part of the research to examine our STEM instruction, teachers in my building took a Pinewood STEM Attitude Assessment. One hundred percent of the teachers surveyed believe students learn more when Science, Math, Engineering, and technology are integrated. All of those same teachers would like to learn more about how to develop quality STEM instruction and they feel comfortable using technology in the classroom. However, only 55-60 percent ask

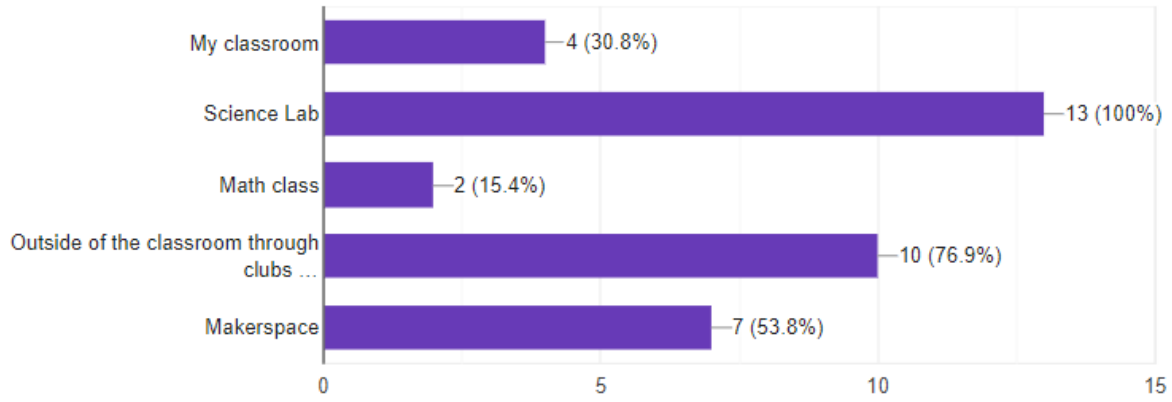
students to design things related to science, create models, and collect and analyze data. The same percentage of teachers felt supported with professional development and felt STEM should be integrated throughout the curriculum. Teachers indicated the biggest barriers to STEM education in an elementary school is knowledge (85%), time (76%), and resources (69%). Only 15 percent felt STEM isn't as important as other subjects. Of the teachers surveyed, 31 percent felt Pinewood provides exemplary STEM education, 48 percent felt we provide more STEM opportunities than other elementary schools, 31 percent felt we provide a similar STEM experience to other schools and no respondent felt we provide limited or no STEM education. Lastly, teachers were asked what they think has been the biggest help to providing STEM education in our building. Of those surveyed, 85 percent identified having a Science lab teacher, 77 percent identified having a dedicated space for Science Lab, 54 percent identified professional development opportunities, 31 percent identified our Makerspace, and 46 percent identified the importance of STEM activities outside of the classroom. This data shows our teachers value STEM education and have a desire to learn more about providing STEM instruction. This positive attitude is an important step in developing an integrated STEM curriculum and I believe illustrates we are moving in the right direction.

Here are some of the results from our Pinewood STEM Attitude Assessment. We have 33 classroom teachers who were asked to take the optional survey, but only 13 participated so results may not reflect the feelings of the entire staff. Teachers were asked to rate the questions 1-5 where 1 was strongly disagree and 5 was strongly agree.



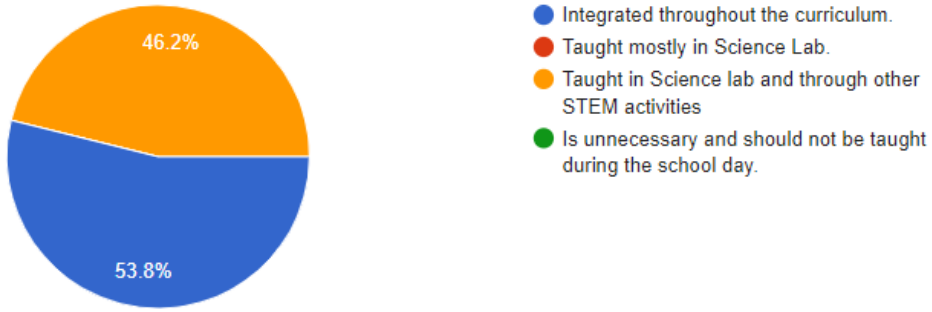
In my opinion, STEM is mostly taught in (check all that apply)

13 responses



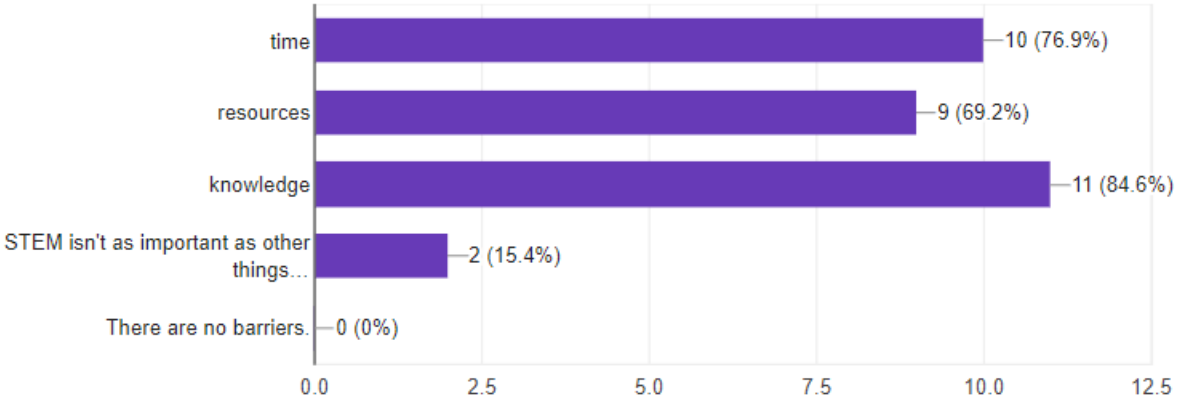
I feel that STEM education should be

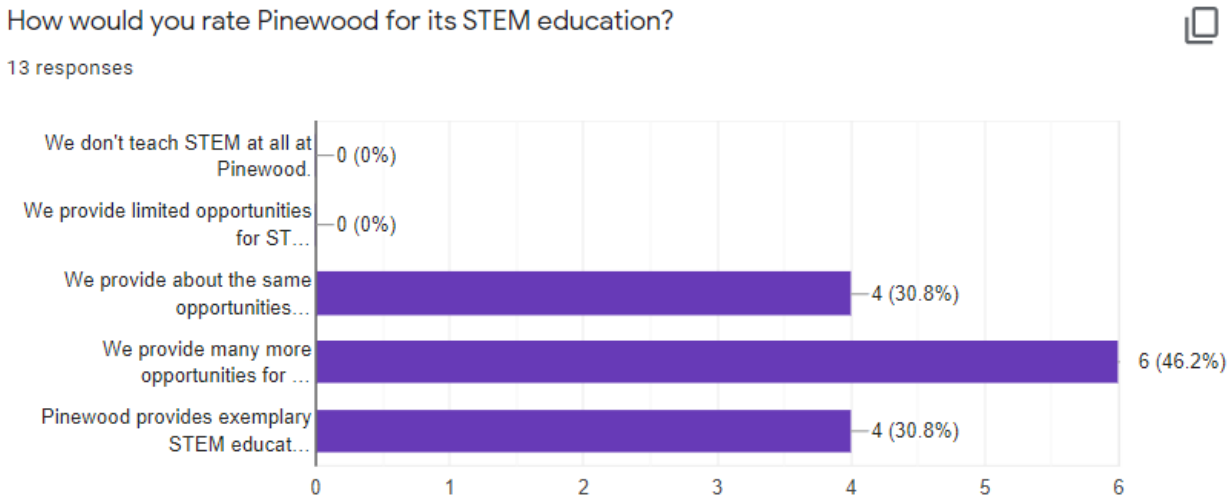
13 responses



What do you think is the biggest barrier to teaching a STEM curriculum?

13 responses





While I would like this data to reflect our entire staff, I do feel this smaller sample provides insight into the positive attitude towards STEM education at Pinewood. It is my belief if the survey were taken by the entire staff, the results would be similar because when I look at the individual teachers who chose to take the survey, they reflect the variety of teachers in our building. The respondents range from teachers who teach a great deal of STEM related lessons and have a lot of confidence in STEM instruction to teachers who rely mainly on Science lab for STEM instruction.

As we look to the future of STEM education at Mohonasen, we know there is room to improve and to grow, but we can also take pride in the progress we have made. Right now, our district is working on developing a portrait of a Mohonasen graduate where we will identify specific characteristics, traits, and skills we want to instill in our students before they graduate. As I imagine what that portrait of a graduate may look like, I definitely feel some of those skills, traits, and qualities will be closely related to STEM education. When I reflect on the changes over the last six years, I am confident we have taught our students important skills like perseverance and collaboration, that we have encouraged creativity and hard work, and that we have helped to develop critical thinking and problem solving skills. In our teaching staff, we have introduced the concept of teaching the Engineering Design Process. We have worked to integrate ELA, Math, Science, and Technology, and we have tried to overcome the barriers to the successful integration of STEM education through supporting our teachers with professional development, time, and resources. We are moving forward withthe process of providing more STEM opportunities for our students.

Our next steps include maintaining the programs we have started as well as growing and improving our STEM education opportunities. One initiative we will be starting is Makerspace 101 as a professional development opportunity for our teachers. Our new Makerspace is popular, but many teachers have approached me because they want to learn how to fully utilize the space. They want to create STEM challenges for their students and push their students to try new things. They are looking for ways to integrate the Makerspace with the curricula they are already teaching. The goal of Makerspace 101 will be to give teachers creative ideas of how to use the Makerspace and to empower them to come up with STEM activities that tie into the

Social Studies, Math, ELA, and Science curriculum. This will be a before school professional development opportunity for teachers similar to other PD programs I have offered. This program will help to overcome the barriers we have identified with teaching STEM - teacher confidence, time, and resources.

In addition, we have started the Pinewood STEM Academy this year. This is a program where students track their involvement in STEM programming and develop a digital portfolio of the STEM projects or classes in which they have participated. Students create a Google slide with a picture of their project and a short reflection. They start this portfolio in third grade and continue to add to it throughout fourth and fifth grade. The concept was developed with the help of a high school technology teacher and is similar to the Technology portfolio they will develop as a high school student. As students add to this portfolio they earn Pinewood STEM Academy credits and if they earn tencredits by the end of fifth grade they receive a Pinewood STEM Academy certificate at their Moving Up ceremony. This goal of this program is to encourage students to reflect on their STEM experiences, to help track student participation, and to allow students to see their growth over time in the area of STEM.

Next year, we are looking to develop and implement a technology curriculum for our students in grades three-five that aligns with the NYS Computer Science and Digital Fluency Learning Standards K-12. This will ensure our students have a common experience as they learn technology at each grade level. Having this continuity in our technology curriculum will help in STEM education for a number of reasons. First, technology is part of STEM education itself, but we will also be able to develop integrated curriculum utilizing technology since the students will have a consistent base. We are envisioning a curriculum that teaches our students how to use Google products, how to type, how to code, and digital citizenship. Once students have these skills, we can work to develop STEM projects that tie into our Science and Social Studies curriculum.

These steps will help to ensure sustainability. By providing additional professional development for our teachers, developing a technology curriculum, and creating student portfolios which give our students a voice and choice in their STEM education, we are further enhancing our culture of STEM. We are working to eliminate the barriers of teacher confidence, time, and resources. The more steps we take to ingrain these things as part of everyday curriculum, the more STEM becomes part of everyday instruction at Pinewood.

“Tell me and I forget. Teach me and I remember. Involve me and I learn.” – Benjamin Franklin

I think this quote sums up what we are trying to accomplish through STEM education at Pinewood. By overcoming barriers to STEM education, we are working toward this goal with our teachers and students. Pinewood teachers identify a lack of knowledge of STEM as the biggest barrier to providing STEM education to students. Involving teachers in STEM education by providing professional development to help them understand science content, teach STEM strategies, and give time to develop lessons helps to create a culture of STEM. These steps

empower teachers and give them the confidence to try new things and take risks. This is also our approach with students. We have created a culture where hands-on learning is the norm in Science and now in Makerspace. Students are learning because they are involved, engaged, and motivated. Students are willing to take risks, make mistakes and learn from those mistakes. At Pinewood, we have been working on building a culture of STEM for the past six years and this is still a work in progress. We will continue to work to improve and extend integrated STEM learning by evaluating our programing and striving to bring quality STEM education to all of our students.

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