Benefits of Maker Education for Secondary Institutions:

An Investigation into Space for Collaboration

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SCED544 Capstone II

Dr. Anna Monteiro

Endeavor

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Abstract

The purpose of this study was to explore the benefits of implementing a Makerspaces for secondary education. The recent Maker movement has been expanding with the apparent consensus among educators that collaboration and hands-on learning is beneficial for all students. The Woodstock Academy has been busy developing a Makerspace, this space was designed for students and teachers from all disciplines to take advantage of. The administrative processes for the space and views of community members have not yet been fully defined. The community members participating in this study include teachers, students, councilors, parents and outside community experts. Qualitative data was collected to identify current views, practice, expectations and benefits of the Makerspace. Results from this study will be shared with the Woodstock Academy administration and used to establish standard practice and process for the Makerspace.

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Benefits of Maker Education for Secondary Institutions: An Investigation into Space for Collaboration

Introduction

According to Maker ED https://makered.org/ **"**Maker education offers a transformational approach to teaching and learning that attends to the real and relevant needs of learners and humans." The MIT Edgerton Center states on their website http://k12maker.mit.edu/ "The essence of the Maker movement is democratizing innovation: giving everyone the tools to create, the courage to fail, and the empathy to solve problems as a community." Maker Education blends curriculum with physical engagement allowing student to apply skills and knowledge by creating solutions to a problems, less theory and more action. The purpose of this study is to explore the benefits of implementing a Makerspaces for secondary education. The Woodstock Academy has been busy developing a Makerspace, this space has been designed for all students from all disciplines to access. The administrative processes being used and the views of community members have not yet been clearly defined. These community members include teachers, students, councilors, parents and outside community experts.

Over the past five years, there has been a push in education for Problem Based Learning, Science Technology Engineering and Math and Maker activities/project. "In the US, even the White House has gotten involved in the movement hosting the first White House Maker Fair in 2014. This new ''maker movement'' has been embraced by schools as a way to motivate students to explore STEM domains." (Holbert, 2016) Different entities represent each of these movements; arguably, their intent is the same. Use hands-on problem based learning to execute processes that develop skills and build knowledge as solutions are developed. For example, NGSS addresses a need for PBL as it relates to science. ITEEA directs its STEM supported data

toward Technology and Engineering. While these two both do an excellent job addressing active learning in their own context they remain separate, neither acknowledges the actions of the other.

The problem solving process of creating such artifacts improves understanding. "Formal education has become such a serious business, defined as success at abstract thinking and high stakes testing, that there is no time and no context for play. If play is what students do outside school then that is where real learning will take place and that is where innovation and creativity will be found" (Honey& Kanter, 2012). Play involves interactions between individuals allowing them to practice physically and emotionally forming understandings of those interactions.

Skill and Career based curriculum such as shop, foods and arts programs create PBL, STEM and Maker type artifacts that support traditional core subject in math, writing and reading. " Yet all too often, the focus on "college readiness" and "career readiness" remains in two distinct silos, even though there is little question that reading, writing, communications and mathematical reasoning are all core skills for success in postsecondary education, in the workplace and for citizenship and that all educators should help students develop, deepen and refine these core skills." (Meeder & Suddreth, 2012) These core skills depend on cooperative interactions between community members. Unguided addiction to technology and social media may be widening the social emotional gap as instantaneous transfer of information does not allow time for practice or reflection.

Multiple entities governing education have recognized the importance of hands on learning. Several approaches engage students such as PBL, STEM and most recently Maker. These paradigms are the vehicles that will prepare students for real-world interactions. A Makerspace may provide all members within an educational community an opportunity to

work together and exhibit their talents.

Problem Statement

Whether Science, Math, English or Art are being taught paradigms in secondary education remain focused on a particular discipline. PBL, STEM and Maker while all similar are recognized as separate approaches and methods. They all need to have a space or place for students to perform their hands on activities. If in fact these separate paradigms are similar then collaboration between the disciplines may result in a standard process that can evolve and be used by all.

At the secondary level there tends to be a disconnect from the application models that allow students to be creative, developing solutions in a hands on way by applying a mixture of knowledge, skills and tools. College readiness has become a competition for admission to renowned institutions. Students are pushed to take higher-level classes at an insurmountable rate leaving little time for students to practice and apply their learning.

Secondary education is lacking cooperative spaces where students can effectively work together with community input, i.e. Physics has their lab, Robotics has their lab, and Culinary has their lab. All of these spaces are accessible for only one curriculum. There is no unifying space for true freethinking problem solving. There is no lab where all students can collaborate, no opportunity for students to mix and apply all of their learning.

With the current state of violence in schools, educators are searching for ways to create inclusive communities that value and take advantage of different points of view. The creation of meaningful cooperative spaces where students can effectively work together with community input may be one solution in developing a vested interest in education for all members.

The three areas that will be explored in this study are process, use and community views. If a space were set aside for students to be creative developing solutions using hands on activities, how would this area be scheduled? What are the processes and procedures that would work best for the students and faculty members? Does the Makerspace have a place in non-traditional maker type classes? Is the makerspace beneficial for the secondary education community?

Hands on projects give students a unique opportunity to explore their learning. If space and time are provided teachers and students will take advantage of those opportunities no matter what subject is being taught. Community member will experience various benefits of the Makerspace. The space will have different effects on the different groups and individuals using it, some of those benefits will be more obvious than others.

Review of Literature

Teachers in secondary institutions have been encouraged to introduce PBL, STEM and Maker projects/activities into their curriculum. Most of these projects align with a specific curriculum presented by specific entity linked to specific needs. These separate groups are focused on their own parts and do not collaborate with each other, even though one could argue that they all are using a similar methodology and processes to reach student goals.

In "A Cognitive Analysis of the benefits of Maker Kids" (Kaun, 2012) Dr. Karen P. Kaun presented results from elementary students participating in Maker style activities. These activities aligned with Common Core and NYSED. Students used a problem solving through an invention approach developed by Maker Kids. Students worked collaboratively creating artifacts and sharing their problem solving experience. In the study, Kaun refers to Blooms taxonomy and

depth of knowledge to construct an argument for Maker style learning. Conversations between students were recorded and the dialogue was used as evidence of high order thinking. The collaborative nature of making was recognized as a key factor; bring the class together to meet common goal.

Another study "Active learning increases student performance in science, engineering, and mathematics" (Klymkowsky, 2014) provides statistical evidence for STEM classes over standard traditional lecture style instruction for undergraduate courses in science, technology, engineering, and mathematics.

Other articles such as "The Promise of the Maker Movement for Education" (Martin, Lee, 2015) researches recognized the benefits of creating an artifact. "It has long been argued that children and youth can learn by playing and building with interesting tools and materials (Montessori, 1912)" They present data conducive to improving education over all but there is no collaborative bridge crossed or association to other approaches that get similar results even though the methods are similar. These articles are siloed, directing their efforts in support of one aspect of what and do not address the movement as a whole. While specific learning indicators are covered in detail, relationships between them are not exposed as one methodology. NGSS, ITEEA and NCTM all agree that making, constructing, collaborating and real-world problem solving enhances learning for secondary students but educators all approach it as a slice of their own pie and not a shared experience.

The collaborative components of creating artifacts has tangible benefits that are difficult to quantify. One being teamwork, which lends itself to community building. Similar to a veteran player on a baseball team, the metrics are not evident but the team performs better with his

presence. Collaborative experiences between teachers (using the same methodology), administrators, students, parents and community leaders may be a way to grow secondary education into a thriving training ground for a global community. Educators of America believes that PBL is one of the best ways to connect students and their schools to their surrounding communities and the real world https://educatorsusa.org.

A group from the MIT Edgerton Center lead by Diane Branscazio and Leilani Roser spent a year working with local teachers and administrators to develop a Maker Methodology that could be applied to any curriculum at any grade level. Many contributions from a variety of primary and secondary institutions reside there. They created a library of resources for schools instituting makerspaces to draw from, these procedures and processes have been posted on their website http://k12maker.mit.edu/ . The Woodstock Academy is instituting some of these ideas but they have not been evaluated for success.

In the article *The 'Maker' Movement Is Coming to K-12: Can Schools Get It Right?* Herold brings to light some interesting questions "Should making happen primarily in a dedicated space or inside every classroom? And is the purpose of maker education to help students better learn the established curriculum or to upend traditional notions of what counts as real learning?" It is clear that the Maker Movement is here and schools are beginning to experiment with these spaces. At the moment there are no standards since every situation is a bit different and Makerspaces are a new frontier. Some schools are jumping in while others are waiting to see evidence of the benefits.

Research Design and Methodology

Qualitative data was collected through interviews and surveys of community members. Focus groups included faculty, students, parents, administrators and local business professionals. The interviews were conducted face-to-face and through e-mail when appropriate. Interviews established the knowledge, methods and processes that were being applied to the space. Surveys were administered electronically; pre-surveys were distributed to community members who agreed to participate in the study. The pre-survey data determined views, feelings and understanding of community members prior to actual engagement in the space. A second round of interviews and surveys were administered near the end of the study to identify any changes in thinking, attitudes and feelings as result of participation in activities within the Makerspace. Similar group data from surrounding communities was collected to identify common processes being applied to similar spaces.

Any recordings, handwritten notes or audio from interviews were cataloged electronically and stored for further review. At the completion of the study all recordings and other individual specific media will be destroyed. Winnowing was used for analysis focusing on relations to the survey questions, allowing codes to emerge as the data was collected.

Some of the checks employed to ensure reliability and validity include; Triangulating, so themes could be established based on converging several sources (focus groups). Clarifying bias by developing an honest self-reflection of my interest in the study based on my views of

education and site association. Drift in definitions of codes was checked by comparing data and

memos during the study and an external auditor having no stake in the study was be employed.

This study took place at The Woodstock Academy, a rural independent high school in

New England. Focus groups for the study included teachers, administrators, community

members, parents, and students. Thirty four students were selected from the classes that were

using the Makerspace to take pre and post surveys. Fourteen faculty members form The

Woodstock Academy, one community professional and one faculty member from another district

were interviewed about their experiences in the Makerspace or other similar collaborative lab.

The schedule was established to correlate with the second semester of the 2018-2019

school year at The Woodstock Academy. Faculty candidates were identified December 2018.

Other community members were recruited January 2019, the beginning of classes second

semester. Interviews and surveys were administered per designated schedule, the study and

schedule was designed to have minimal impact on instructional time for students and teachers

(see appendix H).

Description of data Analysis

The community members that participated this study were divided into three groups;

students, faculty and off site members (see appendix H for codes and details).Three categories of

data were identified to establish a baseline and triangulate common themes among the

community members. Pre survey questions, initial interview questions and observations

established the first category **"What do I know about a Makerspace"**. This data determined

experience and prior knowledge among members before any instruction or use of the

makerspace. Observations and interview questions about current practices and procedures

complied data for **"How do I use the maker space"**. Although procedures are in place and

being used they have not been fully defined or tested. Open response and interview questions

identified the third category **"How can I be more efficient in the Makerspace"** community

members had an opportunity to make suggestions that could improve the Makerspace based on

their recent experiences.

What do I know about a Makersapce? Pre Survey, Observations and Interviews

Pre introduction data showed that community members did not understand the need or use of a

Makerspace. They could not give a definition or describe how the space might be used. A few

member from AF and BF had some ideas but were not clear about the processes and procedures

that should be used in such a space. There were concerns about safety and training for teachers

and students. See the data samples listed below:

 All Participants-67.5 % percent of community members did not know what a makerspace was.

All participants - 80% Did not know where the Makerspace was located in the school

All participants - 42% felt they had average capabilities with technology

Observations – 72.5% did not know that they would be allowed to use the space after regular

school hrs.

Group DS-90% indicated they had been in a Makerspace 0-3 times.

Group DS - 85% said they apply things they learn in one class to other classes.

Group DS - 80% indicated that they like to work in groups some of the time.

Group DS- 80% indicated that they like working alone some of the time.

Group DS- felt they had skills that would be usefully in a group project.

Groups- AF, BF, EF, FF-had some ideas about how to use the space could be used.

How do I use the makerspace? Post Survey, Interviews, Observations

All participants – 91.5 % knew what a makerspace was and could define it.

All participants – 100% knew where the makerspace was located

Groups- BF, EF, FF- used the space for a verity of Maker projects. Classes included SPED

applied skills, English 1, and Mythology. Activities included posters, catapults, board game

design, and graphic displays. These faculty members assigned content specific projects, materials

and gave brief instruction. Instructors did not supply any technical training. Students from FF were allowed to use the 3D printer if they had previous training. Students were given content specific rubrics but were able to add their own creative touch to demonstrate their learning. Students worked in teams or groups. Students made use of materials and hand tools in the room scissors, markers, pencils, tape, hot glue and other craft type materials. Students were able to spread out along the workbenches and tables to work. Instructors work with students to solve and problems.

After the use of the space by community members there was a significant increase in interest for managing the space and times that the space would be open from 51% to 65%. Instructors and students became more comfortable with the space and 97% of students were able to complete a Maker project in the designated amount of time. Instructors and students agreed that the space fit their needs and will return for future activities. The space and the equipment were not used to full potential by instructors who were not familiar with those processes at this time, however students that had received training used their knowledge to employ some of the available equipment.

A teacher from EF commented, "The makerspace provided a unique experience for collaboration and allowed students to display their skills while demonstrating newly acquired knowledge". Students who working together had enough area to move about comfortably without interfering with the work of others. Having materials and small hand tools on mobile carts proved advantageous, students could gain access from a multiple angles. . Instructors enjoyed the space and commented on their ability to move from group to group easily without disturbing other groups. Safety concern were minimal, standards were established by the faculty members based on their comfort level and training in the space. Instructors felt that they had an opportunity to develop closer relationships with their students through their interactions while in the space.

Group DS- Students worked in teams, they were given basic instruction for 6 different mediums/processes (3D printing, logo creation, T-shirt design, green screen, Arts /crafts, and

graphic design. They were then then asked to choose one and use it to promote a computer game they designed. Students relied on each other's experience and understanding as they shared ideas. They work freely and made use of all of the technology in the room. Students were excited to try something new and enjoyed the break from a traditional classroom setting. Technical understanding of many of the process increased, 3D printing was the top technology used with vinyl cutting a close second. When asked "What did you gain from using the makerspace?" replies ranged from technically specific skills like 3D printing to freedom of choice for a project and time for collaboration. Some students used the Makerspace during their off block to make their own projects.

How can I be more efficient in the Makerspace? From Interviews, Post Survey, Post Activity Interviews

Since this is a community space that should be shared and explored by all, members were encouraged to make suggestions after experiencing the Makerspace. Group G wasn't sure if the space was structured enough and felt that the work could be done in other lab spaces. They also felt that activities and projects should focus on a single technology rather than allowing students' freedom to roam the space using materials and technology at will. Group G and Faculty members felt safety concerns could be reduced with some sort a certification process for students that could be easily identified by faculty members. Faculty members suggested an I.D. card or coin. Faculty agreed logistically there should be a better signup procedure, currently notifying the teacher or administrator in charge is not enough. They wanted to be able to see a real-time calendar so they could plan around it. It was also suggested that there a running log tracking materials and maintenance issues should be kept in the space and filled in by faculty members using the space. Some other equipment that is needed or could be purchased included a large paper cutter and a laser engraver. It was noted that having 1 or 2 pieces of a specific technology would limit the number of students able to use those pieces at any given time. Teachers would also like some more technical training so they could allow students to use more of the equipment. Dust, wood dust covers everything, "is there a way to reduce or eliminate the dust?"

A valid concern that was brought forward by faculty member that used the space. The explorations in woods class uses the Makerspace daily as a woodshop. The instructor needs to be in the space every day and would have difficulty sharing the Makerspace with other classes for that block.

Students had few suggestions other than they want more and more time to explore. They felt the space was adequate and they enjoyed the time to create. A few student expressed interest in managing the space possibly as a mentor if they could get credit for doing so. Others said they would like to use the Makerspace after school but so far, there have only been a few participants. One students said "Other students need to be told the Makerspace is open."

Action Plan

After reviewing literature on the use and implementation of a Makerspace. There is considerable evidence that Makerspaces can be an important resource for students at the secondary level. Benefits of such a collaborative environment vary and are dependent on the institutions philosophy for implementation. It appears that educators from all disciplines should have an opportunity to take advantage of these spaces. The processes and procedures governing a Makerspace should evolve with input from all community member. Since this is the first year the Makerspace will be open at The Woodstock Academy it will take some time to get everyone comfortable with the space. The goal for this planned action is to improve the processes and procedures being used by the community in the Makerspace and enhance the benefits of the space for all members.

It is clear after reviewing the initial data collected form the first few months of operation that the community has found areas that can be improved upon. I will continue to monitor the processes and procedures being used and at the completion of this first semester I will distribute another series of interviews and surveys of community members to establish common practice. These common practices, rules, procedures, processes and administration will be published for all members to review and implement before the start of the fall semester.

Based on the data already collected I will develop a series of initial changes to be implemented by community members using the Makerspace. Five of those changes include an interactive real time calendar for activities within the space allowing members to view, sign up and collaborate. A materials replacement list to restock materials and establish budget responsibilities. A coin badging system and master list indicating student proficiency with machinery and technology. An on line activities bank for instructors and students to display their work and allow sharing of curricular materials. I will also institute a weekly open lab time for community members after regular school hours for training and individual activities.

At this time there are few challenges. The Makerspace and its operation have been backed by the administration and community members appear to be committed to using the space. The only concern I have is the diversity of the members using the space. The initial groups' views have been positive and their participation has been ample. The first obstacle will be recruiting more departments, students and instructors. Asking members to step away from normal routines to try something new can be challenging. The development of standards should make the process more convenient and less ominous. Having the online activity bank will allow members to relate activities to their curriculum and develop options to enhance their students learning. The only other obstacle, I do not have an answer for at this time, is the use of the space by the explorations in woods class. They occupy the Makerspace for a full block every day so other classes will not have access at that time. Administration has suggested they use another space on non-building days. While this proposal seems plausible opportunities are only present during the introductory portions of the course and result in two weeks of opportunity for other classes.

I will be relying on support and participation from other community members; there are several teachers and students that have expressed interest in managing and being advocates for the Makerspace. Teacher input is paramount to the success of the Makerspace; they will be the members that develop curricular activities to support student learning. I will be documenting and compiling the data they provide, their onsite observations and actions will improve the processes

and procedures being used. Students may have an opportunity to mentor others or manage the space during and after school hours. The hope is that they would receive curricular credit as an independent study for their participation.

The implementation of this action plan will begin May 2019. The scheduling calendar is in the process of being made. The coins have been designed and will be distributed per master list. The online activities data bank will be developed over the coming weeks. The materials list will be posted in the Makerspace. The Makerspace will be open Thursdays after school from 2:30pm to 4:00pm. A list of these developments and changes will be distributed to the participants of this study and presented to new members as they make use of the space.

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Appendix A

IRB Approval

January 10, 2019

Dear Peter Sumner,

This letter is to notify you that your IRB Application for ***Benefits of Maker Education for Secondary Institutions*** has been approved by the IRB committee at Adams State University. You may now proceed with completing your study as specified in your application.

Please remember that it is your responsibility to report any issues that may affect the safety/confidentiality of human subjects as well as any changes that substantially shift the focus of your study.

If you have any questions or concerns, please feel free to email me at curtislgarcia@adams.edu.

Best,

Curtis L. Garcia
Department Chair/Assistant Professor
Department of Teacher Education
Adams State University
curtislgarcia@adams.edu
719.587.8202

Appendix B

Administrative Approval

Date: September 9, 2018

Mrs. Singleton

Associate Head of School The Woodstock Academy

57 Academy Rd

Woodstock CT, 06234

RE: Permission to Conduct Research Study

Dear Mrs. Singleton

I am writing to request permission to conduct a research study at Woodstock Academy. I am currently enrolled in the Masters of Art in Curriculum and Education with STEM Certificate program at Adams State University, Alamosa, Co. and am in the process of writing a research proposal to be approved by IRB. The study is entitled: Benefits of Maker Education for Secondary Institutions.

I hope that the school administration will allow me to recruit 20 students: 10 boys and 10 girls from the school who are participating in activities in the Maker Space to anonymously complete 2 surveys. Parents and legal guardians of these students will be asked to anonymously complete their own survey. I also hope to interview and survey 4 Faculty members who are using of the Maker Space. Interested students, who volunteer to participate, will be given a consent form to be signed by their parent or guardian returned to the primary researcher at the beginning of the survey process. Parents who volunteer to participate will also be given consent forms to be signed and returned to the primary researcher. Faculty who volunteer to participate will be given consent forms to be signed and returned to the primary researcher. The study will take place during the second semester of the 2018-2019 school year.

If approval is granted, student participants will complete 2 surveys via Survey Monkey to be taken at their own leisure. The survey process should take no longer than two 15 minute sessions. Parent participants would complete the survey at home through the same electronic system. The survey results will be pooled for the study and individual results of this study will remain absolutely confidential and anonymous. Should this study be published, only the pooled results will be documented. No costs will be incurred by either The Woodstock Academy or the individual participants.

Your approval to conduct this study will be greatly appreciated. I will follow up with a telephone call next week and would be happy to answer any questions or concerns that you may have at that time. You may contact me at my email address: psumner@woodstockacademy.org

If you agree, kindly sign below and return the signed form in the enclosed self-addressed envelope. Alternatively, kindly submit a signed letter of permission on Woodstock Academy letterhead acknowledging your consent and permission for me to conduct this survey/study.

Sincerely,

Peter Sumner Technology and Engineering Woodstock Academy
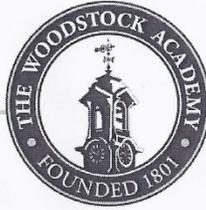
Approved by:

Holly G. Singleton	*(signature)*	10-9-18
Print your name and title here	Signature	Date

October 8, 2018

To Whom It May Concern:

Peter Sumner, Technology and Engineering teacher at The Woodstock Academy, has permission to complete a study (Benefits of Maker Education for Secondary Institutions) using students and data from The Woodstock Academy.

Sincerely,

Holly G. Singleton
Associate Head of School
The Woodstock Academy

W

Appendix C

Pre-Student Survey Questions

All surveys are anonymously pooled

Knowledge of a Makerspace
1. How many time have you been in a Makerspace?   *0-3, 4-10, 10-15,   over 15*
2. How often do you expect to use the Makerspace this semester? *0-5 times, 6-10 times, over 10 times*
3. Would you have interest in managing the Makerspace?   Yes   No
4. If the Makerspace were open after school hrs. Would you use it? Yes   No
5. Do you like to build things? Yes   No
6. How many elective courses have you taken? *0-3, 4-6, 7-10, more than 10*
7. Have you had opportunities to build any physical objects during class? Yes   No
8. If you built something physical, did you have the necessary tools? Yes No

About you
9. Do you consider yourself? *Male, Female, Other*
10. Do you like to work alone? *Never, sometimes, all of the time*
11. Do you like to work as part of a team? *Never, sometimes, all of the time*
12. Have you learned new technology on your own at home? *Yes No*
13. Do you like open-ended assignments? (no definite answer) *Yes No*
14. Do you like to have instructions for everything you do in school? *Yes No*
15. Would you like to create your own assignments? *Yes No*
16. Have you applied something you learned in one classroom to an assignment for another class? *Yes No*
17. Are there certain skills that you have that a team would benefit from? (academic, technical, physical) *Yes No*
18. Are you impressed with skills other students in your classes have? *Yes No*
19. Have you ever learned anything from another student? *Yes No*
20. If you need something do you feel you can make it? *Yes No*
21. If you need something do you feel you can design it? *Yes No*

Technical and Mechanical skills
22. On a scale of 1-4(4 being the highest) How familiar are you with tools?
    a.   *1-not very 2 somewhat 3 average 4 above average*
23. On a scale of 1-4 How familiar are you with Technology?
    a.   *1-not very 2 somewhat 3 average 4 above average*
24. Do you build or assemble things at home? (ie models, furniture,) *Yes No*
25. Have you ever repaired a toy? *Yes No*
26. Have you ever 3D printed? *Yes No*
27. Have you ever repaired anything electronic? *Yes No*
28. Have you ever made graphics? (Ie stickers, brochures, posters) *Yes No*
29. Have you ever used a hot glue gun? *Yes No*
30. Have you used design software? *Yes No*
31. Have you ever made a video? *Yes No*
32. On a scale of 1-4 How familiar are you with video editing?
    a.   *1-not very 2 somewhat 3 average 4 above average*
33. On a scale of 1-4 How familiar are you with audio editing?
    a.   *1-not very 2 somewhat 3 average 4 above average*
34. Have you ever used green screen technology? *Yes No*
35. On a scale of 1-4 Rate you interest in technology?
    a.   *1-not very 2 somewhat 3 average 4 above average*
36. On a scale of 1-4 Rate your interest in creating?
    a.   *1-not very 2 somewhat 3 average 4 above average*
37. Do you play board games? *Yes No*
38. Do you play Video games? *Yes No*
39. Have you ever made a game? *Yes No*
40. Do you enjoy Art? *Yes No*
41. Do you enjoy literature? *Yes No*
42. Do you enjoy Music? *Yes No*

Check all that apply

43. Where did you learn your technical skills? ie software, hand tools, machines
    Home, Woodstock Academy, Private lessons, Other
44. What is your favorite lab space (s) to work in?
    Culinary, Chemistry, Physics, Engineering, Art, Music Tech
45. What classes have you taken? Check all that apply
    Science, Art, Physical Education, Health, Technology, Engineering, Culinary, Family, Business, History, Math, English, Woodworking, Multimedia
46. Choose your hobbies/interests? Check all that apply
    art, music, reading, hiking, fishing, woodworking, team sports, individual sports, gaming, rc vehicles, model building, computer programming, travel, photography, baking, arts and crafts, robotics, mechanics, work

Fill in
47. What is a makerspace?
48. Are there any new technical skills that you would like to learn in class?
49. Are there any tools that you would like to learn how to use?
50. What do you think you will gain from having access to the Makerspace?
51. What class are you currently enrolled in that will be using the Makerspace?

Post-Student Survey Questions

All surveys are anonymously pooled

Knowledge of a Makerspace

1. How many time have you been in a Makerspace?   *0-3, 4-10, 10-15,   over 15*
2. Would you have interest in managing the Makerspace?   *Yes   No*
3. Have you used the Makerspace after normal school hrs.? (2;15) *Yes   No*
4. Do you like to build things? *Yes No*
5. Have you had opportunities to build any physical objects during class? *Yes   No*
6. If you built something physical, did you have the necessary tools? *Yes No*

About you

7. Do you consider yourself? *Male, Female, Other*
8. Do you like to work alone? *Never, sometimes, all of the time*
9. Do you like to work as part of a team. *Never, sometimes, all of the time*
10. Have you learned new technology on your own at home? *Yes No*
11. Do you like open-ended assignments? (no definite answer) *Yes No*
12. Do you like to have instructions for everything you do in school? *Yes No*
13. Have you create your own assignments? *Yes No*
14. Have you applied something you learned in one classroom to an assignment for another class? *Yes No*
15. Are there any skills that you have that a team would benefit from? (academic, technical, physical) *Yes No*
16. Are you impressed with skills other students in your classes have? *Yes No*
17. Have you ever learned anything from another student? *Yes No*
18. If you need something, do you feel you can make it? *Yes No*
19. If you need something, do you feel you can design it? *Yes No*

Technical and Mechanical skills

20. On a scale of 1-4(4 being the highest) How familiar are you with tools?
      1-not very 2 somewhat 3 average 4 above average
21. On a scale of 1-4 How familiar are you with Technology?
      1-not very 2 somewhat 3 average 4 above average
22. Do you build or assemble things at home? (ie models, furniture,) *Yes No*
23. Have you ever repaired a toy? *Yes No*
24. Have you ever 3D printed? *Yes No*
25. Have you ever repaired anything electronic? *Yes No*
26. Have you ever made graphics? (Ie stickers, brochures, posters) *Yes No*
27. Have you ever used a hot glue gun? *Yes No*
28. Have you used design software? *Yes No*
29. Have you ever made a video? *Yes No*
30. On a scale of 1-4 How familiar are you with video editing?
      1-not very 2 somewhat 3 average 4 above average
31. On a scale of 1-4 How familiar are you with audio editing?
      1-not very 2 somewhat 3 average 4 above average
32. Have you ever used green screen technology? *Yes No*
33. On a scale of 1-4 Rate you interest in technology?
      1-not very 2 somewhat 3 average 4 above average
34. On a scale of 1-4 Rate your interest in creating?
      1-not very 2 somewhat 3 average 4 above average
35. Have you ever made a game? *Yes No*

Check all that apply

36. Where did you learn your technical skills? ie software, hand tools, machines
      Home, Woodstock Academy, Private lessons, Other
37. What is your favorite lab space (s) to work in?
      Culinary, Chemistry, Physics, Engineering, Art, Music Tech, Makerspace

Fill in

38. What is a makerspace?
39. Are there any new technical skills that you would like to learn in class?
40. Are there any tools that you would like to learn how to use?
41. What do you think you will gain from having access to the Makerspace?
42. What class are you currently enrolled in that will be using the Makerspace?
43. Do you have a favorite tool or process that you used in the Makerspace? i.e. laser, 3d printing, vinyl transfer
44. Is there anything that should be changed in the Makerspace?

Appendix E

Nonstudent Survey Questions

Nonstudent Survey Questions

All surveys are anonymously pooled

Knowledge of a Makerspace

1. How many times have you been in a Makerspace? *0-3, 4-10, 10-15, over 15*
2. Would you have interest in managing the Makerspace? *Yes   No*
3. Have you used a Makerspace? (2;15) *Yes   No*
4. Do you like to build things? *Yes   No*
5. Did you ever to build any physical objects during a class while in high school? *Yes   No*
6. If you built something physical while in high school. Did you have the necessary tools? *Yes No*

About you

7. Do you consider yourself? *Male, Female, Other*
8. Do you like to work alone? *Never, sometimes, all of the time*
9. Do you like to work as part of a team. *Never, sometimes, all of the time*
10. Have you learned new technology on your own? *Yes No*
11. Do you like open-ended work? (no definite answer) *Yes No*
12. Do you like to have instructions for everything you do? *Yes No*
13. Have you create your own designs or solutions to a problem? *Yes No*
14. Have you applied something you learned in high school to your job? *Yes No*
15. Are there certain skills that you have that a team would benefit from? (work, technical, physical, social) *Yes No*
16. Are you impressed with skills others have? *Yes No*
17. Have you ever learned any marketable skills from a coworker or fiend? *Yes No*
18. If you need something do you feel you can make it? *Yes No*
19. If you need something repaired can you figure it out? *Yes No*
20. If you need something do you feel you can design it? *Yes No*

Technical and Mechanical skills

21. On a scale of 1-4(4 being the highest) How familiar are you with tools?
    a. *1-not very 2 somewhat 3 average 4 above average*
22. On a scale of 1-4 How familiar are you with Technology?
    b. *1-not very 2 somewhat 3 average 4 above average*
23. Do you build or assemble things at home? (ie models, furniture,) *Yes No*
24. Have you ever repaired a toy? *Yes No*
25. Have you ever 3D printed? *Yes No*
26. Have you ever repaired anything electronic? *Yes No*
27. Have you ever made graphics? (Ie stickers, brochures, posters) *Yes No*
28. Have you ever used a hot glue gun? *Yes No*
29. Have you used design software? *Yes No*
30. Have you ever made a video? *Yes No*
31. On a scale of 1-4 How familiar are you with video editing?
    1-not very 2 somewhat 3 average 4 above average
32. On a scale of 1-4 How familiar are you with audio editing?
    1-not very 2 somewhat 3 average 4 above average
33. Have you ever used green screen technology? *Yes No*
34. On a scale of 1-4 Rate you interest in technology?
    1-not very 2 somewhat 3 average 4 above average
35. On a scale of 1-4 Rate your interest in creating?
    1-not very 2 somewhat 3 average 4 above average
36. Have you ever made a game? *Yes No*
37. Where did you learn your technical skills? ie software, hand tools, machines
38. *Home, Woodstock Academy, Private lessons*

Check all that apply

39. Where is your favorite place to work (s) to work in?
    a. *Shop, office, lab, Makerspace, kitchen, retail floor, other, home*

Fill in

40. What is a makerspace?
41. Are there any new technical skills that you would like to learn?
42. Are there any tools that you would like to learn how to use?
43. What do you think students will gain from having access to a Makerspace?

Appendix F

Interview Questions

Interview Questions

All interview questions will be identified anonymously in the final report, participant information will be destroyed.

Teacher

1. Can you tell me what you know about Maker Education and Makerspaces?
2. When you have access to the Makerspace how do you plan to use it?
3. Do you feel you are properly trained to use the Makerspace?
4. Are there any tools, technical systems or software that you wish you or your students knew how to use?
5. Are there any tools, technical systems or software that you wish you had access to?
6. Is there any training that you have received for using the equipment in the makerspace?
7. Are you familiar with any processes and procedures for the Makerspace?
8. Do you have any safety concerns for your students using the Makerspace?
9. If a person is assigned to manage the Makerspace are you comfortable asking him/her for help?
10. Do you have any concerns with students using the Makerspace?
11. Do you have any suggestions for teachers and students using the Makerspace?

Non-Teacher

1. Can you tell me what you know about Maker Education and Makerspaces?
2. Are there any labs where you work that would be considered a Makerspace?
3. Who maintains the equipment and orders materials?
4. How do you identify how can and cannot use certain equipment?
5. What are the processes and procedures you use to keep your labs safe and efficient?
6. What are the most important skills or attributes you look for in an employee or co-worker?
7. Do you have any concerns with students using the Makerspace?
8. Do you have any suggestions for teachers and students using the Makerspace?

Appendix G

Consent and Assent Forms

RESEARCH PARTICIPANT CONSENT FORM

Title: Benefits of Maker Education for Secondary Institutions.

Peter Sumner - Adams State University Department of Education

Purpose of Research

The purpose of the research is to explore the benefits of Maker education for students at the secondary level.

Procedures

Students, Parents and Faculty members will be electronically surveyed and /or interviewed about their knowledge and experiences working in the Maker Space at The Woodstock Academy.

Duration of Participation

The study will take place 2nd semester of the 2018-2019 school year at The Woodstock Academy. Students will complete 2 - 15 minute surveys, Parents will complete 1 - 15 minute survey, faculty members other community members will be interviewed and complete 1-15 minute survey.

Risks to the Individual

There are no risks for participants.

Confidentiality/Use of Records

All data will be anonymously pooled for the final report. At the completion of the study, all names will be removed from any and all data.

Contact Information

Primary Investigator

      Name: Peter Sumner

      Email: psumner@woodstockacademy.org

      Phone: 860-928-6575 ext. 4207

Voluntary Nature of Participation

"I understand that I can withdraw my participation at any time and will not suffer a penalty for doing so."

"I HAVE HAD THE OPPORTUNITY TO READ THIS CONSENT FORM, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND AM PREPARED TO PARTICIPATE IN THIS PROJECT."

Minors need to complete page 2 assent form

_____   _____

Participant's Signature   Date

_____

Participant's Name

_____

Researcher's Signature

RESEARCH PARTICIPANT CHILD/MINOR ASSENT FORM

Title: Benefits of Maker Education for Secondary Institutions

Peter Sumner Adams State University Department of Education

I _____, understand that my parent/guardian have given permission for me to take part in a study concerning_____ under the direction of_____.

Voluntary Nature of Participation

My participation in this project is voluntary and I have been told that I may stop my participation in this study at any time. If I choose not to participate, it will not affect my grade or status at Woodstock Academy in any way.

"I HAVE HAD THE OPPORTUNITY TO READ THIS CONSENT FORM, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND AM PREPARED TO PARTICIPATE IN THIS PROJECT."

_____   _____

Participant's Signature   Date

Research Data Codes and Collection Schedule

Date	Makerspace Activity	Group	Data type
1/15/19-4/5/19	Discussion Throughout Study	1 Teacher 14 Students **JF/S**	(interview)
2/10/19	Discussion	Offsite teacher Group **G**	(interview)
2/12/19	Discussion Space/Setup	Local business Group **G**	(interview)
2/15/19	PD session	5 teachers-**Group AF**	(interview/Survey)
3/01/19	Demo/Student Activity	3 teachers 17 SPED-**Group BF/S**	(observation)
3/08/19	PD Session	2 teachers - **Group C**F	(interview)
3/08/19	CS 1 and 2 Pre Survey	28 Students -**Group DS**	(survey)
3/14/19	Maker orientation Pre Activity	2 teachers - **Group EF**	(interview/survey)
3/18-19/19	Maker Activity	2 teachers 15 students- **Group EF**	(interview/survey)
3/18-19/19	CS 1 and 2 Maker orientation	28 students orientation -**Group DS**	(observation)
3/19/2019	Discussion Maker post	2 teachers - **Group EF**	(interview)
3/25-26/2019	CS 1 and 2 Maker Activity	28 students- **Group D**S	(observation)
3/28/2019	CS 1 and 2 Post Survey	28 students- **Group DS**	(survey)
4/02-05/19	Maker Activity	2 teachers 24 students -**Group FF/S**	(interview)

Appendix I

Makerspace Diagram

TECHNICAL SPACE

VIDEO/AUDIO

MATERIALS PROCESSING

3d AND LARGE FROMAT PRINTING

Co2 LASER

PIANT ROOM