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Makerspace in the Elementary Art Room

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MAKERSPACE IN THE ELEMENTARY ART ROOM

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ABSTRACT

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This thesis explores how to effectively integrate STEAM (Science, Technology, Engineering, Arts and Math) concepts in an elementary art classroom by employing 2 different Makerspace areas:

1. A Makerspace table to house engineering based building manipulatives and activities for independent and group exploration.

2. A Makerspace craft area for inventing and creating choice based explorative work.

The study documented students Makerspace participation over a period of several months. Data was collected and analyzed to assess the trends and efficacy of the Makerspace classroom activities. The Conclusion of the study showed how students employ creative problem solving techniques and the Engineering Design Process while engaging in self-directed Makerspace activities.

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE

CHAPTER 1

INTRODUCTION

I have been an elementary school art teacher for 16 years and as I have gained experience and knowledge in my field my educational practices, pedagogy, curriculum and teaching style have all evolved. I have worked at several different schools through my career and I find that my curriculum changes to adapt to the needs of my school community and to meet school wide goals and missions. The school I work at currently became a STEAM (Science, Technology, Engineering, Arts and Math) elementary school five years ago. I have been working to integrate STEAM philosophies and curriculum into the art room. Over the last few years, I have had some successes and failures, and have learned a lot about what works and what does not. I began to think about how as an art teacher I could authentically integrate STEAM concepts into the art room and my curriculum.

The main way I had implemented a STEAM curriculum in the past was through teacher directed whole class lessons that incorporated STEAM ideas and aligned across the curriculum. For this research I wanted to add to my STEAM integration practices in my art classroom by adding two new Makerspace components to my classroom environment. While I continued and enhanced my practice of whole class STEAM integrated guided lessons, the part of my classroom that became the most exciting for me were these multifaceted Makerspace areas that were the driving force of my action research project.

Rationale

I was initially interested in creating Makerspaces in my classroom to modify and expand on a practice I have employed since I first began teaching. I have always provided *free time* art activities for my students to choose from when they finished the day's tasks for the project we were working on. The free time space in my classroom was stocked with a multitude of amazing art choices including coloring sheets, drawing paper, tape, hole punchers, colored paper, string, stencils, magazines and more. For years I was frustrated when students rushed through my meticulously planned and structured projects that intentionally met the art standards, to get to free time. Students would shed tears if they did not finish their projects in time to have free time before the end of the art period. There were and still are a handful of students that take their time and really enjoy every bit of my guided art instruction. However, all of my students love time for creative abandonment, with the freedom to choose materials and supplies.

It occurred to me one day that all of my students inherently enjoyed creating art. I began to inquire what my students liked most about art and the vast majority of my students said that what they loved most was free time. This information allowed me to begin to have a radical shift in how I perceived this time. I started to understand that the ability for students to choose, plan, and create whatever they wanted was not only precious and unique to their time in the art room, but crucial to their creative development.

This free time practice began 16 years ago as a way to fill time and curb behavior issues by keeping children busy. Initially it functioned as an effective classroom management practice. Today it has evolved into a space for students to independently explore, create, and problem solve with the materials of their choosing. Students have told me that this time is one of the

highlights of their entire school week. They look forward to coming to art to be able to independently explore materials and make whatever they are interested in.

I still believe in the importance of my skills and project based art curriculum which fosters student ability and understanding of art processes, mediums, techniques, and purposes. In fact I am able to observe that the skills and techniques that I teach during my structured lessons transfers into the student's free time endeavors quite frequently and readily.

Recognizing the value of this unstructured, self-directed, creative time in my students' very structured school day, I continue to challenge myself to provide an engaging free time area. I strive to provide choices and materials that enhance self-directed creations. I recently changed the name of the free-time area to the *Makerspace area* to embody the intent of my implementation of this space for my research.

STEAM

When STEAM became my elementary school's school-wide focus, I began to collaborate with my teammates in to integrate lessons across the curriculum to support the STEAM focus of our school. I became familiar with the many current buzzwords in the STEAM education movement such as: *21st century skills, CPS (creative problem solving), EDP (engineering design process), project based learning* and *Makerspaces*. It became evident to me that many of these concepts that are on the cutting edge of current educational research could be practiced in the art room through Makerspace activities that would support STEAM concepts. It also became clear that many core STEAM practices are also integral parts of the visual arts. Engineering is steeped in artistic practices, creative problem solving and the EDP are also fundamental for art making. The Engineering Design Process as taught by our science teacher is a circular path of problem solving in which students are always assessing, changing and fixing. The idea is to get them

thinking about what their options are, how to solve problems and how to make changes in their plan. In elementary school our goal is to make students familiar with this process of trying things and making changes. Simply defined the EDP path is, *Ask, Imagine, Plan, Create, Improve* (Engineering is Elementary, n.d. para 3).

My intention for developing new art experiences for my students became focused on how I could further integrate these ideas into my classroom. I wanted to discover how I could provide a variety of art based learning situations that offered my students the opportunities to explore STEAM concepts rooted in self-directed creative problem solving and the EDP outside of my traditional teacher guided practices. I realized that the creative problem solving process occurs naturally and fluidly when students are making, inventing and building projects. Creative problem solving or CPS is defined by the Creative Education Foundation as "a proven method for approaching a problem or a challenge in an imaginative and innovative way" (Creative Education Foundation, Creative problem solving, para, 1).

In the beginning of the 2016-2017 school year, I implemented a Makerspace table that housed a variety of engineering based building manipulatives (see Appendix E for a list of these activities), and a Makerspace craft area stocked with a wide variety of supplies for students to choose from to create and build unique self-directed projects (see Appendix F for a list of supplies). I also continued to collaborate with my teammates to develop STEAM based integrated lessons (the science/engineering lab, and technology lab teachers). I continually integrate relevant STEAM concepts into my structured curriculum incorporating math, science and technology connections. This integration is an important ongoing part of my teaching practice but is not the focus of this action research project.

This Makerspace action research project gave students the opportunity for choice based activities, independent learning, and creative problem solving situations. My intention was to integrate STEAM learning in an authentic way, to provide activities that would help my students develop problem solving skills that will help them become independent learners, and to increase the likelihood that they could utilize these skills in other subject areas. This did not replace my existing art curriculum, but happened alongside it.

Throughout this action research project I was guided by my knowledge and experience that accrued over years of teaching art to young children. Children love to create. They love to experience the act of making, building things, playing, and bringing something new into being. The skills and knowledge that is gained from the experience of planning, designing and creating things is unique and invaluable. My goal was to provide experiences that enhanced my students' knowledge of the arts and other subject areas, while building independent problem solving skills transferable to any subject area or situation. Self-directed creative activities help students build problem solving skills that applicable to all aspects of their life. This one of the most important things we can offer our students.

Research Question

The purpose of my research was to explore how to effectively integrate STEAM concepts in an elementary art classroom by employing two different Makerspace areas:

1. A Makerspace table to house engineering based building manipulatives and activities for independent and group exploration.
2. A Makerspace craft area for inventing and creating choice based explorative work.

Through incorporating these different Makerspace choices in the art classroom, I aimed to engage students in active, hands on problem solving by providing self-directed individual and cooperative creative learning experiences.

Definition of Terms

I have identified the following terms for the purpose of my study:

Makerspace: For the purpose of this research project I utilized the following definition of a makerspace derived from; https://www.makerspaces.com/what-is-a-makerspace/

> A makerspace is a collaborative work space inside a school, library or separate public/private facility for making, learning, exploring and sharing that uses high tech to no tech tools. These spaces are open to kids, adults, and entrepreneurs and have a variety of maker equipment including 3D printers, laser cutters, CNCmachines, soldering irons and even sewing machines. A makerspace however doesn't need to include all of these machines or even any of them to be considered a makerspace. If you have cardboard, Legos and art supplies you're in business. It's more of the maker mindset of creating something out of nothing and exploring your own interests that's at the core of a makerspace. These spaces are also helping to prepare those who need the critical 21st century skills in the fields of science, technology, engineering and math (STEM). They provide hands on learning, help with critical thinking skills and even boost self-confidence.

STEAM: Current trend in Education that focuses on science, technology, engineering, arts and math.

Creative Problem solving (CPS): A proven method for approaching a problem or a challenge in an imaginative and innovative way", (Creative Education Foundation.org 2017).

Engineering Design Process (EDP): EDP path is a method for problem solving for children that follow these steps; "Ask, imagine, plan, create, improve" (EiE.org, 2017).

Engaged: Involved in an activity: occupied, busy (Merriam Webster Dictionary)

Engineering Building Manipulatives: In the case of my study, engineering building manipulatives are prefabricated building modulus with which students are free to create and build unique structures.

CHAPTER II

LITERATURE REVIEW

The reason for this action research project was to explore the efficacy and impact of a Makerspace area in incorporating STEAM ideas into the Elementary art room. One of the main goals I aimed to explore thorough this research was how a Makerspace table could support my school's STEAM based curriculum focus by engaging students in active hands-on creative problem solving activities and enhancing my skills based curriculum by providing self-directed individual and cooperative creative learning experiences.

Currently within and outside the realms of education the Maker Movement is popular and gaining more credibility and momentum, "The Maker Movement, a technological and creative learning revolution underway around the globe, has exciting and vast implications for the world of education" (Libow Martinez, & Stager, 2016, p.1). This chapter will explore the history of Makerspaces, the current definitions and practices of Makerspaces, the educational philosophy surrounding the movement and how these different ideas relate to my area of interest and research.

Makerspaces

Many Makerspaces began, and still are housed today, in places outside of formal education such as libraries, museums, and community centers. Makerspaces are places set up with a variety of materials and tools, places where people can create anything from craft objects to technology based projects. Davee, Regalla, and Chang (2015) identify Makerspaces as "an extremely wide variety of creative endeavors, tools, demographics, and types of places where

making happens" (p. 4). The literature about Makerspaces provides a variety of definitions. Some elaborate on the inclusion of complex technology and power tools to constitute a Makerspace, and some believe that wherever making happens is a Makerspace. As the Maker Movement evolves, so do the types of Makerspaces. Davee, Regalla and Chang (2015) identify different categories of maker spaces such as "Dedicated Makerspaces, Distributed Makerspaces, Mobile Makerspaces, Possibility boxes, Portable carts and more" (p. 6). I agree with Davee when he says, "At the most basic levels, a Makerspace can be as simple as a table or a backyard with sticks, mud and bricks" (Davee 2014, p. 3). Technology can bring more complex ideas and processes to a Makerspace, but for this study advanced technology is not essential and utilizing arts and crafts materials is just as legitimate. The possibilities for Makerspaces are as wide and vast as your own imagination. They all have one thing in common, they provide a space and supplies for creating or *making* things.

The Maker Movement

So what actually is the Maker Movement and where did it come from? Bilkstein and Worsley attribute the roots of the Maker Movement to three main events "the invention of the first FabLab at MIT around 2001 ...the creation of the Maker Faire (and *MAKE* magazine), in 2005, and the growth of technology-rich informal education programs" (Bilkstein & Worsley, 2016, p. 65). Following these events, the Maker Movement sprung up all around America in libraries, museums, mobile units and more recently in formal education. Makerspace materials included everything from arts and crafts building activities, to power tools, circuits, and code writing.

Three distinct types of Makerspaces evolved, each with its unique name, philosophy and specialty: Makerspaces, Fablabs, and Hackerspaces. It is not the purpose of this paper to delve

deeply into the differences between these different categories of Makerspaces but on a very basic level, the differences are the technologies they employ. Van Holm (2014) differentiates the spaces by saying,

> the term (Makerspace) became attached to community workshops where members share tools and was formulated in contrast to hackerspaces, which were more focused on computers and electronics. Fab labs originate directly from the Massachusetts institute of Technology's Center for Bits and Atoms and the course 'How to make (almost) anything', and became a model for digital fabrication workshops. (p. 3)

I will use the term Makerspace as a broad category that embodies all of these modalities. Each type of Makerspace evolves independently to serve the needs of the people who create them, each Makerspace is unique unto itself. In addition to the three main categories of Makerspaces described by Van Holm, spaces where people make, tinker, and employ the Maker philosophy have sprung up around the globe and go by many other names. Davee, Regalla & Chag (2015) highlight a few alternative names for makerspaces in their research, "Art Center, Design-lab, Innovation Lab, Make Space, Makery, Tech Center" **(**p. 4). These alternative Makerspaces are housed in a variety of places, some in schools and some in the public sector. This idea of making is taking root in an organized way and is called by many names, but most of these spaces and the making activities they accommodate abide by a similar philosophy as described by Libow Martinez & Stager (2016),

> Tinkering is a powerful form of 'learning by doing,' an ethos shared by the rapidly expanding Maker Movement community and many educators. Real science and engineering is done through tinkering. We owe it to our children to give them the tools and experiences that actual scientists and engineers use…(p.3).

The Maker Movement is gaining popularity in education because it is an ideal fit to support the STEAM curriculum. AnnMarie Thomas, who is the Executive Director of the Maker Education Initiative noted that, "One of the things that struck me in discussions with other engineering

professors around the country was how many students had little experience in actually building thigs" (Thomas, 2012, p.1). The Maker Movement in Education has the potential to begin to offer solutions for this problem.

The key events that birthed the Maker Movement were also accompanied by the trend in education for more STEM (science, technology, engineering and math) schools that could help address the perceived lack of skills in the areas of science, technology, engineering, and math of our students entering the workforce. To remedy this, our government created the Educate to Innovate initiative in 2009 to encourage schools to adopt a curriculum rich in science, engineering and math, to help the United States become more competitive on a global level in the years to come. President Barak Obama said,

> One of the things that I've been focused on as President is how we create an all-hands-on-deck approach to science, technology, engineering, and math… We need to make this a priority to train an army of new teachers in these subject areas, and to make sure that all of us as a country are lifting up these subjects for the respect that they deserve. (Obama, Third Annual White House Science Fair, April 2013).

Maeda (2012) writes about the focus of the government to evolve educational practices. He says,

> The White House reminds us that 'a world-class STEM workforce is essential to virtually every goal we have as a nation--whether it's broadly shared economic prosperity, international competitiveness, a strong national defense, a clean energy future, and longer, healthier lives for all Americans. (p. 1)

The inception of the Maker Movement and the push for STEM education created the perfect partnership, as the two go hand in hand today. Not all STEM curriculum and activities are connected to Makerspaces or the Maker Movement, but the two have evolved side by side and the Maker Movement has become an excellent platform to implement and enhance STEAM curriculum and ideas. The use of the artistic process inherent in the design process and making

culture, pave the way to add the arts to the STEM mix, which changes the acronym STEM to STEAM.

What do makerspaces have to do with education and the way children learn? At the very heart of the Maker Movement lies the idea of learning by doing, and creating as an experience. Kurti, Kurti and Fleming (2014) state that:

> Educational Makerspaces and maker education have the potential to revolutionize the way we approach teaching and learning. The maker movement in education is built upon the foundation of constructionism, which is the philosophy of hands-on learning through building things. (p.8)

There are many scholars in the field that agree that this process of learning by doing is powerful. Blikstein and Worsley, in Makeology Volume 1, (2016) write, "Progressive educators and researchers have been questioning traditional schooling and prescribing constructivist, student-centered approaches based on authentic, meaningful experiences in the world" (p. 65). When looking at the evolution of educational theory and practice, "...it suffices to say that long before the label 'maker' was coined, researchers had been busy building the theoretical foundations for it (constructivism, critical pedagogy, constructionism, project-based learning)" (Blikstein & Worsley, 2016, p. 65).

The current direction in art education supports a student centered experiential approach to pedagogy, where problem solving skills and experience are emphasized. Art Education Magazine dedicated two full issues to STEAM education (Art Education Volume 69, Issue 6 and Volume 69, Issue 4) that explore how STEAM, problem solving and art are being implemented in pedagogy across the country. In her article, *Designing for the Future of Education Requires Design Education*, Berk (2016) explains how future educational models should focus more on teaching problem solving skills that are applicable across disciplines.

When planning the implementation of a Makerspace in my classroom, I have found that there are many ways that a Makerspace can be utilized to support STEAM based problem solving skills and experiences. The world is holistic and a multitude of connections can be made between science, technology, engineering, arts and math. Marshall and Donahue (2014) discuss the fundamental similarities in processes between art and science:

> Certainly, scientific process and artistic process share many attributes. They both combine intuition, imagination, logic, and rationality; they thrive on rigorous observation, making connections, distilling things down and projecting beyond. Furthermore, artists use logic. (p. 47)

I would add that engineering and math also share similar processes and Makerspace activities utilize attributes of problem solving to execute ideas that span across the curriculum. By helping teach and utilize fundamental thinking and planning skills through the creative process applied in Makerspace activities, student's ability to problem solve will be improved. A Makerspace can easily align with specific learning objectives related to any of the STEAM subjects.

I agree with Davee (2014) when he says:

> All children deserve more opportunities to express themselves in a myriad of forms, to make in a million ways, and learn about the world and each other using their built in tools of learning: play, imagination, and their constant drive to create, to make connections and things. (p. 3)

CHAPTER III

METHODS AND PROCEDURES

Action Research Design

My study was an arts-based action research project. Sagor defines action research as, "A disciplined process of inquiry conducted by and for those taking the action. The primary reason for engaging in action research is to assist the actor in improving or refining his or her actions" (Sagor, 2011, p. 1). The purpose of my arts-based action research project was to explore how multifaceted Makerspace areas in the elementary art classroom could support the STEAM objectives, engage students in active creative problem solving, and enhance a skills-based curriculum by providing self-directed, choice-based individual and cooperative creative learning experiences.

This research was approved by the Institutional Review Board (IRB) of The University of Northern Colorado in the fall of 2016 and took place in my art classroom in Fort Collins, Colorado during the 2016-2017 school year. The school is a k-5 elementary school with a population just under 600 students. The Makerspace was implemented with first through fifth grade. My students had art once every five days for 45 minutes, and I continued to teach my skills and standards based art curriculum and also provide time at the end of each class period for Makerspace activities. The purpose of my research was to explore how to effectively integrate STEAM concepts in an elementary art classroom by employing two different Makerspace areas:

1. A Makerspace table to house engineering based building manipulatives and activities for independent and group exploration.

2. A Makerspace craft area for inventing and creating choice based explorative work.

Through incorporating these different Makerspace choices in the art classroom I aimed to engage students in active creative problem solving by providing self-directed individual and cooperative creative learning experiences.

The action research was ongoing throughout the year. I arranged my art class schedule to allot a block of time during each class for my students to use the Makerspace. The Makerspace was available to all of my art students in first through fifth grade almost every time they came to art. I observed and collected data from my fourth grade students in the form of a researcher's journal, photographs, individual student data sheets to track activities, and student surveys. I believe fourth grade students have the skills and foundational art knowledge that made them an ideal population for this research.

I collected data from 25 fourth grade students who returned the consent forms (see Appendix C) that enabled them to have their work and progress observed and documented as part of this action research study. The surveys, photographs and research notes used for data analysis and presented in Chapter Four were collected from this group of students. Only students with signed consent forms were considered for the population from which I selected data. I collected data on 25 fourth grade students over a period of three months. All students in all of my classes received the same instruction regardless of whether or not they were included in the study.

Students were allowed to explore the makerspace area for an average of 15 minutes during each art period. Students were allowed choose what to do or create from the activities and materials that were provided for that day. I rotated different engineering manipulatives for building on the Makerspace table area several times throughout this study. I also added a wide variety of building and crafting materials to my Makerspace craft area as I acquired them, for students to build and create with. For their 15 minutes of Makerspace time, students could choose to work at the Makerspace table to build independently or with others using the building manipulatives that were housed on the table for that time, or students could choose to build and create whatever they wanted using the multitude of supplies provided at the Makerspace craft area. Students' progress, engagement, and choice was observed and recorded as they choose and participated in different makerspace activities.

Figure 1. The Makerspace Table

Figure 2. The Makerspace Craft area

Data Collection Tools

The four main data collection tools I used were:

1. I kept a running research log/journal as I planned, implemented, and observed the different phases and facets of this research. I used this information to inform my data collection and to help implement and inform my research.

2. I used iPads to photograph and store student work and images of the different Makerspaces areas and activities. These photographs would later be analyzed and compiled into student snapshots.

3. I developed a tool to monitor student activity choice. I used this table to collect data for three class periods on each of the 25 students I tracked for my study.

Data Collection sheet, 4th grade, Day 1

Date:

Student:
Time at Maker:
Activity Description:

Outcome Description:

Picture? Y N
Student Survey? Y N

Figure 3. Student Observation Form

4. I created a student survey for students to fill out to reflect on what they created. I did not end up using this survey in my data analysis as it did not prove beneficial to my findings.

Name: Class:
Date:

Student Survey

What did you create?

How did you create it?

What was hard about it?

What was easy about it?

Did you ever have to change your plan?

What did you like most about this activity?

Figure 4. Student Survey Form

For this study I, the teacher researcher, was the sole collector of the data. Students participated by filling out surveys. I collected official data after their three class periods with Makerspace time. The use of iPad's was a quick and efficient way for me to collect visual data. Keeping a running journal of observations became second nature and was easy to fit it into my busy schedule.

By analyzing the data, I was able to assess the value of each lesson or activity. I was be able to see what activities were preferred by my students and how they used materials in new and inventive ways. I was able to observe how and if different activities facilitated student interaction, creation, and group problem solving. The data provided trends for which activities the students preferred individually and as a group. I analyzed the photographic data to assess whether the activity met the goals of providing creative problem solving opportunities, keeping students engaged and supporting the STEAM curriculum.

Data Analysis Procedures

To analyze the data, I compiled a "student snapshot" on each student to house all of their data. This included pictures of their creations and activities, and the field notes I took while observing their activities. By graphing and plotting this information gleaned from this data, I was also able to see and analyze trends and preferences in Makerspace activities, the materials and tools that were preferred, the trends in individual and group problem solving and the preferences for type of creation.

Limitations

This research study was limited in a variety of ways:

- This research study was conducted with some of the 4th grade students at my elementary school and was limited by analyzing only a small group of students in one grade level at one school.
- There was limited time for data collection, I often felt rushed collecting data while maintaining and teaching a normal teaching schedule.
- The Student population I collected data from was limited to those fourth grade students who had turned in their consent forms.
- The data from student surveys was limited because students did not always take time to thoughtfully fill out the surveys when they were engaged in creating.
- The students that were part of my data collection population were sometimes absent and thus not available for data collection.
- Some students form the data collection population got behind on artwork and did not have time for Makerspace activities which inhibited data collection.
- For this study I had a large pool of students to collect data from. I followed the activities of 30 fourth grade students which often proved to be a challenge to collect detailed accurate data.
- The extra 15 minutes of time it took each day to stock Makerspace craft area was limiting. Some days I was too busy with planning, meetings and regular teacher obligations to manage the space.

CHAPTER IV

FINDINGS AND ANALYSIS

I collected data on 25 Students, in three different fourth grade classes over a period of three months, documenting their activities during the 15 minutes of Makerspace time provided at the end of each class. I collected the official graphed data over three class periods, but took field notes and pictures over a three month period. During this time the students could choose a self-directed activity from the different activities that were provided. I kept a data sheet on each student each of the three days I allotted for official data collection. As time permitted I photographed the student with their work. One of my goals was to analyze the data to determine what activities the students preferred, and what materials the students preferred to work with. Through this study I also wanted to provide opportunities for group and individual problem solving activities, which I was able to observe as the students chose their different activities. I provided two main areas for students to choose from for their Makerspace activities for this action research project, the Makerspace craft area and the Makerspace table.

Figure 5. Three photographs of the Makerspace Craft area

The students were allowed to choose to create whatever they wanted from any of the materials, tools and supplies that were available in this area. The students often used a variety of supplies to create their works and often created more than one thing during their Makerspace time. Sometimes their creations were two-dimensional and sometimes they were three-dimensional. The materials were stocked daily and varied and through the course of the study as different items were acquired and provided.

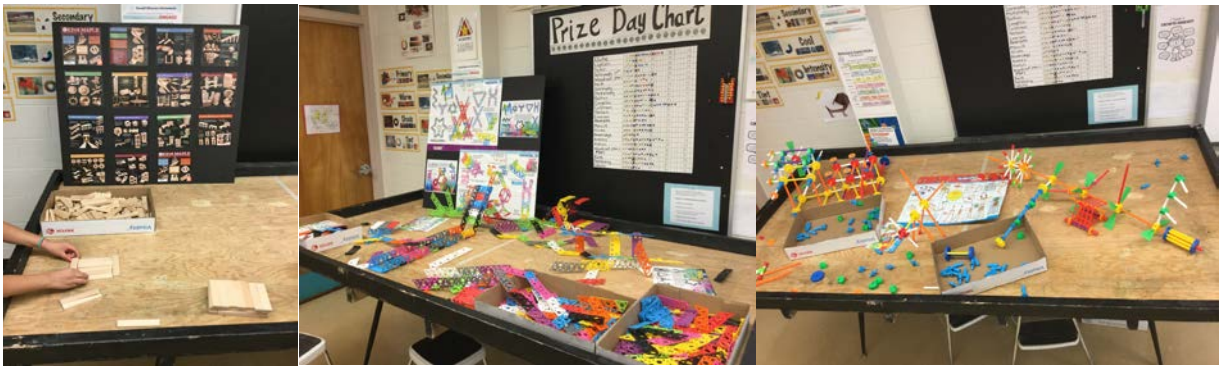

Figure 6. Three Photographs of the Makerspace Table

The Makerspace table is a large table on which I provided different building and engineering manipulatives for exploration each week. During the time of my study that I was collecting data, these manipulatives included; Keeva Blocks, Q-bits and Tinker-toys.

This first graph shows what choices the 25 students made for their Makerspace activities on observation Day one, Day two and Day three.

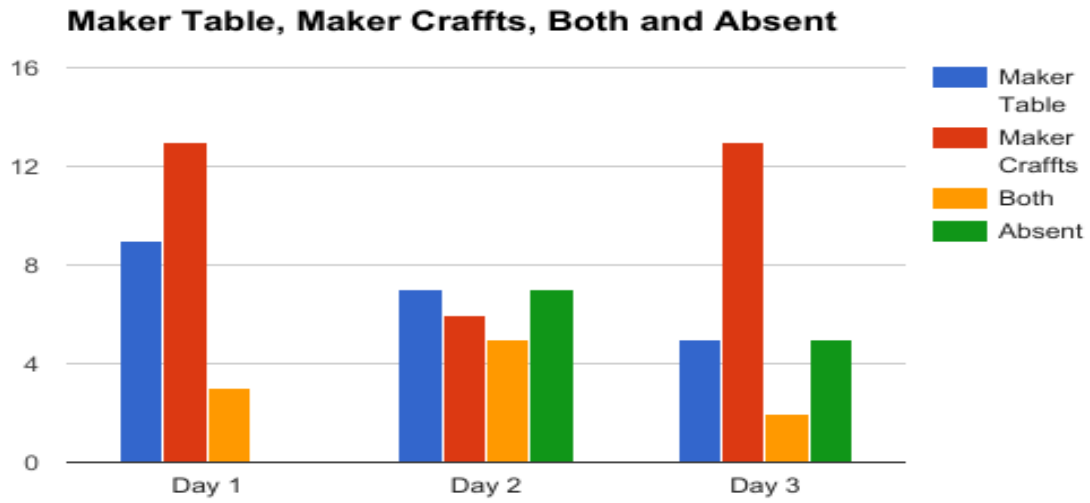

Figure 7. Graph showing Makerspace activities

On day one and three more students chose Maker Craft activities. On day two, more students chose to work at the Maker Table. On all three days some students chose to participate in both activities. The graph also takes into account students that were absent from the pool of 25 students on each day data was recorded.

One of the main questions I was exploring through this action research project was how I could provide individual and group problem solving activities. The following graph shows the students individual and group activity choices on the three days the data was recorded.

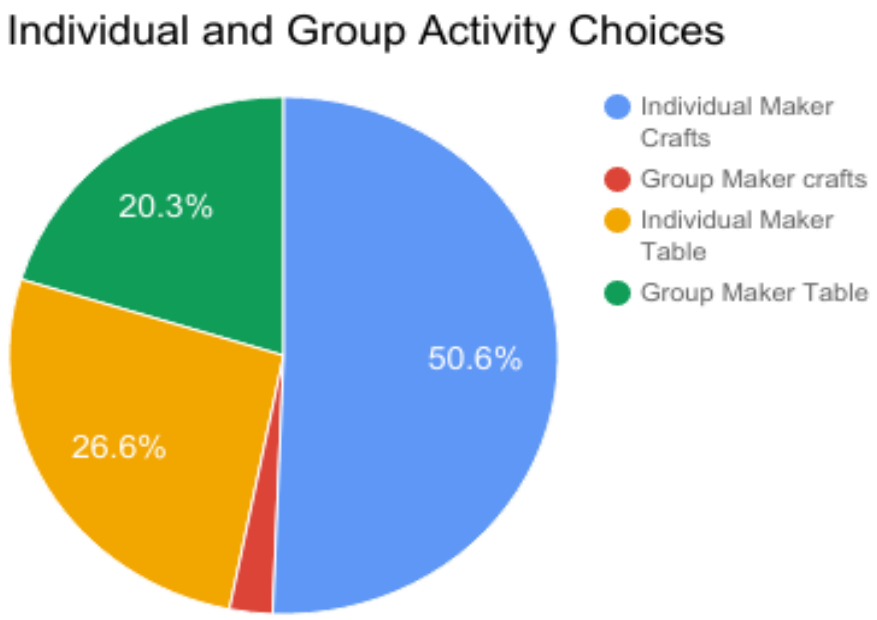

Figure 8. Pie chart showing Individual and group activity choices

Material and Tools

The data in this graph shows that when these students were given the freedom to choose their activity, 77.2% of the time they chose to work independently, and the other 22.8% of the time they chose to work in groups. The nature of the activities provided created opportunities for the students to create and problem solve. It was up to them to choose if they were going to work alone or with others. I was surprised to learn through the graphing of this particular data that the individual Maker craft area was the most popular choice at 50.6 %. It was ahead of the other choices by 24% or more.

One of my objectives for collecting this data was to discern which activities were preferred by the participating students. I used the data collected to determine preferred Makerspace craft activities and then in subsequent graphs, broke it down into several categories. The first graph shows the frequency of material use and tools used by the student participants

that chose the Makerspace crafts for their activity during the three class periods that data was collected. It should be noted that the students often used many items for a given project and often made more than one project, this graph shows the trends in material use for all materials used by all the students who chose to use the Makerspace crafts on all three days of observation.

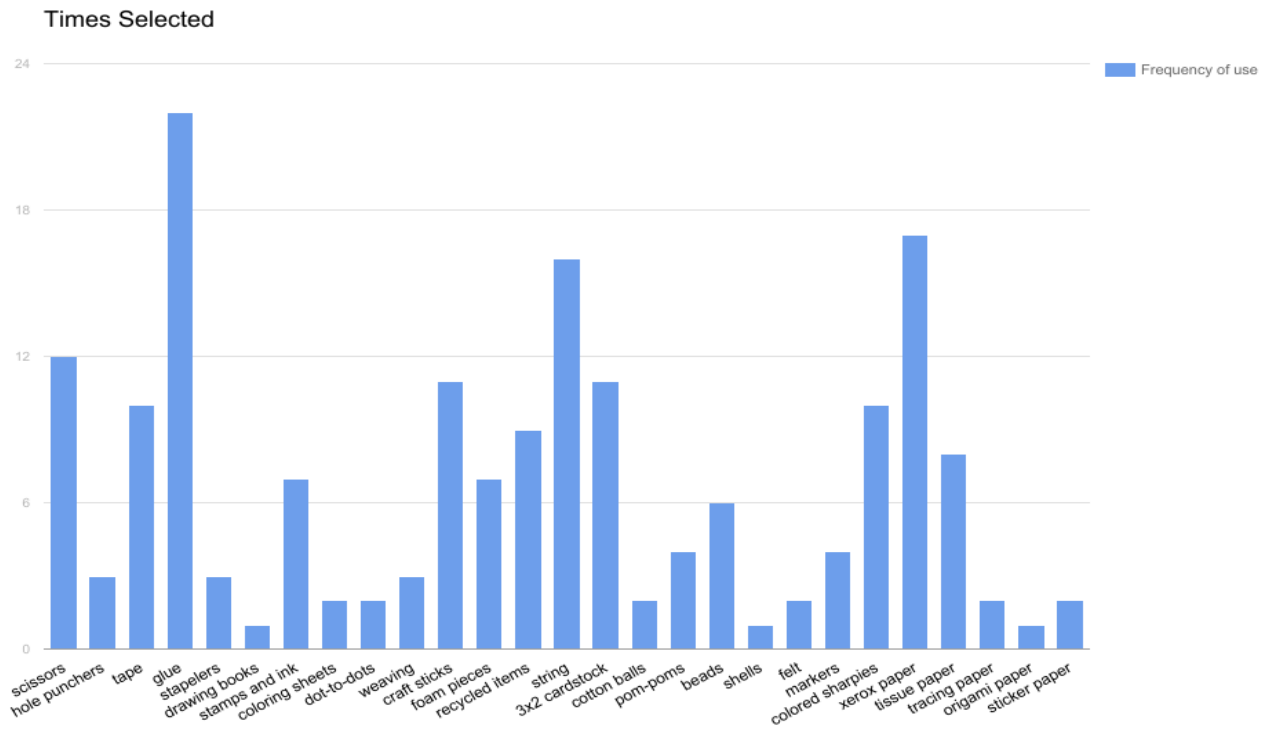

Figure 9. Bar graph showing material choices

I also broke this graph down into five different categories; tools, activities, building materials, medium, and paper for easier interpretation.

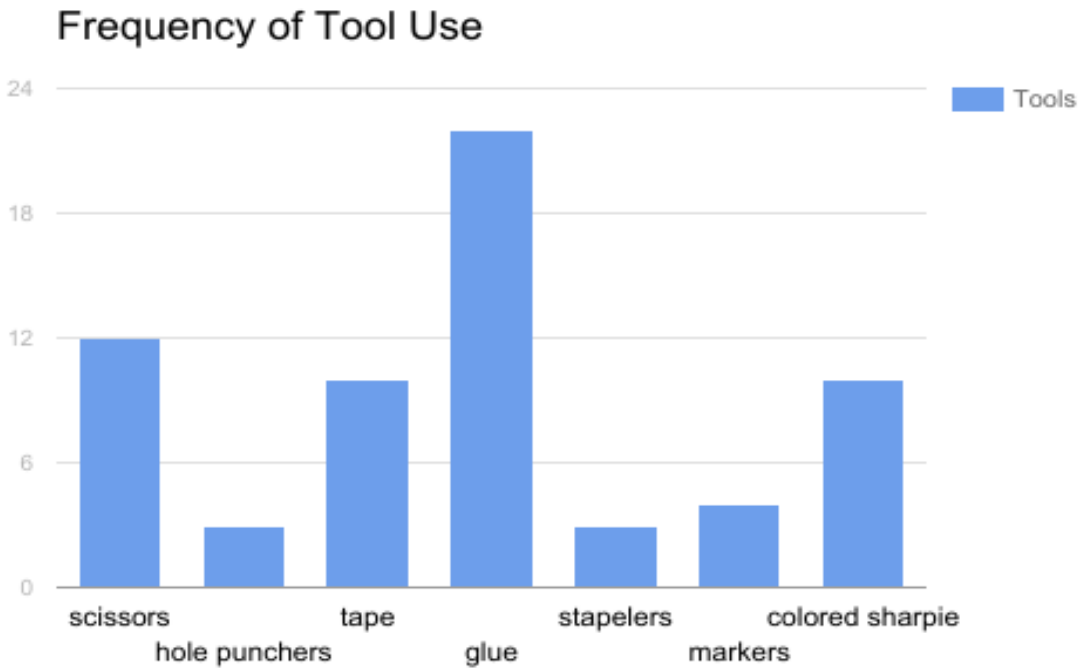

Figure 10. Bar graph showing Frequency of tool use

This graph shows that when students are creating during their Makerspace craft time, the four most frequently used items are glue, scissors, and colored sharpies. From my observations and pictures, these items are used in a multitude of ways to create unique items (see Appendix D).

The next graph shows how many times students chose certain activities. This graph does not include all of the activities that were available, just the skills based activities.

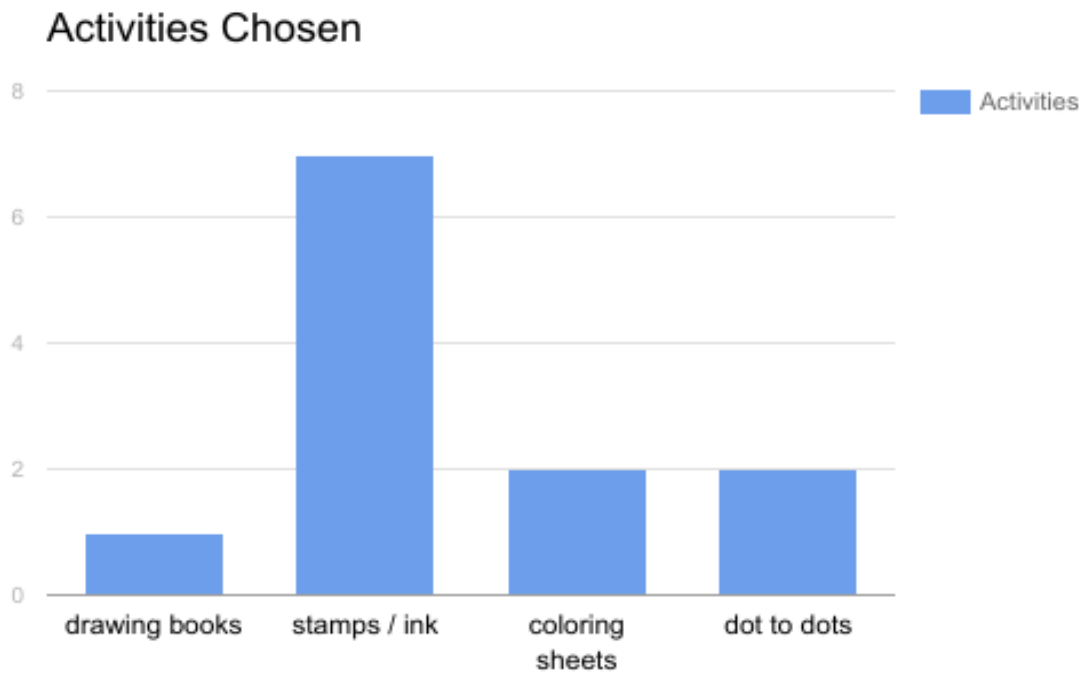

Figure 11. Bar graph showing activities chosen

The analysis I acquired from this graph shows that over the three days of observation, only 18 times (the total number of choices recorded on this graph) the students chose to do an activity that was pre-fabricated. A far greater number of students chose to create a sculpture or drawing of their own invention, rather than use coloring sheets, drawing books and activity sheets. The number of students that chose to use stamps and ink pads is higher than the other three choices, perhaps because it was a novelty so students were eager to explore it. Perhaps the nature of stamping is more creative and should not be included in this group.

In the next graph I isolated the building materials chosen by students who used the Makerspace craft area to build three-dimensional creations

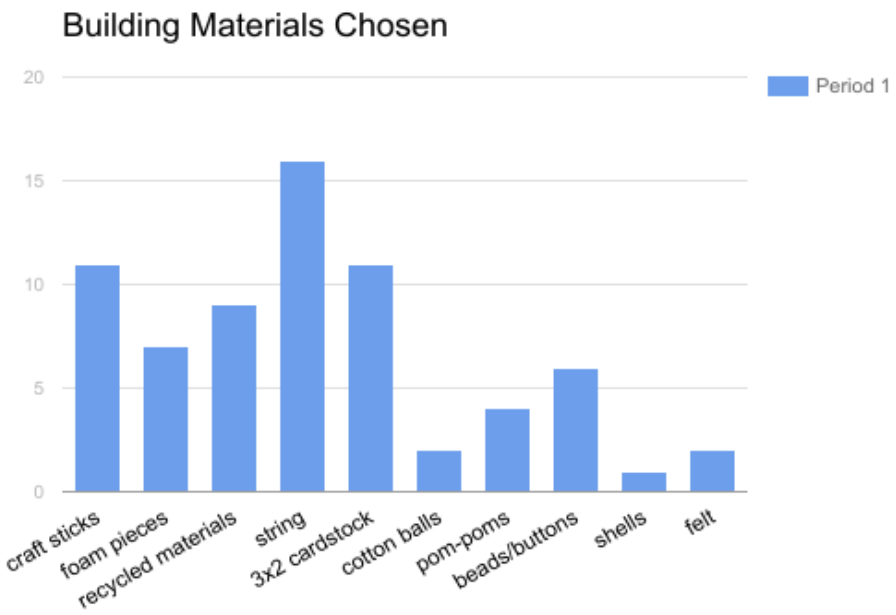

Figure 12. Bar graph showing building materials chosen

This graph shows that the most popular choices for building materials are string, craft sticks, recycled material and foam pieces in that order. These materials lend themselves to be utilized in a variety of ways with an infinite number of outcomes.

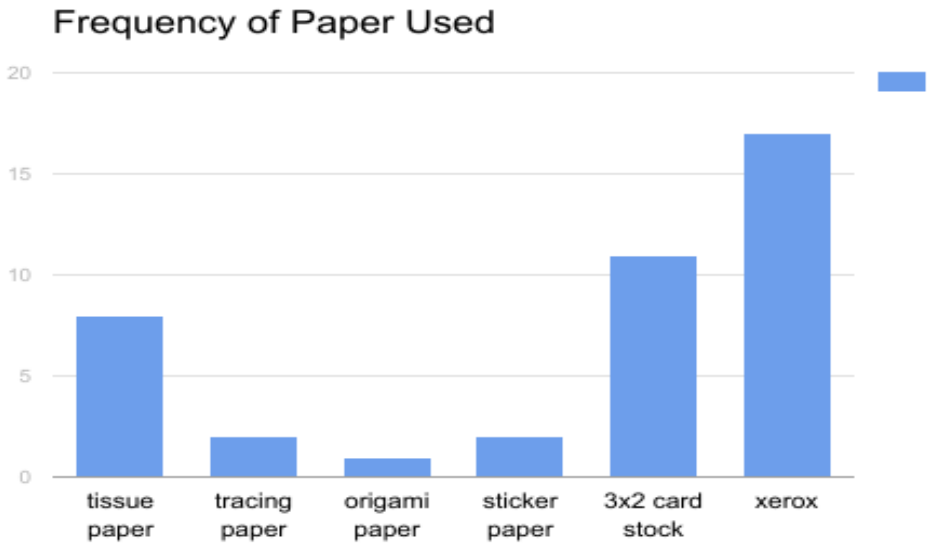

Figure 13. Bar graph showing Frequency of paper used

This graph shows that copy paper was the clear favorite for creations with these students at the time the data was recorded. The 3x2 card stock was the second favorite, used often as a building block for creation, and the third favorite choice was the tissue paper, perhaps because it is thinner and less versatile to use as a building block for sculptural creations.

Types of Creation

As my research progressed I became interested not only in the type of materials that were being used by students, but the type of creation they were making. I observed the creation of many two-dimensional art works as well as three dimensional sculptural creations. The following graph shows the breakdown of the types of creation that were employed by the students.

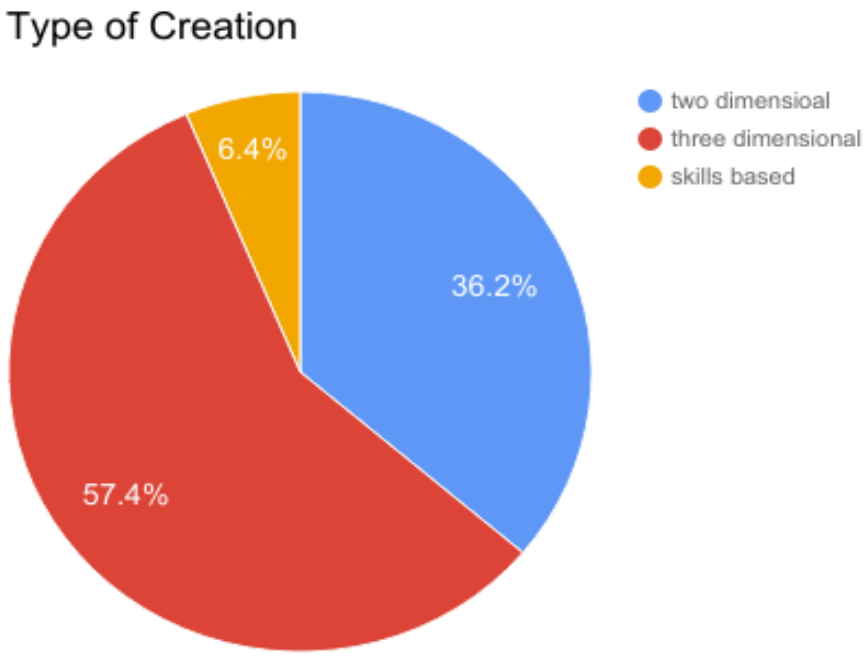

Figure 14. Pie chart showing type of creation

Of the student activity that was recorded, this graph shows that over these three days, of the students that chose Makerspace craft activities, 57.4 % chose to use materials to build three dimensional creations, 36. 2 % chose to use materials to create something two-dimensional and

6.4 % chose to partake in pre-fabricated skills based activities, such as coloring sheet or dot-to-dots. The majority of the students chose to build unique sculptural creations with a variety of supplies.

The following images and information are examples of two of the 25 Student Snapshots of student activity I created as I was compiling and analyzing data in relation to my study. I recorded data snapshots on all 25 different students from three different fourth grade classes in the form of observation notes and images. All 25 of the data snapshots are located in the appendix. Below is an example of two student snapshots.

Student Snapshots

S7: Student 7

3/29-Maker crafts, pom-poms, glue, string, creating a key chain

4/6-Absent

4/13-Continued to work on weaving project

Date unsure: Maker crafts, building with cardstock, 3-D building sculpture

Date unsure: Maker crafts, gluing paper together, hole puncher, string, kite?

Figure 15. Student 7 snapshot photographs

S9: Student 9

3/29-Maker crafts, drawing and cutting, creating his own puzzle with paper and glue

4/6-Maker crafts, drawing and cutting

4/13-Maker crafts, drawing and cutting, made a mask out of cut paper

Date unsure: Maker crafts, origami

Figure 16. Student 9 snapshot photographs

Findings in Relation to the Research Question

As I stated in Chapter One the intention of my research was to effectively integrate STEAM concepts by incorporating these different Makerspace choices in the art classroom. I aimed to engage students in active, hands on creative problem solving by providing self-directed individual and cooperative creative learning experiences. I found that while students were actively participating in the Makerspace activity of their choosing it was evident by the outcome of their work that they were employing both creative problem solving skills and the engineering design path in this self-directed informal setting. In the terms and definitions section of this paper I defined *Creative Problem solving (CPS)* as, "a proven method for approaching a problem or a challenge in an imaginative and innovative way", (Creative Education Foundation.org 2017), and the *Engineering Design Process (EDP)* as a method for problem solving for children that follow these steps, ":Ask, Imagine, Plan, Create, Improve" (EiE.org, 2017). These concepts are inherent when children are inventing, creating and building unique creations. They are imagining what they want to create. They are planning their creation. They are choosing materials and supplies to execute their creation. They are problem solving and making choices and changes along the way, they are improving upon their plan as they go, often

changing materials and techniques to better serve their needs and achieve the desired outcome of their plan.

When children are choosing their own activity, they are automatically self-directed. The opportunity to work in groups was offered and 22.8% of the time students chose to work in groups, while 77.2% of the time they chose to work alone, which shows both group and individual problem solving opportunities were utilized. The data that was collected and analyzed shows that my initial intention and goals for this action research project were clearly met. I photographed many of the student's creations as part of my data collection. Below you can see a small sample of the outcomes and creations from student's makerspace time.

Student Creations

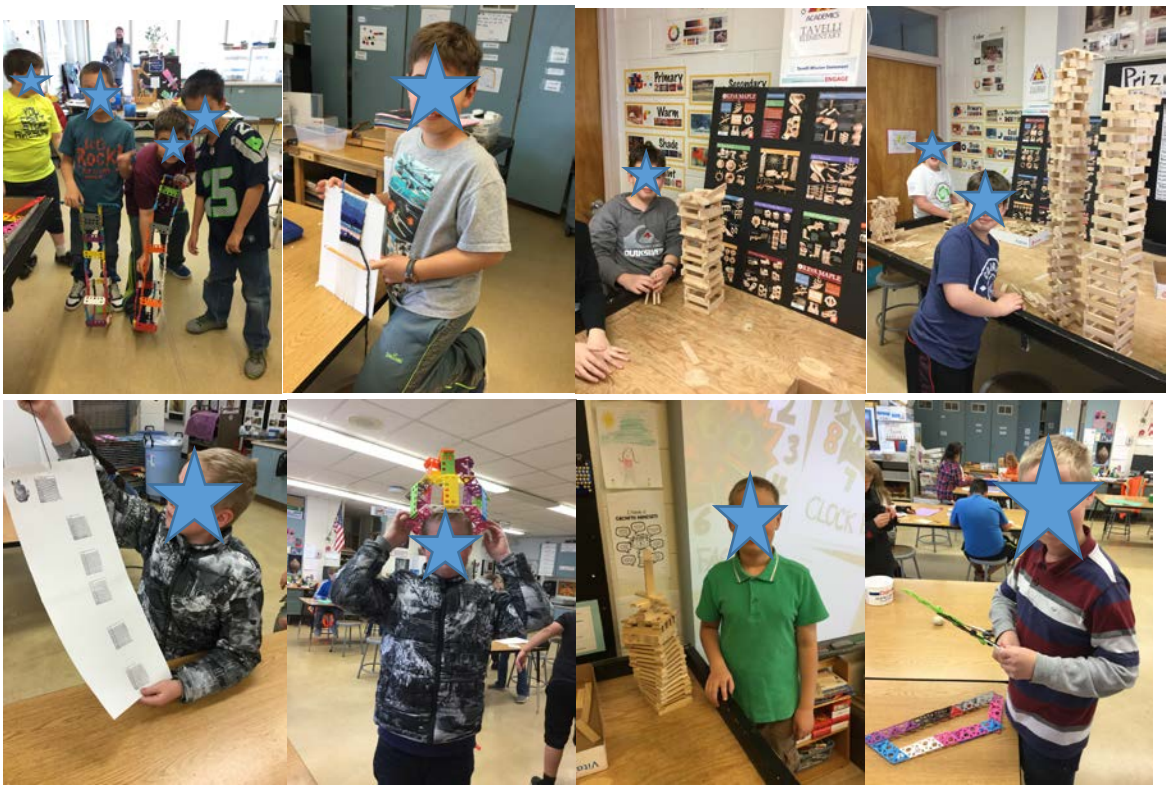

Figure 17. Eight photographs of student creations

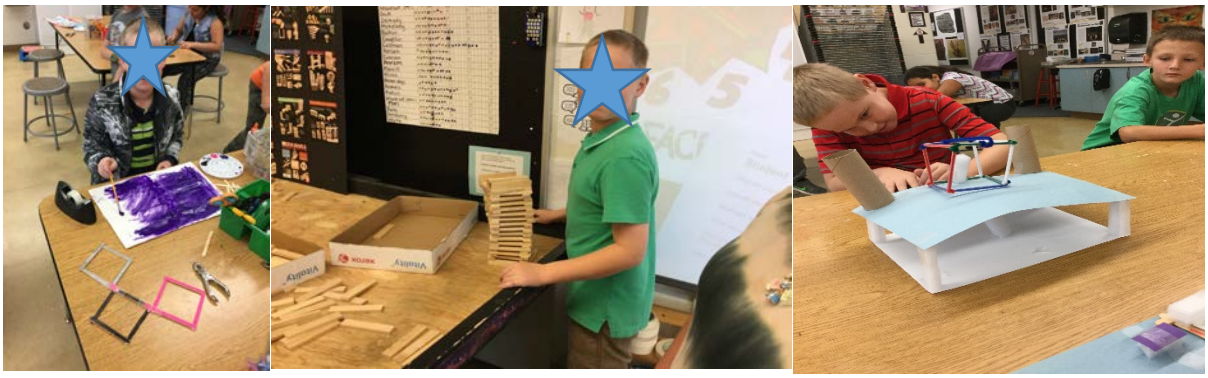

Figure 18. Three photographs of student creations

CHAPTER V

CONCLUSIONS

There were many things I learned through the course of this arts based action research project. There were many considerations that I did not predict that became evident as the study progressed. I stated in my IRB that I was originally going to include STEAM lessons and lesson plans in my research that I have developed and implemented across the curriculum by collaborating with my Science and Technology teachers. While this is completely relevant to my STEAM integration practices as a teacher, I quickly realized this was a topic in and of itself and for the purposes of my research I decided to focus solely on the Makerspace integration in the art room. I have broken my observations and conclusions into several categories for consideration.

Data Collection

I collected Data from 25 fourth grade students from four different fourth grade classes. I implemented the Makerspace curriculum with all of my k-5 elementary school students. There are around 600 students in my school. The limited population that the data was collected from was not representative of the whole k-5 experience with the Makerspaces, or even of the fourth grade population. I observed that each grade level had their own different developmental interactions with the Makerspaces. Moving forward I could see how collecting data across grade levels, recording the activities of a broader range of participants could prove to be beneficial. Researching further the experiences of children of different ages could be a possible topic for further inquiry.

Teacher as Researcher

As I embodied my role as *Teacher as Researcher*, it became evident that there was a lot of time consuming activities related to this study. I had to make time to not only plan for the Makerspace, but to stock and maintain these areas and this took at least 15 minutes a day, in addition to my regular teaching, planning, and preparation responsibilities. I also had to purchase items for the Makerspaces that had to come out of my already tight ordering budget. My specials team wrote and was awarded an Innovators Grant this year, which was exciting for our school! I was fortunate that my Makerspace was a big part of that grant and I was allotted a portion of the funds which helped me to stock this area. Moving forward I will have to carefully budget, plan and seek alternative avenues for materials and supplies.

I also found it difficult at times to collect data while maintaining my normal classroom duties. Often times students needed my help with projects, or clean up took longer than expected which made data collection impossible or stressful at the very least. I did my best to collect as much accurate data as possible while managing a full classroom. There was definitely a learning curve, and I got better at managing this as time went on.

The nature of the data collection tool evolved as the study moved forward and it became clearer to me how to develop data collection tools to meet my needs. I originally thought that the students' surveys would be analyzed and included in my chapter four, but after reading through them, I decided not to use them. The students were so engaged in their Makerspace activities that they did not take their time to fill out the surveys accurately or in any detail. This realization reinforced that the students are engaged and invested in what they are doing to the extreme that they could not stop to write down reflections.

Classroom Management

The implementation of the Makerspace created new areas to consider for classroom Management. I had to teach classroom norms in relation to these areas. I found that often behavior escalated at the Makerspace table due to the excitement of the building tasks and the nature of conflicts that arise when students are working in groups. The main rule I had to implement was that if students were not getting along and treating each other and each other's creations with respect, they could not participate in the activity. I had to make sure that the Makerspace activities did not create additional classroom management issues. As the students became familiar with the expectations for the Makerspace areas their behavior improved. I found that when you allow students more freedom of choice and a multitude of activities to choose from the behavior can escalate unless you have firm expectations in place, and as a teacher you must follow through consistently with enforcing the classroom norms and expectations.

Another area where classroom management was a challenge was in the maintenance and cleanup of the Makerspace craft area. Students often left the area a mess, not cleaning up after themselves. I had to create norms about how to maintain this new area. I tried to instill a sense of pride and ownership in my students for this studio space. I will have to admit that this was an ongoing issue, I had to spend extra time at the end of each class period to check the Makerspace craft area and have students come back up and clean it up. I found that students were so engaged in what they were creating that it was very hard to get them to stop what they were working on to clean up!

Student Activities

After conducting this research and spending time analyzing the data I saw trends that students often engaged in the same or similar activities repeatedly. It raises some questions for

possible future study; is it better to have a more structured space with specific challenges, or is full choice and important part of the process? Should I push students out of their comfort zone and require that they try different things? Is it better to allow them to continue to pursue what is most interesting to them? And by doing this do they become an *expert* at certain things?

I also observed that the boys tended to gravitate more towards the Makerspace table where hands on building activities were happening. This raises the question of gender preferences and could also lead to some very interesting studies.

Another interesting and exciting observation was that skills were transferring from our formal lessons to the Makerspace activities. One example of this was when we were making puppets for our guided lesson and during Makerspace time many of the students were inventing their own kind of puppets out of a variety of materials. I also was able to observe skills and activities transferring form things they were learning in science. An example of this transference was when they were learning about bridges in the science lab and several students built bridges in various forms and mediums during their Makerspace time, discussing their creations using science vocabulary. It was exciting to see the students transferring this knowledge!

Conclusion

Introducing the two Makerspaces in my classroom was an amazing experience. Now more than ever I am drawn to the Maker movement. I witnessed firsthand and was reminded daily of how children love to create. They love to experience the act of making, building things, playing and bringing something new into being. I saw how the skills and knowledge they gain from the experience of planning, designing, and creating things was unique and invaluable. It instilled a sense of ownership, pride, and connection to their work that guided lessons often to not afford. The Makerspaces in my classroom allowed for my students to engage their creative

problem solving skills and express themselves in new and different ways. These experiences also allowed students to transfer knowledge from other subject areas. Moving forward, the Makerspaces will not replace my teacher-directed pedagogy, but will continue to be implemented alongside it to create a multi-faceted teaching and learning environment. The Makerspace learning activities will supplement and enhance my teacher directed skills-based lessons and will continue to provide the opportunity for self-directed creative problem solving based on choice and access to many the many different materials provided. My continuing goal as an art educator is to provide experiences that enhance my students' knowledge of the arts and other subject areas, while building independent problem solving skills they can transfer to any subject area and utilize in their daily life experience.

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APPENDIX A

Institutional Review Board Application

Title: Maker space in the Elementary Art room
Researcher: Kathleen Robinson, Teacher/Researcher

A. Purpose

a. The purpose of my research is to explore how a maker space table in the elementary art classroom can support the STEAM curriculum, engage students in active, hands on problem solving and enhance a skills based curriculum by providing a self-directed individual and cooperative creative learning experiences. I will be exploring different maker space projects to determine what kinds of hands on activities in the makerspace are appropriate for elementary age students and are successful in my art classroom for achieving these goals. Through this research I will be exploring and developing a makerspace curriculum for the elementary art room that supports STEAM curriculum and provides the opportunity for individual and group problem solving and creating.

> ““**Doing” Is What Matters**
> Makers learn to make stuff by *making* stuff. Schools often forget this as they continuously prepare students for something that is going to happen next week, next year, or in some future career. The affordable and accessible technology of the Maker Movement makes learning by doing a realistic approach for schools today.” (Making Matters! How the Maker Movement Is Transforming Education, By Sylvia Libow Martine sans Gary S. Stager, http://www.weareteachers.com/blogs/post/2015/04/03/how-the-maker-movement-is-transforming-education)

b. I have noticed through my years of experience teaching elementary school art that my students most enjoy having free time to create whatever they want. It occurred to me that a maker space could help to structure this self-directed creative exploration time for my students while enhancing the STEAM focus at our school and providing a valuable space for self-directed hands on creativity and problem solving. The makerspace will allow freedom with some direction for the exploration of ideas and

challenges that will be rooted in the STEAM concepts of engineering and math based problem solving activities. I plan to provide a variety of materials and challenges on the Makerspace table that will be incorporated into the art classroom and enhance my current skills based art curriculum. I will allot time during each class for my students to use the Makerspace. I will collect data based on my personal observations, photographic and video documentation and recorded interviews with my students.

c. The subjects are of elementary school age. The research will present no more than minimal risk to human participants and will involve the use of personal observations, photographic and video documentation and recorded interviews with my students. The research will be conducted in an established educational setting involving normal educational practices, with Kathleen Robinson as the teacher/researcher. This application is for an Expedited Review Procedure.

B. Methods

a. Participants

i. The sample will be taken from Tavelli Elementary School, in Poudre School District, in Fort Collins, Colorado. The name of the school will not be included in the research; instead a pseudonym will be used to reference the school. Only the researcher will have access to the name of the school in relation to this pseudonym

ii. The sample will derive from the 2016-2017 class of 4th grade students (ages 9-10) at Tavelli Elementary taught by the teacher as researcher. Fourth graders have been chosen as the appropriate grade for this research because there is time and space to implement the maker-space into the 4th grade art curriculum. 4th grade students also have the skills and foundational art knowledge that will make them and ideal population for this research. Students will be recruited to have their work and progress observed and documented as part of this research based on their own desire and willingness to participate. If the students are interested in participating, they will take consent forms home to discuss with their parents or guardians. Only students with signed consent forms will be considered for the population from which I will randomly select data. This selection will be based on observable moments, active participation and completion of activities.

iii. Students will be aware that participation does not affect their evaluation or grade in the class. Subjects will be identified in the research using pseudonyms; their real names will not be used. Only the researcher will have access to the subjects' real names in relation to their pseudonyms

b. Data Collection Procedures

i. If students are interested in participating, they will be asked to take the consent and assent forms home to discuss with their parents or guardians.

Only students who return signed consent and assent forms will be considered for the population from which data is collected.

ii. Students will use the makerspace table for 15 minutes during the art period to explore the lesson/challenge for the day. I will change the lesson/activity available on the makerspace table once all students have participated (I project that this will be every 2-3 weeks to allow for all students to have time to rotate through this station, they only have art for 45 minutes once a week). Students' progress and engagement will be observed as they engage in maker space activities. I will keep a running log/journal of my own as I plan, implement and observe different lessons in progress.

iii. Using i-pads subjects will be videotaped and/or photographed in the progress or upon completion of their maker space lesson.

iv. Using i-pads students and projects will be photographed.

v. Using i-pads students will be interviewed about their maker Space Experience in a 1-2 minute survey about their experience. If a student is uncomfortable being videotaped for their interview, there will be a written survey they can participate in instead.

1. Survey questions:
    a. What did you create?
    b. How did you create it?
    c. What was hard about it?
    d. What was easy about it?
    e. Did you ever have to change your plan? If so, how?
    f. What did you like the most about this activity? (The surveys may vary using questions appropriate to each different lesson, as my research includes creating curriculum, the lessons are not yet determined.)

vi. I plan to document each different maker space lesson in this way using at least one student to document the process and outcome of each lesson. I will then be able to use this data to help assess the value of each lesson.

c. Data Analysis Procedures

i. The data will be compiled in the researchers personal google drive.

ii. The video and photographic data will be analyzed to assess whether the project/lesson met the goals of providing creative problem solving opportunities, keeping students engaged and supporting the STEAM curriculum.

iii. The researcher will take notes, analyze and record observations and conclusions derived from data in a working document on her google drive that will house all collected data analysis regarding this research.

iv. After all data has been collected and analyzed, the researcher will choose the successful lessons from the research to create a curriculum for Elementary art room STEAM maker space tables.

d. Data Handling Procedures
   i. The data will be collected on the researcher's personal iPad and stored in the researchers private google drive. Only the researcher will have access to the data. Data will be kept in a locked cabinet in the teacher as researcher's classroom at Tavelli Elementary in Fort Collins, Colorado for the duration of the research. Consent and assent forms will be retained by the research advisor, Dr. Connie Stuart for a period of 3 years.
   ii. Subjects will be identified by pseudonyms; their real names will not be used.
   iii. Only the researcher will have access to subject's real names in relation to their pseudonyms.
   iv. Data will be used for approximately one year after the completion of the research.
   v. Data will be destroyed (permanently deleted) approximately 2 years after the completion of the research.
   vi. To project subjects of elementary school age, data will not be released in any form other than research publication and the processes involved in research publication. Videos will not be released publically to prevent subject identification.

C. Risks, Discomforts and Benefits

a. The risks inherent in this study are no greater that those normally encountered during regular classroom participation.

b. Discomfort my occur if subjects are unsure of how to answer an interview question or do not want to be videotaped; the subjects will be reminded that there are no right or wrong answers and that the interview (videotaping) is optional, they may participate in the written survey if they prefer.

c. It is likely that the participants will benefit from participation by gaining knowledge, experience and skills through the enriching activities provided.

d. Other art teachers who are interested in maker spaces may benefit from this research and curriculum formation as a result of this study.

D. Costs and Compensations

a. There will be a shift in art making time, as 15 minutes of each class period will be dedicated to the maker space activities and taken from normal studio practice

E. Grant Information (if applicable)

a. This study will not be funded by a grant

ASSENT FORM

APPENDIX B

Institutional Review Board

ASSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH UNIVERSITY OF NORTHERN COLORADO

Hi!
My name is Katie Robinson and I am the Art teacher at Tavelli Elementary. I am also a student and researcher at the University of Northern Colorado. I am currently researching how to incorporate STEAM concepts into our art room using a Makerspace table. I will be developing new curriculum (ideas and lessons) throughout the year during our art classes together.

All students in my Art classes will get to use the Makerspace and experience the activities, but I need a few students to volunteer to allow me to document their experiences as part of my research. To volunteer you must sign this form AND return a signed consent form from your parents. If you are a volunteer, I will take pictures of your work in the maker space and ask you questions about each project. I will record your answers for my research. This will all happen during your regular art time, there are no extra requirements from you, only that you agree to allow me to record and document your experience. This will in no way affect your art grade. Your participation is greatly appreciated and will help me create an effective Makerspace curriculum.

If you would like to part of my research with the Makerspace table, please sign your name below and write todays date next to it!

_____

Student Date

_____

Researcher Date

APPENDIX C

CONSENT FORM

Institutional Review Board

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH

Project Title: Makerspace in the Elementary Art Room
Researcher: Kathleen Robinson, M.A. Art and Design, UNCO, Art Teacher Tavelli Elementary, Fort Collins, CO
Phone: (970)-488-6768 **E-mail**: krobinso@psdschools.org

Hello 4th grade families,

My name is Katie Robinson and I am the Art teacher at Tavelli Elementary. I am also a student and researcher at the University of Northern Colorado. I am currently researching how to incorporate STEAM concepts into our art room using a Makerspace table. I will be developing new curriculum (ideas and lessons) throughout the year during our art classes together.

The purpose of my research is to explore how a Makerspace table in the elementary art classroom can support the STEAM curriculum, engage students in active hands on problem solving and enhance a skills based curriculum by providing self-directed individual and cooperative creative learning experiences. I will be exploring different Makerspace activities to determine what kinds of hands on activities in the Makerspace are appropriate for elementary age students and are successful in the art classroom for achieving these goals. There are no foreseeable risks to participating in this study.

All students in my 4th grade Art classes will get to use the Makerspace and experience the activities, but I need a few students to volunteer to allow me to document their experiences as part of my research. For your child to volunteer you must sign this form and your child must return the form to me. If your child is chosen to be a volunteer (you will be notified), I will take pictures of their work in the maker space and ask them questions about each project. I will record the answers and take photographs for my research. **This will all happen during your child's regular art time, there are no extra requirements from your child, only that you and they agree to allow me to record and document their experience**. Participating or choosing not to participate in this research will in no way affect your child's art grade. Your child's willingness to participate is greatly appreciated and will help me create an effective Makerspace curriculum.

If your child chooses to participate their identity will remain anonymous. They will not be identified by name in my research.
Please e-mail me if you have any questions krobinso@psdschools.org

Participation is voluntary. You may decide not to allow your child to participate in this study and if (s)he begins participation you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Having read the above and having had an opportunity to ask any questions please sign below if you would like to participate in this research. A copy of this form will be given to you to retain for future reference. If you have any concerns about your selection or treatment as a research participant please contact Sherry May, IRB Administrator, Office of Sponsored Programs, 25 Kepner Hall, University of Northern Colorado Greeley, Co 80639; 970-351-1910

If you would allow your child to be a part of my research with the Makerspace curriculum development, please sign and date below, and have your child return this form to me.

Thank you for assisting in my research!
Sincerely,

Kathleen Robinson, Art Teacher, Tavelli Elementary

Student Date

Parent Date

Researcher Date

APPENDIX D

STUDENT DATA SNAPSHOTS

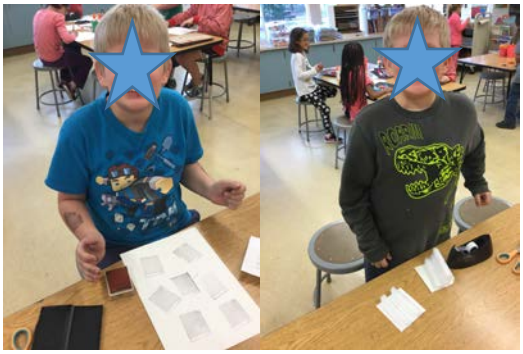
Student Snapshots

S1: Student 1

3/29-Maker-table, Q-bits for 5 min. Moved to Maker crafts, using paper plates, glue and craft sticks.

4/6-Maker-table, Keeva blocks, had behavior issues and had to choose different activity. Cutting string.

4/13-Maker crafts, experimenting with stamp pads



S2: Student 2

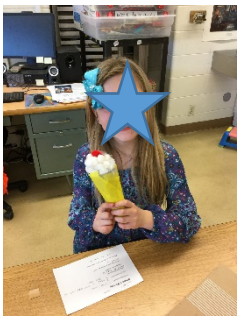
3/29-Maker-table, Q-bits, building and exploring, moved to dot to dot -skills based activity/coloring sheet

4/6-Started a Maker table, Keeva blocks, moved to dot to dot, skills based activity

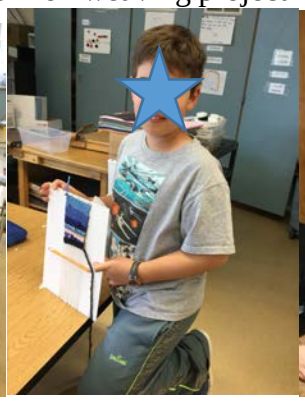
4/13-Maker crafts, experimenting with stamp pads, tracing images

S3: Student 3

3/29-Maker crafts, gluing building with pom-poms and recycled cardboard, ice cream cone sculpture (sharing ideas with Sari and Kailyn)
4/6-Maker crafts, string, paper, cutting, sharpies, yarn, created a “fuzzy pet” sculpture
4/13-Absent



S4: Student 4
3/29-Maker-table, Q-bits, working on a group project, “bike” from instruction sheet, with 3 others
4/6-Maker crafts, sticks, felt, created an invention, contraption, moved to Maker table, Keeva blocks
4/13-Continued to work on weaving project

S5: Student 5
3/29-Maker-table, Q-bits, working alone, exploring pieces and then working with several other students.
4/6-Absent
4/13-Maker crafts, experimenting with stamp pads


S6: Student 6
3/29-Maker crafts, creating and building with pom-poms and recycled cardboard
4/6-Maker crafts, string, shells, cardboard, glue, created and assemblage
4/13-Continued to work on weaving project

S7: Student 7
3/29- Maker crafts, pom-poms, glue, string, creating a key chain
4/6-Absent
4/13-Continued to work on weaving project
Date unsure: Maker crafts, building with cardstock, 3-D building sculpture
Date unsure: Maker crafts, gluing paper together, hole puncher, string, kite?

S8: Student 8
3/29-Maker table, Q-bits, working by self, and then with others, all creating similar shapes with Q-bit pieces, helping each other, discussing process ‘how did you do that?’, ‘here, let me show you’, ‘like this’
4/6-off task, not creating, behavior issues
4/13-Maker crafts, experimented with stamp pads

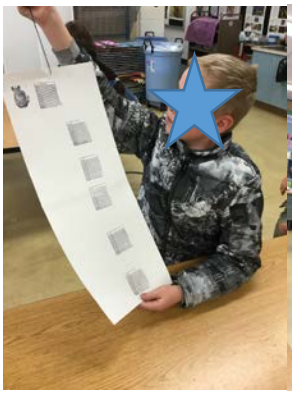
S9: Student 9
3/29-Maker crafts- drawing and cutting, creating his own puzzle with paper and glue
4/6-Maker crafts, drawing and cutting
4/13-Maker crafts, drawing and cutting, made a mask out of cut paper
Date unsure: Maker crafts, origami

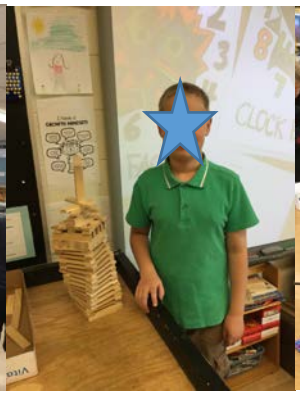
S10: Student 10
3/29-Maker crafts, using pom-poms and recycled cardboard into an ice cream cone sculpture (sharing ideas with Talia)
4/6-Absent
4/13-Absent
Date unsure- Maker table Keeva blocks

S11: Student 11

2/28-Maker crafts, Paper, Makers, craft sticks, “I am making confetti”, hole puncher
3/7-Absent
3/28-Making up classwork
4/4-Maker crafts, experimenting with stamps, making card with bunny stamp


S12: Student 12
2/28-Maker crafts, painting, created a frame with craft sticks
3/7-Maker table, building with Keeva blocks
3/28-Maker crafts, tag board, craft sticks, buttons, foam, build “bed for iguana”, switched to Maker table, Q-bits first time exploration of manipulatives, built a “flame thrower”
4/4-Maker table, Q-bits, made a hat, also did Maker crafts, paper, craft sticks, stamps, he created a banner.







S13: Student 13
2/28-Maker table, creating with Keeva blocks, looking at example ideas, building and planning, trying to create a specific structure
3/7-Maker table, working with Keeva blocks, building a ramp with 2 others

3/28-Maker table, Q-bits, first time exploration of manipulatives, built and invention, “I created a storm trooper car”
4/4-Maker table, Q-bits, experimenting with pieces, seeing how they work, had to choose another activity (behavior issues), did Maker crafts, Dry erase board

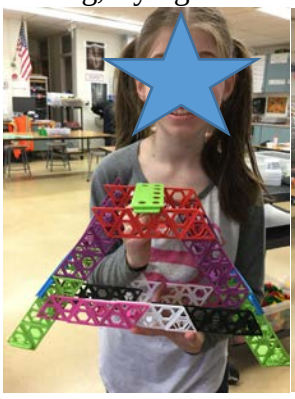
S14: Student 14
2/28-Maker crafts, string, cards, paper, construction a box with the cards, using string and foam and glue and tape
3/7-Maker crafts, building with foam blocks, stapler, tissue paper, created a sleeping bag and a bedroom
3/28-Maker crafts, bead, feather, glue, cardstock, made a “badge thingy”
4/4-Maker crafts, paper, markers, craft sticks, made a huge poster, tactile, tracing paper mixed media. “It is a giant bed”

S15: Student 15
2/28-Maker table, building with Keeva blocks
3/7-Maker table, building with Keeva blocks
3/28-making up classwork
4/4-Maker crafts, experimented with stamping

S16: Student 16
2/28-Maker crafts, “I made a fuzzinator”, Yarn, cotton balls, tissue paper and craft sticks.
3/7-Absent
3/28-Maker crafts, Making creating, beads, paper, buttons, glue, making a “fun house”
4/4-Maker crafts, cone, cardboard, tissue paper, decorated the cone with string and tissue




S17: Student 17
2/28-Maker table, building with Keeva blocks, working on a tall structure, standing on a chair to build her structure as tall as possible
3/7-Maker table, building with Keeva blocks
3/28-Maker table, Q-bits exploring new maker manipulative, building and experimenting
4/4-Maker table, Q-bits, experimenting, building, looking at the poster of examples and problem solving, trying to create different things. Moved to Maker crafts, to use beads and string.



S18: Student 18
3/6-Maker table, building with Keeva blocks, working with Josh and Ben on a group project

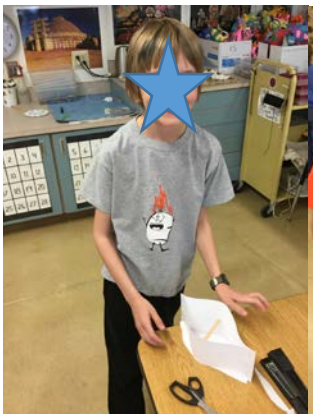
3/20-Maker table, building with Keeva blocks, working with another student, builds long bridge/ramp (lots of excitement)
4/3-Maker table, Q-bits, working with Josh, “let's make what Riley’s making”... an octagon tower


S19: Student 19
3/6-Maker table, working with Ben and another student, joins group building effort
3/20-Catching up on project
4/3-Maker table, Q-bits, working alone, build structure, “superman thing”

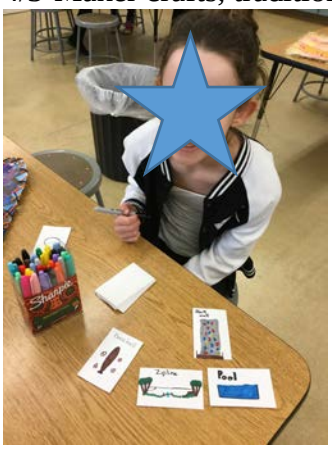
S20: Student 20
3/6-Maker table, building with Keeva blocks
3/20-Building with Keeva blocks, alone, created a boat, switched to Maker crafts and created an airplane sculpture
4/3-Maker crafts, glue, craft sticks, foam, stapler. Just building a sculpture, no end goal.

S21: Student 21
3/6-Maker table, Keeva blocks, making a spiral form from the example poster, working alone
3/20-Maker table, building with Keeva blocks, working alone, building an elaborate structure form example board. Moved to maker crafts, beading on a string, created character with craft sticks, foam and a picture
4/3-Maker table, Q-bits, Worked with Eddie to create octagon, planning, “I need all the black”...

S22: Student 22
3/6-Maker table, Keeva blocks, working with miles, went to Maker crafts, skills based, drawing and moved back to building with the keeva blocks
3/20-Maker table, building with Keeva blocks, then switched to Maker crafts and created and airplane out of foam pieces
4/3-Maker table, Q-bits, worked with Riley making octagon, then switched to maker crafts, paper, stapler, craft sticks, “the Titanic” (fourth graders just made boats in science, transfer)

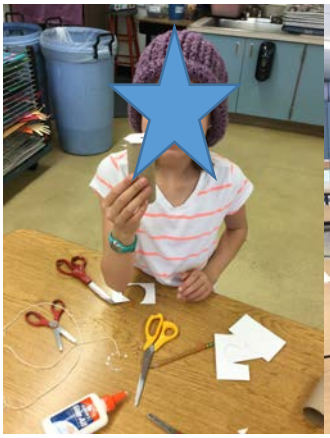


S23: Student 23
3/6-Maker craft, cards with sharpies, making cards, pictures with words, she was creating a game/activity with the cards
3/20-Catching up on project
4/3-Maker crafts, traditional media, paper sharpies, drawing



S24: Student 24
3/6-Maker crafts, created a character/puppet with craft sticks, string, cotton balls and markers, “disco Eddie”
3/20-Maker crafts, made bracelet with beads and string
4/3-Absent


S25: Student 25
3/6-Maker crafts, using cards and sharpies, making nice cards for friends
3/20-Maker crafts, creating with feathers, beads and foam
4/3-Maker crafts, “I am making a telephone” toilet paper tubes, glue and string. “And I am going to test it when I am done”.



APENDIX D

LIST OF MAKERSPACE TABLE ACTIVIES

1. Keeva blocks
2. Q-Bits
3. Tinker Toys
4. Magna Tiles
5. Marble Madness
6. Modeling clay with toothpicks

APPENDIX F

LIST OF MAKERSPACE CRAFT AREA SUPPLIES

Tools

1. Scissors
2. Hole punchers
3. Tape
4. Glue
5. Stencils
6. Scrapbooking scissors
7. Rulers

Activities

1. Drawing books
2. Dry erase boards
3. Stamps and ink pads
4. Coloring sheets
5. Dot to dots
6. Origami supplies

Building supplies

1. Craft sticks
2. Foam pieces

3. Recycled cardboard
4. String
5. Cardstock
6. Cotton balls
7. Pom-poms
8. Beads
9. Shells
10. Felt

Types of paper

1. Xerox
2. Construction paper
3. Tissue paper
4. Tracing paper
5. Origami paper
6. Sticker paper