# A Space for Making

## Obstacles that Inhibit People from Attending a Community College Makerspace

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CEP 822: Approaches to Educational Research

December 6, 2018

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At the start of each fall and winter semester, a welcome week event is held for all students attending Macomb Community College. The purpose of this event is to welcome new and current students to the campus and help them become acclimated to all the services and activities available to them as a Macomb Community College student. Various clubs, departments, and student organizations have the opportunity to join the welcome week festivities by setting up a table on campus that highlights and demonstrates what their specific area has to offer. Being awarded an innovation grant from the college at the beginning of 2018 to create a makerspace, this was the ideal opportunity for us to get out in front of students and talk to them, interact with them, display some of the different technologies and gadgets available to students that attend the makerspace, and build excitement about our space where students can come together to collaborate, innovate, learn, explore, and create something amazing!

During welcome week at the start of the fall semester, we gathered 30-34 email addresses of interested individuals from all areas of study and disciplines at the college. Two weeks following welcome week, we sent out an email to the individuals on our email list announcing the date, time, and location of our first meeting. We held a kickoff meeting to introduce the makerspace to the college with approximately 25 people in attendance. The initial meeting was held during the day and we fully understood that not everyone would be able to attend because of previous engagements, class schedules, and work schedules, but we had a good response and attendance nonetheless. During the first week that we were open, we had two members attend. During the second week, we had five members attend. On average, we have approximately three to four members in attendance each week. We are now approximately two and a half months into

its inception and our membership is very low. This action research project aimed to answer the research question: what obstacles and factors are inhibiting people from attending the makerspace?

Examining and identifying the factors and obstacles that are inhibiting people from attending the makerspace provides crucial information in assisting us to better break down those obstacles or at least minimize them, so that interested people may be more willing to visit the makerspace and potentially become a member of our makerspace community. Situated within the research of identifying what obstacles and factors are inhibiting people from attending the makerspace, the overarching goal of the makerspace at Macomb Community College is to increase its membership. Growing our makerspace community invites the diversification of ideas and people, as well as the density of ideas, which are an integral part to innovation and the foundational principles that should be present within a makerspace community and environment.

A diversified community that incorporates varied expertise levels, talents, culture, demographics, and skill sets lends itself to a more dynamic and diverse learning environment that provides a sense of community among its members. Identifying and breaking down barriers, eliminating obstacles, and identifying existing factors that make our makerspace "great" and a welcoming community, all play important roles in diversifying and increasing our membership and growing our community. This project will examine the factors and obstacles that are inhibiting people from attending a college makerspace. Supporting literature research regarding makerspaces in higher education and educational settings, the affordances of a makerspace as a learning environment, and the creation and implementation of a makerspace will be presented.

Qualitative and quantitative data was collected for analysis from student survey(s), observational studies, and informal email communications and conversations and was analyzed

using descriptive statistics. Identified commonalities from the collected qualitative data was assembled into an Excel spreadsheet where the mode was determined based on a set of defined variables to assist in categorizing, sorting, and analyzing responses. Based on the collected data (qualitative and quantitative), several inhibiting factors were identified as well as factors that may draw students to the makerspace and suggestions for increasing membership within our makerspace community were provided.

Based on the collected data, there is a wealth of useful information and suggestions available that will allow us to move forward and better assist us in educating people more effectively about makerspaces, the types of projects that people can work on, our available equipment and resources, getting our message out about collaborating with others, and creativity and expression – all of which is encompasses the overarching goal of increasing membership within the makerspace at Macomb Community College by minimizing the factors that may be inhibiting people from attending the makerspace.

## Literature Review

What is a makerspace and what makes it tick? If you build it, will they come? "A makerspace is a physical space where individuals can build and create. University-based makerspaces often focus on encouraging creativity, interdisciplinary collaboration, entrepreneurship, and/or experiential education" Farritor (2017). The makerspace at Macomb Community College emphasizes those very qualities that Farritor writes of, specifically when it comes to identifying characteristics that are key to a creative and innovative culture. Farritor identifies the following five key characteristics:

- The presence intrinsic motivation.
- The presence of unstructured activities.

- The design of the makerspace in such a way that to support innovation through a diverse membership.
- Presence of diverse ideas.
- Established mechanisms in place to bring new ideas together help them grow, and see them come to fruition.

A makerspace can be seen as a community and when students are part of a community it can assist in expanding their learning experience outside the classroom. Makerspaces are different than a classroom lab and/or course in that the students that participate in the makerspace are self-directed, are participating because they want to (intrinsic motivation), and the whole "grading" aspect is nonexistent. Students are not there to earn a grade or fulfill a degree requirement; they are participating because it's an environment that encourages creativity, collaboration, experiential learning, and entrepreneurship. Unstructured activities and allowing ample time to complete an activity is an important component within a makerspace. These types of activities and unlimited time to complete them, allow students to problem solve in their own way rather than being presented with step-by-step solutions and engage in "unscripted thinking" which Farritor describes as central to innovative thought (Farritor, 2017, p. 391). Within the makerspace at Macomb Community College, one of the primary goals is to increase our membership and by so, we are also diversifying our makerspace community. Diversification of ideas and people, as well as the density of ideas are crucial to innovation and are part of the foundational principles that should be present within a makerspace community and environment. Diversification of ideas and people and the density of ideas in this context, relates to various levels of expertise within a given field and/or various fields, skill sets in different areas, different educational backgrounds in terms of classes and courses of study, and varied personal and

professional backgrounds. In addition, having ways for members to connect with each other and discuss and grow their ideas are extremely important as well. We are promoting the CIE (center for innovation and entrepreneurship) department at college to help students connect and discuss potential innovative business ideas. Four of out of the five key characteristics that Farritor writes about, are present within the makerspace at Macomb Community College, however we are not seeing the "diverse membership" in our maker community.

In higher education academic makerspaces, students can engage in sharing practices that aid in exploration of technical and design skills (Wilczynski, Wigner, Lande, & Jordan, 2017, p. 38). There is a distinction of makerspaces found in a higher education setting that pertains to its specific culture and the community of the participants but its underlying focus is the same across the board – sharing, collaborating, diversity of users, and innovation. One of the foundational principles regarding makerspaces is that participants in the space are "exposed to mind-sets that foster the more nebulous qualities, such as those of a lifelong learner and effective communicator." (Wilczynski et al., 2017, p. 36)

One of the common themes existing in an educational makerspace is that of individuality, this emerges from the different and various solutions that students create when working on a particular project or problem (Kurti, Kurti, & Fleming, 2014). Innovation also emerges when students are being challenged to come up with creative solutions to a problem. The makerspace environment incorporates the use of modern tools and technology (e.g., 3D printers, 3D software, mobile applications, etc.) into its space but the environment itself is at the very top of the list when it comes to requirements. In order for a makerspace to survive and flourish, the environment needs to be supportive and inspirational. The feel of a makerspace environment includes:

- The feelings that students perceive within the makerspace (they must be attracted to the space and want to use it).
- A makerspace must have makers otherwise it's just a space with unused tools and resources.

An inspirational makerspace environment invites curiosity (i.e., pique the member's interest), inspires wonder, encourages playfulness, and celebrates unique solutions by praising and noticing members within the maker community for what they are doing and have accomplished (Kurti et al., 2014). In addition, we have to ensure that the tools and resources available within the makerspace are of interest to those seeking to join our maker community. As pointed out in the article, "The environment and tools of great educational makerspaces", beginner tools inspire curiosity without the need for a lot of instruction and direction, and intermediate tools keep students engaged, spark collaboration among members, and teach more complex skills. (Kurti, Kurti, & Fleming, 2014).

The definition, foundational principles, and suggested requirements for a makerspace have been identified and supported based on the provided literature above with an overarching message of collaborative learning, intrinsic value and need, inspiration, sharing, diversity, creativity, and innovation across multiple disciplines. "The big part of any makerspace is that students are there because they want to be there. They need to have an intrinsic need to go to the space. Students love the ability to make whatever they want in the space. It is a level of personalization that is important in getting students into the makerspace," advises Nicholas Provenzano, Middle School Technology Integrator & Makerspace Director at University Liggett School (personal communication, October 29, 2018). These are all wonderful qualities to have existing within a space for learning, but it circles back to the need and requirement of

participants within the maker community in order for a makerspace to flourish and remain sustainable. In the research to follow, several factors and obstacles that are inhibiting from people from attending the makerspace have been identified and if we work to break down those barriers, we may see an increase within in our maker community that affords a "density of ideas" (Farritor, 2017), intrinsic value, collaborative learning, inspiration, sharing, diversity, creativity, and innovation across multiple disciplines within the makerspace at Macomb Community College.

## Methodology

I collected both qualitative and quantitative data during my research to assist in answering the research question: what obstacles and factors are inhibiting people from attending the makerspace?

I decided to conduct two student surveys (Appendices A and B) to serve as the foundation for my research. Two survey links were dispersed via email and course announcements within Canvas (the college's Learning Management System) to two sets of students at the college and remained open for a two-week period. The first group of recipients included 30-34 email addresses from interested students gathered during welcome week at the start of the fall semester. The second set of recipients was comprised of students that are currently enrolled in one or more IT-related (information technology) courses at the college. Please note that included within the second group of recipients, were students from our ITCS-1010 introductory Computers and Information Principles course, which is a required course for both IT and non-IT majors at the college within select programs. Including students from the ITCS-1010 course provided an opportunity to collect data from students across varied disciplines.

The quantitative data collected for analysis was used to gather information directly from the students (the target audience). The aggregate of the survey data was analyzed for commonalities and assisted in identifying the obstacles and factors that are inhibiting people from attending the makerspace at Macomb Community College. The two surveys that I created for distribution to the student community, were created using SurveyMonkey as the survey platform. Survey responses were collected for a two-week period. At the end of a two-week period, the results were reviewed and analyzed directly within SurveyMonkey and then exported and assembled into a Microsoft Excel spreadsheet for further analysis.

I also decided to conduct multiple observational studies directly within the makerspace lab (Appendix C) and engage in informal email communications and conversations (Appendices D and E) with the college marketing department, CIE director, colleagues, subject matter expert, existing makerspace members, and lab aides respectively. The qualitative data collected focused on a smaller portion of the target audience, which was related to current makerspace members and then expanded to outside the maker community in order to gain insight, guidance, and feedback from additional areas that could potentially affect membership both directly and indirectly within the makerspace and might further assist in identifying any additional inhibiting factors regarding attendance and participation.

Descriptive statistics were used as the method for analyzing the collected data from my research using Microsoft Excel as the primary tool in conjunction with SurveyMonkey. The qualitative data extracted from the surveys, email responses, informal conversations, and the observational studies were added to an Excel spreadsheet (each within its own separate sheet, then combined to assemble the aggregate data) where commonalities were identified and general categories were assigned to the list of responses. The mode and frequency of the responses were

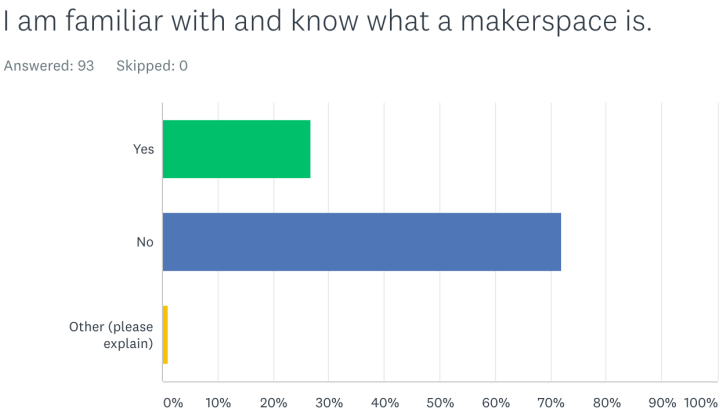
determined, sorted, and then analyzed to help determine the most common obstacles and factors that might be inhibiting people from attending and participating in the makerspace which in turn may affect the lack of membership within our makerspace community. I want to note that even though the surveys were primarily quantitative in nature, I included an "other" option within each question that provided the respondents an opportunity to explain and/or specify other information, which was more qualitative in nature. My observational studies included data from existing members and provided additional feedback regarding what might be inhibiting people from attending.

## Findings

The survey that was dispersed to students that are currently enrolled in one or more IT-related (Information Technology) courses at the college yielded 93 responses. The survey that was dispersed to interested students whose email addresses were gathered during welcome week at the start of the fall semester yielded 4 responses. Aggregate survey data totaled 97 responses respectively.

Within the survey that yielded 93 responses (Appendix A), students were asked about their familiarity with a makerspace and if they were aware that a makerspace existed at the college. This was relevant because not understanding what a makerspace is and not being aware that this is something they could participate in at the college, might have a direct impact on its membership and factor into why people may not be participating in the makerspace and which might be seen as an obstacle. As shown in Figure 1, the survey results indicated that 72.04% of respondents were not familiar with a makerspace and subsequently, 76.34% said that they were not aware that a makerspace existed at the college (Figure 2) however, 44.09% indicated that the makerspace was something they would be interested in as shown in Figure 3.

FIGURE 1 | Familiarity with a Makerspace



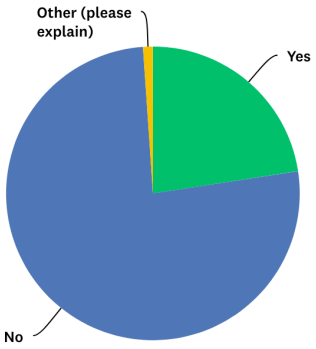

| ANSWER CHOICES | | RESPONSES | |
|---|---|---|---|
| Yes | | 26.88% | 25 |
| No | | 72.04% | 67 |
| Other (please explain) | Responses | 1.08% | 1 |
| TOTAL | | | 93 |

**Note that 67 people (72.04%) surveyed indicated that they were not familiar with and did not know what a makerspace was.**

FIGURE 2 Awareness of a Makerspace at Macomb Community College

I am aware that Macomb Community College has a makerspace available for students.

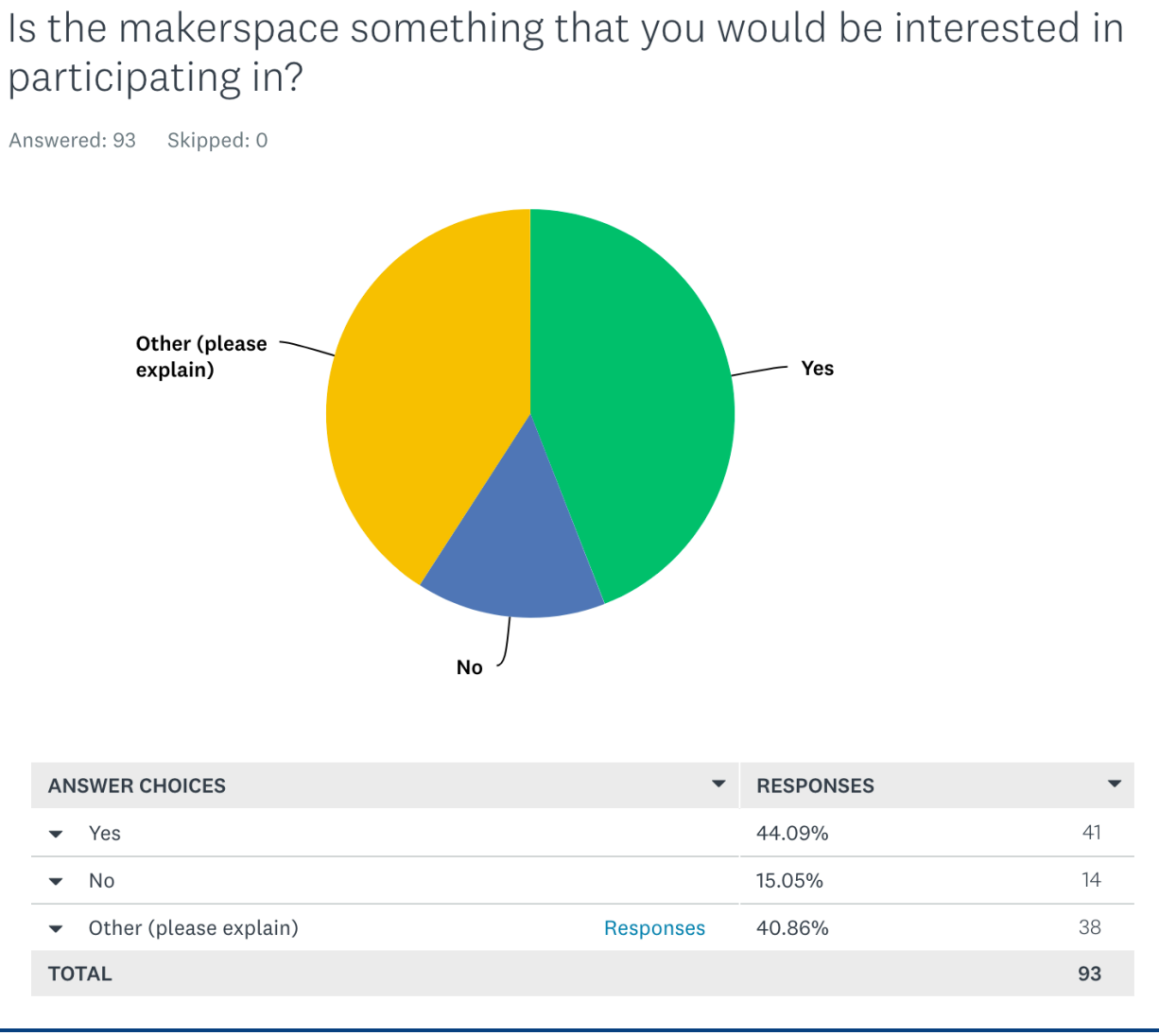
Answered: 93 Skipped: 0




| ANSWER CHOICES | | RESPONSES | |
|---|---|---|---|
| Yes | | 22.58% | 21 |
| No | | 76.34% | 71 |
| Other (please explain) | Responses | 1.08% | 1 |
| TOTAL | | | 93 |

**Note that 71 people (76.34%) indicated that they were not aware that Macomb Community College has a makerspace available for students.**

FIGURE 3 Makerspace Participation and Interest




| ANSWER CHOICES | | RESPONSES | |
|---|---|---|---|
| Yes | | 44.09% | 41 |
| No | | 15.05% | 14 |
| Other (please explain) | Responses | 40.86% | 38 |
| TOTAL | | | 93 |

**Note that 41 people (44.09%) indicated that the makerspace is something they would be interested in participating in.**

In an attempt to further gain an understanding of the obstacles that might be inhibiting people from attending the makerspace, students were asked to identify the days of the week and hours during the day that were most convenient for them if they were to attend the makerspace. Aggregate responses from both surveys indicated that the most convenient time of day to attend was during the afternoon and evening hours with weekend days slightly more convenient than

weekdays as shown below in Table 1. Please note that respondents were asked to select all the times and days that were convenient for them to attend.

TABLE 1 Most Convenient Time/Days to Attend

| **Answer Choices** | **Responses** |
|---|---|
| Weekends | 41 |
| Weekdays | 36 |
| Evenings | 39 |
| Afternoons | 36 |
| Mornings | 19 |

Students were also asked what factors would keep them attending and participating in the makerspace. Based on the aggregate survey responses, Table 2 shows the top factors that are presently inhibiting from people from attending and participating in the makerspace at the college.

TABLE 2 Top Factors Inhibiting Makerspace Attendance and Participation

| **Answer Choices** | **Frequency** |
|---|---|
| Work conflicts | 20 |
| Unfamiliar with makerspaces | 18 |
| Class schedule conflicts | 16 |
| Busy schedule | 11 |
| Lab hours | 9 |

When asked to describe what factor(s) might be inhibiting their attendance and participation in the makerspace at the college, respondents stated the following:

*"Work hours conflicting with the makerspace hours and other obligations that may come up. If I wanted to take full advantage of this great space, I would need less going on so I could commit more time towards the makerspace and come up with new ideas of what to make."*

*"I don't know what it is."*

*"My availability because of my job and my family."*

*"My unique work schedule, schoolwork, and other responsibilities leave me with little time to "create" at this time."*

*"The time it's offered and whether it matches my school days in college."*

*"Unsure of what the makerspace is, but if it's beneficial to me I might attend."*

*"I have a full time job and class after work. Homework on the weekend."*

After the most frequent inhibiting factors preventing attendance were identified, I wanted to determine what qualities were valued the most within a makerspace and what might draw people to the makerspace since interest is present (Figure 3). This was important because if we are able to at least lessen the inhibiting factors so that people may attend and participate in the makerspace, I want to ensure that we providing participants with a positive experience in line with their needs and expectations. Based on the respondents within the welcome week survey and the conducted observational studies (people who are familiar with a makerspace and/or are currently participating), what people might value the most within the makerspace is shown below in Table 3 (the top responses are listed). Please note that respondents were asked to select all that apply and share all the reasons if multiple reasons were applicable.

| TABLE 3 What is Most Valued in the Makerspace |
|---|
| **Answer Choices** |
| Hands-On Activities and Projects (self-interest and/or pre-determined) |
| Experimenting with different technologies (3D printing, networking, AI, IoT, etc.) |
| Direction and assistance from lab aides and/or faculty |
| Creativity and Expression |
| Collaboration with other students |
| Project Kits (Google, Raspberry Pi, etc.) |
| Experimenting with digital options (iPads, Android tablets, etc.) |

Note that people, who are familiar with a makerspace and aware of its affordances, indicated that they are drawn to the makerspace because of the opportunity to engage in hands-on activities which include projects for self-interest and/or pre-determined projects, experimenting with different technologies (anything 3D and IT-related were among the top choices), direction and assistance from lab aides and/or attending faculty, and the opportunity for creativity and expression. Collaboration, working with project kits such as Google AIY Voice and Vision Kits and the Rasbperry Pi as well as experimenting with digital options like iPads and Android tablets, also provided additional value to the makerspace.

*"Macomb's makerspace is a fun and creative place where anyone can come and learn about technology. There are lots of fun projects even if you know nothing about programming. They have something for everyone."*

*"Lots of cool gadgets to experiment with. Great place to practice coding on actual objects like a robot. Even if you're new to coding, the video tutorials will guide you through the process!"*

The quantitative data within this research has indicated that conflicts with work schedules, the unfamiliarity with and understanding the affordances of a makerspace, class scheduling conflicts, busy schedules, and available open lab hours/days were inhibiting factors that might be contributing to the lack of attendance and participation within the makerspace at Macomb Community College. Quantitative data also indicated a strong interest to participate in the makerspace once people become familiarized and educated about the makerspace. For those people that are already familiar, both quantitative and qualitative data revealed intrinsic motivation and that they find value in hands-on activities and projects, experimenting with different technologies, the available direction and assistance from lab aides and faculty, the opportunity to be creative and express themselves, collaborating with others within the space, working with project kits from Google and the Raspberry Pi, and experimenting with iPads and Android tablets.

Qualitative data based on informal conversations and email responses (current members, colleagues, lab aide(s), marketing, the CIE director, subject matter expert, and IT advisory board attendees respectively) provided extremely useful suggestions for drawing people to and increasing membership within the makerspace. Thus far it has been determined that there is an interest in participating in and attending the makerspace (Figure 3) at Macomb Community College, but based on the conducted research, there are also several factors that are inhibiting participation (Table 2). However, since there is interest, it's important to continue to maintain the intrinsic motivation that has brought people to the makerspace in the first place, build upon and provide value to its members, and continue to work on increasing membership, which is an overarching goal at the college in order to receive additional funding to sustain the makerspace. Additionally, increasing membership also affords the density of ideas related to various levels of

expertise within a given field and/or various fields, skill sets in different areas, different educational backgrounds in terms of classes and courses of study, and varied personal and professional backgrounds. The top five aggregate suggestions based on informal conversations, observational studies, and email responses for increasing membership within the makerspace, are shown below in Table 4.

TABLE 4 Suggestions for Increasing Membership within the Makerspace

| **Suggestions** |
| --- |
| High School exposure and involvement |
| Social media exposure |
| Contests |
| Promotional flyers |
| Signage (co-marketing with other departments and areas of the college) |

Nicholas Provenzano (personal communication, October 29, 2018), Middle School Technology Integrator & Makerspace Director at University Liggett School and subject matter expert, when asked, "What methods have you used to target and market your makerspace to students?" replied with the following:

*"One thing I have done is to go and find those students that have an interest in making and reach out to them. I have created a few contests to get students in the space and check it out. Those have worked well in getting students to come back and use the space."*

Other suggestions included:

*"Co-marketing with CIE on the topic of Innovation is a really good idea. Also, working with faculty to recommend students go check it out, and signage."*

*"Inform high school educators. Consider a high school event. Work with the MISD to bring students on campus."*

*"Our team can assist with social media and flyers to promote the makerspace or makerspace events."*

*"Host an on campus event for current students to generate interest and excitement (e.g. a makerspace open house or some sort of competition).*

The conducted research has identified the obstacles that are inhibiting people from attending and participating in the makerspace along with suggestions as to how to increase membership within the makerspace community going forward.

## Discussion

Recall the following question for this research: what are the obstacles and factors that are inhibiting people from attending the makerspace? Aggregate survey responses suggested that the most common factors that are currently inhibiting people from attending the makerspace are related to conflicts with their work schedule(s), not understanding what the makerspace is and the types of projects that can be created and built within the lab (unfamiliarity), conflicts with their class schedules, and their busy schedules that include school, work, studying, and life obligations and how that coincides with the times and days the makerspace lab is open, staffed, and available for use. Realistically, we only have some control over two out of the five factors that are inhibiting people from attending and participating in the makerspace and those factors are designated lab hours and the unfamiliarity with makerspaces. The other three inhibiting factors: work conflicts, class scheduling conflicts, and the obligations of everyday life, are not within our control and are more so related to intrinsic motivation. Nicholas Provenzano (personal communication, October 29, 2018) points out that the "The big part of any makerspace is that

students are there because they want to be there. They need to have an intrinsic need to go to the space."

Let's examine the unfamiliarity factor that is somewhat controllable. In terms of the high percentage of survey respondents that indicated their unfamiliarity with makerspaces, the purpose that a makerspace serves, and what can be accomplished within the space, suggests that we might need to be more effective at educating people about makerspaces and it might be very beneficial to provide examples of completed projects and/or project direction that demonstrates the types of equipment we have available and what can be accomplished with it when people attend the makerspace. Qualitative data indicated that people familiar with a makerspace valued experimenting with different technologies and showed the most interest in IT-related (Information Technology) and 3D-related technologies. These types of technologies correlate nicely with the equipment we have available for people within the makerspace lab which suggests that we may consider including a list along with a few images of our equipment (mainly our 3D and IT-related equipment) within in our promotional flyers, marketing materials, and website so that we may grab the attention and pique the interest of our audience. Survey respondents also indicated that other top factors that might draw them to the makerspace were the types of projects they can work on (hands-on activities) as well as being provided with project ideas and direction, collaboration with other members of the makerspace, available assistance (faculty, lab aide(s), etc.), and the opportunity for creativity and expression. It may be beneficial for us to use these factors as talking points when educating people about the makerspace and include these values within our marketing and promotional materials as well.

The other inhibiting factor that is controllable to a certain degree are the days and times the makerspace is open. Initially we were only open a total of six hours per week. We have since

hired two part-time lab aides, which has expanded our open lab hours to a total of 24 hours per week, which includes both morning, afternoon, and evening hours during the weekdays. It may be beneficial to include a weekend day in the mix since the survey data indicated that weekends were one of the most convenient times to attend the makerspace (Table 1), but this would require permission from the college and we would have to ensure proper staffing during the lab hours which would depend on the availability of the part-time lab aide(s) who cannot exceed more than 12 working hours per week. However, the makerspace lab is fully staffed during the other most convenient days and times during the week as indicated within the survey results (Table 1).

Modifications related to educating the college community (students, departments and areas of the college, and administrators) about makerspaces and all the benefits that they afford should be our "new" starting point. I believe we didn't do enough to provide an understanding of what a makerspace is from the start (we assumed people knew what one was), and we didn't educate people about the types of things that can be accomplished within the space, and promote its affordances e.g., experimenting and playing with technology and our IT-related "toys", building projects that are of personal interest and/or exploration, collaborating with others, and the opportunity for creativity and expression. These messages and topics should be present within our marketing materials, social media posts, and any other types of promotional events that we are involved in going forward (e.g., welcome week at the college, Discover Macomb, high school events, co-venture with the CIE area, etc.). This will involve the support from marketing, administrators, as well as the lab aides, and us as spacemakers and facilitators within the makerspace. In addition to educating people about the makerspace, we need to prepare a list of "suggested" projects for people to work on or use as a starting point. In addition, we need to create, build, and document some example projects that either we have built or current members

have built (or are currently working on) and post that information on our website as well as include pictures and information within promotional flyers and social media posts. We need to make it a point to interact with the marketing department more frequently and a set a goal of having them post to social media at least once a week or more if possible and when applicable. This will also assist with educating people about the makerspace and highlight the types of projects that can be made within the space. We need to get people excited and increase the "intrinsic motivation and need" factor that both Farritor and Provenzano speak of. Regarding inhibiting factors such as work, class, and "busy life" schedule conflicts, those are hard to control on our end but we can continue to try and maintain our weekday open lab hours in the afternoons and evenings since these were some of the most convenient times for students to attend the makerspace lab based on the survey results. I want to note that our open lab hour times and days also depend on the availability of our lab aide(s), which may change from semester to semester. That is yet to be determined.

Based on the collected data from multiple surveys, informal conversations, email responses, and observational studies, there is a wealth of useful information and suggestions available that will allow us to move forward and better assist us in educating people more effectively about makerspaces, the types of projects that people can work on, our available equipment and resources, getting our message out about collaborating with others, and creativity and expression – all of which is encompasses the overarching goal of increasing membership within the makerspace at Macomb Community College while minimizing the controllable factors that may be inhibiting people from attending the makerspace.

This research had its limitations such as the weak participation with the survey emailed out to the 30-34 interested students from welcome week at the start of the fall semester and that I

only received one response back from the three subject matter experts that I emailed. The duration that the surveys remained open provided limited time to collect data, but given that we had a deadline to meet, this made sense. I also realized that some of the survey questions that were included in the surveys could have been asked differently and some questions should have been eliminated while others should have been included. This was mainly due to the modification of my research question late within the project. The affordances of this research were more than I had anticipated and the wealth of useful information and data that I received during this research project from students, makerspace members, lab aide(s), colleagues, different areas of the college, and Nicholas Provenzano (subject matter expert) regarding makerspaces, suggestions and ideas for increasing membership within the makerspace, and the affordances of a makerspace, were amazing!

Looking ahead, I would like to conduct another survey among the Macomb Community College students at the end of the winter semester, after we have instituted the actionable suggestions identified above (e.g., educating people, marketing, providing project ideas and examples, etc.) for another five to six months. I want to revisit whether our efforts have made a difference in an increased understanding and knowledge of what a makerspace is and what can be accomplished within a makerspace. I am also interested to see if there is an increase in membership and participation by the end of the winter semester (May 2019) as a result of our efforts. This would be a useful indicator in helping to determine if the actionable suggestions are steering us in the right direction or if they need to be revisited and/or modified accordingly.

## Conclusion

This action research project aimed to answer the question: what obstacles and factors are inhibiting people from attending the makerspace at Macomb Community College. I concluded

that the quantitative data showed the following inhibiting factors that currently exist within the student base at college are: work conflicts, lack of familiarity with makerspaces, class scheduling conflicts, busy schedules including obligations of everyday life, and available lab hours. I also concluded that the only two factors that are controllable and that we might be able to provide solutions for are the lack of familiarity with makerspaces and open lab days and hours, the other three remaining factors are beyond our control and require intrinsic motivation on behalf of the student. The quantative data also concluded that there is a strong interest in attending and participating in the makerspace (see Figure 3).

I concluded that the qualitative data from this study showed that the most valued qualities within the makerspace were the presence of hands-on activities and projects either based on self-interest or pre-determined based on provided recommendations, the opportunity to experiment with different technologies that may not otherwise be available outside the makerspace, direction and assistance from lab aide(s) and/or faculty within the makerspace, the opportunity for creativity and expression, the opportunity to work with packaged project kits (e.g., Google, the Rasperrry Pi, etc.), and opportunities to work with digital options such as iPads and Android tablets. The people that are attending and participating are enjoying the experience as evidenced by the comments from current makerspace members and people familiar with the makerspace: "It's cool to just go and work on whatever you want to and help each other with what you are working on," "I would be interested to see how 3D printers work. I'm also interested in tinkering with the hardware side of computers, considering I have only ever worked with the software myself," "Lots of cool gadgets to experiment with. Great place to practice coding on actual objects like a robot," and "Macomb's makerspace is a fun and creative place where anyone can

come and learn about technology. There are lots of fun projects even if you know nothing about programming. They have something for everyone."

I concluded that there are a variety of insightful suggestions and ideas for increasing membership within our makerspace community as provided within the collected qualitative data that we need to take advantage of and implement where applicable such as High School exposure and involvement, more exposure on social media, contests, promotional flyers, signage for the makerspace, and co-marketing with other departments at the college.

I concluded based on the literature research within this project that increasing membership and growing the makerspace community at the college is vital in that it invites the diversification of ideas and people, as well as the density of ideas, which are integral to innovation and are part of the foundational principles that should be present within a makerspace community and environment (Farritor, 2017).

Reflecting back to the start of this research project and on its conclusion, I now have a greater understanding of makerspaces and all of their affordances. Originally I thought they were just a "space" where people could assemble and build stuff and were primarily focused on technology. Those are only small images that complete a much bigger picture so to speak. Makerspaces are about learning, making, creating, collaborating, exploring, experimenting, innovating, sharing, and so much more. They can bring people together from all walks of life, all backgrounds, and all experience levels into a judgment-free space that has something offer to everyone. What began as being awarded an innovation grant to start up a makerspace at the college, has blossomed into a rewarding experience with the opportunity to provide a safe space with a lot of cool gadgets and resources for people at the college to assemble and not only learn about and experiment with technology, but to grow and learn about themselves; myself included.

I also learned that there are factors affecting the makerspace that are beyond my control and I should not be so hard on myself for the membership numbers not meeting my expectations at this point in time (we have only been open since mid-September).

The next iteration of this project will include revisiting the surveys and its questions to determine what needs to be modified and then redistributing the surveys after the action items presented within this project have been implemented (within a five to six month time frame) to determine if the same factors are inhibiting people from attending and participating in the makerspace, if we have succeeded in better educating people regarding makerspaces, and if we have increased membership within our makerspace community.

"A makerspace is a physical space where individuals can build and create. University-based makerspaces often focus on encouraging creativity, interdisciplinary collaboration, entrepreneurship, and/or experiential education" Farritor (2017). Build it and they will come.

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## APPENDIX A

Survey questions and verbiage included within the survey that was emailed to the collected 30-34 email addresses during welcome week at the college in Fall 2018 are shown below. SurveyMonkey was used as the survey platform. To view the public dashboard containing the results of the survey, visit https://www.surveymonkey.com/stories/SM-XX3Y356.

Greetings everyone!

You are receiving this email because you have expressed interest in participating in the makerspace at Macomb Community College. Whether you are currently participating or plan to in the future, we value your feedback and want to hear from you! Please take a moment to complete the short survey located at _____ regarding the makerspace. Information from this survey will be confidential and maintain your anonymity and will be used solely for the purpose of improving the makerspace at Macomb Community College.

Thank you, we greatly appreciate your time and participation in this survey.

1. What answer describes you?
    a. Female
    b. Male
    c. Other
    d. Prefer not to answer
2. Which age group describes you?
    a. 18 - 29
    b. 30 – 39
    c. 40 – 49
    d. 50 – 59
    e. 60 or over
3. What area are you majoring in at the college?
    a. Science
    b. Information Technology
    c. Math
    d. Business
    e. Arts
    f. Currently Undecided
    g. General Studies

    h. Other [please explain]
4. Did you have an opportunity to visit the makerspace lab since it opened Fall of 2018?
    a. Yes
    b. No [please explain why]
    c. Other [please explain]
5. What days and times are convenient for you to attend the makerspace lab? (Check all that apply)
    a. Mornings
    b. Afternoons
    c. Evenings
    d. During the week
    e. Weekends
    f. Other [please explain]
6. What types of projects are you most interested in?
    a. [please explain]
7. If you attended the makerspace, did working in the makerspace help you with your learning?
    a. Yes [please explain]
    b. No [please explain why not]
    c. I have not attended [please explain]
8. If you attended the makerspace, which of the following did you use? (Check all that apply)
    a. Raspberry Pi
    b. 3D Printer
    c. Amazon Echo
    d. SunFounder Invention Kit
    e. littleBits kit
    f. Google Vision or Voice Kit
    g. 3D Virtual Goggles
    h. Robots
    i. Circuit boards
    j. Other [please explain]
9. What would you value the most within a makerspace? (Check all that apply)
    a. Collaboration with other students
    b. Direction from the lab aides and/or faculty
    c. Pre-determined and pre-defined project ideas (e.g., online tutorials, YouTube tutorials, etc.)
    d. Project kits (Google, Raspberry Pi, etc.)
    e. Hands-On Activities
    f. Experimenting with different technologies
    g. Creativity and Expression
    h. Experimenting with digital options (iPads, Raspberry Pi, Amazon Echo, etc.)
    i. Inspiration
    j. Other [please explain]
10. Do you have any additional comments, types of things that you would like to see added, and or feedback regarding the makerspace?

## APPENDIX B

Survey questions and verbiage included within the survey that was emailed to students currently enrolled in one or more Information Technology courses during the Fall 2018 semester at Macomb Community College are shown below. SurveyMonkey was used as the survey platform. To view the public dashboard containing the results of the survey, visit https://www.surveymonkey.com/stories/SM-FPCB9NF.

Greetings everyone!

Your participation in this short survey regarding the makerspace at Macomb Community College is greatly appreciated; we want to hear from you! Please take a moment to complete the survey located at https://www.surveymonkey.com/r/NH55DL2.

Please be honest with your responses and anything you wish to share. Your responses and information will be anonymous and kept confidential and will be used solely for the purpose of improving the makerspace at Macomb Community College.

Thank you for your time!

1. I am familiar and know what a makerspace is?
    a. Yes
    b. No
    c. Other [please explain]
2. I am aware that Macomb Community College has a makerspace?
    a. Yes
    b. No
    c. Other [please explain]
3. If you were to attend or do already attend the makerspace at the college, what hours/days are most convenient for you? (Check all that apply)
    a. Mornings
    b. Afternoons
    c. Evenings
    d. During the week
    e. Weekends
    f. Other [please explain]
4. Is the makerspace something that you be interested in participating in?

    a. Yes
    b. No
    c. Other [please explain]
5. What would keep you from attending and participating in the makerspace?
    a. [Please explain]
6. What types of projects would be interesting to work on if you attended the makerspace?
    a. [Please explain]

## APPENDIX C

Observational study protocol conducted in person as an active participant during open lab hours with makerspace members present.

Observations included the following:

- Observed members interacting with each other.
- Observed members interacting with the lab aide(s) and/or faculty.
- Observed the amount of direction members need as they work on their project(s) and/or lessons.
- Observed the types of projects and/or lessons the members are working on.
- Observed the progress of the projects and/or lessons.
- Engaged in dialogue with the current members and asked them what types of projects they are interested in working on beyond what they are currently working on.

### Observational Study Notes

I sat within the makerspace lab along side the members and fully participated by working on my personal project (Google AIY Vision Kit). As I worked, I observed other members in the lab (3-4 students respectively).

- Students were engaged with the project they were working on.
- The 3D printer, Raspberry Pi (w/ breadboard + temperature sensors), Google Voice Kit, Android app development software, hacking, and the Raspberry Pi alone were being used.
- Students were using online tutorials related to their particular resource to learn about the resource and create and build something.

- Often, once a student got something to work as it should, they then ventured out to modify or tweak it. They gained confidence in their ability. They started to try new things.
- If something did not work or function as it should, students began problem solving by visiting additional online tutorials, asking questions of each other and the faculty to try solve the problem.
    - Debugging
    - Offered possible solutions
- When an issue arose and students seen another student struggling to get something to work, they began to collaborate and help each other out to try and find a solution
- Students would ask questions about the projects other students were working on
    - Showed genuine interest in each other
    - Provided suggestions
- Varied level of expertise in the lab
    - Students working together

**Makerspace Website**

One of our current members is currently building a website for the makerspace. He is very excited about the opportunity because it allows him to work on a "real" project, he sees it as great learning opportunity, and is very engaged with this project.

As I observed last week (11/5/18) as an active participant as we discussed the website he is building and showing me his progress:

- He showed a lot of excitement and enthusiasm
- He was eager to show me what he has done so far

- Myself, the computer support technician that was in the room fixing computers, the lab aide collaborated and shared ideas regarding the content of the website (this was awesome!)
- It was a collaborative effort adding new widgets and technical components to the website
- You could see his confidence in his skills growing as he explained to me how to use one of the development tools he is using for the website, how to add widgets to site, etc.
- I am also receiving emails from him outside the posted lab hours regarding the website which is great to see!
    - Engagement is there!

**Informal Conversations with Current Makerspace Members Notes**

I had an informal conversation with the lab aide, computer support technician, co-spacemaker (Martin), and a makerspace member regarding what they felt would draw more students to the makerspace:

- We came up with a list of projects that may be fun for students to work on, we thought that by listing them on the website it would provide students with a place to start
    - The list included a variety of different projects to spark innovation (mostly for beginners to start)
- We also discussed building a flow chart that lists three categories of projects: beginner, intermediate, and advanced.
    - Use tech speak to name them, e.g., newbie, etc. to make it fun!

    - List a variety of projects underneath each category to give students a starting point
    - Projects would be geared towards the available equipment we currently have in the makerspace
        - The may include simply completing an online tutorial that teaches the students about the Raspberry Pi and at the end they get a certificate
- We discussed a projects page on the website that would highlight current makerspace projects
    - Include a picture and short description of the project along with what resources were used
- We talked about putting up flyers across both campuses with some general information and showing pictures of some of the stuff we are working on
    - The flyers were just created and printed, I'm waiting for them to be delivered
    - Flyers included the Raspberry Pi, a 3D printed keychain, temperature sensors, etc.
- We talked about a re-grand opening for the Winter semester
- We talked about social media presence
    - My personal account
    - Marketing at the college
- We also talked about making sure students know it's free!

## APPENDIX D

Informal Interview Protocol that was conducted either in person (face-to-face) or via email.

I'm doing an action research project to determine various ways and methods of how to increase membership within our makerspace community. We want to create a more dynamic and diverse learning environment that provides a sense of community among its members and teaches essential 21st century skills that prepares members for the workforce. Currently our members are all IT majors and we would like to grow and expand our membership to include all disciplines and areas across the college. If you have a few moments, I'd like to ask you a few questions. Your anonymity will be maintained unless you wish to be identified and at that time, written permission will be required.

The following questions were asked of the CIE director and marketing at the college. Please note the some of the questions were modified where applicable based on the participant since not all participants teach courses at the college as shown in the responses listed below.

1. What suggestions do you have for increasing membership within the makerspace at the college? What ways would be most effective?
2. How do you think we can pique the interest of non-IT majors and students so they want to participate within the makerspace?
3. How do you suggest we target and market the makerspace to non-IT majors?
4. Are any of your students currently attending the makerspace? If so, do they find it useful and engaging? What type of feedback are you receiving from your students?
5. Do you have any suggestions of additional activities we can include in the makerspace e.g., guest speakers, hands-on demonstrations, etc.?

6. Do you feel that current hours and days we have established for the makerspace lab are sufficient? [Our current hours were provided.]
7. What types of different tools and resources do you suggest we add to our makerspace lab? [A list of the types of tools and equipment we current have available was provided.]

**Responses**

**Jason Cale – Senior Writer, Macomb Community College:**

- Host an on campus event for current students to generate interest and excitement (e.g. a makerspace open house or some sort of competition).
- Inform high school educators. Consider a high school event. Work with MISD to bring students on campus.
- See if you can be on the agenda at the Winter Semester Business Degree Basics session for current students.
- Inform other faculty across campus. Faculty Development Day (FDD) could be one forum.
- Speak with other departments and let them know about the makerspace:
- Admissions and Outreach performs campus tours and high school visits. The makerspace is something fun and exciting they could tout to prospective students!
- Counseling and Academic Advising can discuss the value of the makerspace to students who are looking for a creative outlet or ways to grow their skills.
- Student Life and Leadership has several student organizations that may be able to help get the word out and/or participate.
- Work with Patrick to get something posted in the My Macomb student portal.

- Contact Kathy Fisher (Provost Office) about posting makerspace events on the college calendar (Active Data Calendar).
- Consider having a presence at next year's Welcome Week (hosted by Student Life and Leadership).
- Where our team comes into play is by assisting with social media and flyers to promote the makerspace or makerspace events.

**Ellen Lux – Director, Center for Innovation and Entrepreneurship (CIE), responses are in blue:**

1. What suggestions do you have for increasing membership within the makerspace at the college? What ways would be most effective?

As discussed, co-marketing with CIE on the topic of Innovation is a really good idea. Also, working with faculty to recommend students go check it out (which I think you've done, right?). Signage (just not the same ole same ole).

Social Media coverage: Tell stories (meet Joe, he just printed his very own key chain... - pic of joe with key chain and a quote "I came to makers and learned..."

2. How do you think we can pique the interest of non-IT majors and students so they want to participate within the makerspace?

I think your message should be: Fun, anyone can do it, belonging to something cool, free stuff :)

3. How do you suggest we target and market the makerspace to non-IT majors?

Use your faculty relationships to ask if you can give a quick presentation to classes or leave some marketing flyers. Show the vision of why they may want to check it out (use the

story of the autism app guy or someone who created something from the 3D printer) -- hype the cool result and that anyone can do it (it's not too hard). We could ask the student business Biz-o-vation club to host a meeting there -- get the students to market it for you -- I'd be glad to suggest this for you.

5. Do you have any suggestions of additional activities we can include in the makerspace e.g., guest speakers, hands-on demonstrations, etc.?

Yes! Let's talk, I have some ideas. The drone guy I mentioned would probably be glad to come in, a presentation on automation, future of work, etc. "come see a presentation on how work will change in the future... are you ready?... come play with some of the technology that will drive the future.

Also at a recent conference there was a guy who programmed Alexa to vet business plans (no kidding) maybe we could snag some of that content and do a co-event on the cool things in IT and business that are being done with Alexa -- then have one of your current maker's participants share the simple program they created and tell how they did it.

I just thought of a guy who needs to do a student presentation to satisfy his Innovation Fund agreement -- he created an ice cream device (food tech) -- maybe we could bring him in -- advertise the business and IT connection -- and then have time for students to play with the tech after. His company is www.iserve.cool and I we discussed a winter presentation event.

6. Do you feel that current hours and days we have established for the makerspace lab are sufficient? Our current hours are as follows: Mondays: 9am-3pm, Tuesdays-Thursdays: 3pm-9pm.

Seems reasonable -- maybe a comment card in the room asking for feedback from current participants? Or, include this as a question if you do a survey.

7. What types of tools and resources do you suggest we include our makerspace lab?

Maybe some how-to's and get started examples of what can be done -- One of your attendees stopped into the CIE with a very cool 3d keychain -- he was very excited about it -- you could get him to present how he did it - peer to peer. Advertise it on social media -- come see how joe designed and made his very own key chain -- it's fun, it's hand's on, you'll have help getting stared, it's free. Maybe a contest for the best keychain, best invention, best idea, best failure?

Let's set up a brainstorming session of how we could work on a few co-events/co-marketing ideas. I think we could do some cool stuff together. I can host a CIE event in your space (lunch and learn on entrepreneurship topic) and we can definitely work on some co-signage. "Come to Center Campus A building where Macomb Innovates" -- Makers space A - xxx CIE A-206 M-Th & hours. We need to interrupt people like that suicide week shoe exhibit -- everyone was talking about it because it was different, creative, and meaningful.

Your survey was such a good idea -- maybe you could also share with me some of the best feedback you got when we get together. I have high confidence you will figure it out & I look forward to working with you if you decide it makes sense!

## APPENDIX E

Email sent to subject matter expert(s).

Greetings _____,

My name is Jacqueline Wanner and I'm a full-time faculty member at Macomb Community College. We have recently started up a makerspace at the college located in Macomb County, MI through the funding from an innovation grant that we received. I'm doing an action research project to determine various and methods of how to increase membership within our makerspace community. We want to create a more dynamic and diverse learning environment that provides a sense of community among its members and teaches essential 21st century skills that prepares members for the workforce within the STEM and STEAM fields. Currently our members are all IT majors and we would like to grow and expand our membership to include all disciplines and areas across the college.

If you have a few moments, I'd like to ask you a few questions. Your anonymity will be maintained unless you wish to be identified and at that time, written permission will be required. Thank you very much your time.

1. What suggestions do you have for increasing membership within our makerspace at the college?
2. What ways would be most effective based on your experience?
3. How do you think we can pique the interest of students across multiple disciplines?
4. What methods have you used to target and market your makerspace to students?
5. What types of projects are most interesting to your makerspace members?
6. Do you provide pre-determined projects to your current members or do you allow the members to create their own based on their interests?

Any additional information and advice you can provide regarding running a makerspace would be very much appreciated and welcomed.

## Email Response

**Nicholas Provenzano, Middle School Technology Integrator & Makerspace Director at University Liggett School (Grosse Pointe Public Schools, English and Social Studies teacher), responses are in blue:**

Thanks for reaching out. I'm happy to answer your questions for you. There are posted below.

1. What suggestions do you have for increasing membership within our makerspace at the college?

The big part of any makerspace is that students are there because they want to be there. They need to have an intrinsic need to go to the space. Part of that has to do with the classes they are taking. Are teachers offering students an opportunity to demonstrate understanding through the creation of artifacts? Project/Problem Based Learning is the best approach to help sustain and grow a makerspace.

Identify teachers that might be willing to create a project for their class and have that class meet in the Makerspace where the students can be shown the different tools that are available to them to complete the assigned project. Sometimes it is identifying those early adopter teachers that are willing to give things a try and letting them talk up the space to other teachers after they use it with students.

2. What ways would be most effective based on your experience?

I think it is finding one teacher and working with them to create projects that would allow students to utilize the makerspace.

3. How do you think we can pique the interest of students across multiple disciplines?

At this level, it will need to be the teachers that assign projects that allow for the creation of diverse projects. Anyone that is focusing on education should be interested in exploring the space. It opens up many possibilities for projects, but the teaching methods need to evolve in such a way that allows for the students to demonstrate understanding and mastery through the creation of artifacts.

4. What methods have you used to target and market your makerspace to students?

One thing I have done is to go and find those students that have an interest in making and reach out to them. I have created a few contests to get students in the space and check it out. Those have worked well in getting students to come back and use the space.

5. What types of projects are most interesting to your makerspace members?

Students love the ability to make whatever they want in the space. 3D design has been popular and using design to create on the laser cutter has been very popular as well.

6. Do you provide pre-determined projects to your current members or do you allow the members to create their own based on their interests?

Both. I have some packages projects I can give to students who want to do something, but are not sure where to start. Sometimes I point them in a direction based on what they seem to be interested in at the moment. It is a level of personalization that is important in getting students into the Makerspace.

The most important part of the Makerspace is the culture of the school around it. If teachers are not using Project Based Learning in their classroom that allows students to create a variety of different ways to demonstrate understanding, then the students will have no need for a makerspace. If teachers are using PBL, then it is important that the director of the Makerspace make overtures to these teachers to see how they can collaborate on a project to get students

using the space. Makerspace growth will be slow, but the more that students use it and share that with their peers, the usage will go up.

Thank you for reaching out. If there is anything else I can do to support your Makerspace, please let me know.