

The Impact of Makerspaces on the Students That Volunteer to Mentor Makers

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INTRODUCTION

The *intent* of this work was to better understand the benefits that are experienced by students who work as mentors in MIT's makerspaces. We did so via a survey to collect quantitative information and open responses that will be used to guide follow on surveys that delve more deeply into specific topics. The understanding gained from this survey is *important* as it provides insight that helps us understand that the benefits of peer-based makerspaces are not lop-sided. Student makers see the benefits of these spaces, and student mentors also see substantial benefits from their experience. We envision the impact of this work will be to (a) to encourage students to join as mentors in peer-based mentoring and (b) inspire follow on work at other universities that helps the broader academic maker community better understand how makerspaces benefit peer mentors.

Peer mentorship is practiced in several universities, for example, Case Western, Yale, Olin, Georgia Tech, Stanford, Berkeley and others. Peer-based mentoring has been in-place at MIT since 1937 [1], the year the MIT Student Hobby Shop was 'cobbled together' in the basement of one of its buildings by a group of students. That shop was later converted to a technician-run facility, however in 1974 [2] MITERS was launched as another undergraduate student-run makerspace. Today, MITERS has several dozen members, but this is small compared to MIT's undergraduate population of several thousand students. For many years, MIT's glass lab has utilized highly skilled, undergraduate glass blowers to help in training and oversight, but this again is small compared to MIT's overall undergraduate population. MIT needs more student mentors, and this will depend in-part upon their understanding the benefits of such a position.

Approximately 3 years ago, MIT started to expand the role of peer mentorship in its makerspaces. This was specifically to create more community-type makerspaces [3] that have better access and provide an overall better student experience via community interaction. The expansion has occurred mainly through the creation of the MIT MakerWorkshop [4,5], MIT Protoworks [6] and MIT MakerLodge [7]. During this expansion, MIT made use of information obtained during visits to many schools that practiced peer-mentoring. We also learned a great deal from a Georgia Tech study on benefits and negative impacts [8] of makerspaces on students. From these information sources, we were able to craft a program that would increase the number of student makerspace mentors. Today, MIT has over 140 student mentors that work or volunteer their

time in community-based student makerspaces.

Some of these spaces are student run or student managed, i.e., MakerWorkshop and MakerLodge. Some of them are staff-run, i.e., MIT Glass Lab and ProtoWorks. In these spaces, student mentors fulfill many roles - space management, training, oversight and community building. These student mentors are essential to maintaining safe and vibrant community makerspaces at MIT. They have been shown to enable many benefits for student users of makerspaces, but less work has been done to examine the benefits these students receive from acting as peer mentors within makerspaces. In this paper, we explore some forms of impact that service has on student mentors. We've extracted information, in terms of numbers and comments that we hope others will find useful when considering how to start or expand their peer-based mentoring programs.

ABOUT THE SURVEY

We surveyed current and former mentors from six MIT makerspaces that rely heavily on student volunteers. The survey was anonymous to ensure candid responses and we disassociated the optional email field with the rest of the results before analysis. Of the approximately 200 students invited to complete the survey, 41 responded (20.5%). The survey questions may be found in the Appendix A. The broad areas we explored are:

- How much time they spend mentoring and making
- What they value from the experience
- What the impact has been on their studies, life and skills
- What they liked best and least
- What surprised them

HOW MENTORS SPEND TIME MENTORING AND MAKING

At MIT, the majority of student mentors (85.4%) indicated that they spent 2-5 hours per week as mentors in the makerspaces. In addition to that, student mentors said they spent several more hours as makers in their makerspaces. The distribution of time spent is provided in Table 1. We had an even split between undergraduate and graduate student mentors with two having served as mentors as both. What is interesting here is that this indicates they (as a group) spend almost the same amount of time making and mentoring.

Table 1 Mentor Time Spent as Makers (not Mentors) in Makerspaces

Less than 2 hr/wk	46.3%
2-5 hr/wk	34.2%
6-10 hr/wk	07.3%
11-20 hr/wk	07.3%
Greater than 20 hr/wk	04.9%

MOTIVATION AND VALUE PERCEPTION

Access to makerspaces and equipment was the top reason why the students joined as a mentor in a makerspace - 36 of 41 respondents (87.8%) answered to this effect. Learning new things was also highly rated, with 34 respondents choosing this reason. Teaching other students 29 (70.7%) and joining a community 24 (58.5%) rounded out the main reasons for joining a makerspace as a mentor. Twelve respondents

(29.2%) mentioned meeting new people as a reason they became a mentor. We expected that access to space and tools would be highly rated as student mentors are given expanded access to tools compared to student users. For example, 24/7 access (on the buddy system) is a ‘perk’ of serving as a student mentor in the three of the largest student-enabled makerspaces, MITERS, MIT MakerWorkshop and MakerLodge.

IMPACT ON PERSONAL AND PROFESSIONAL ELEMENTS

The survey indicates positive impact on school work, maker skills, mentor/teacher skills, leadership skills, and career preparation. Only two respondents indicated a “somewhat negative” impact on school work. Student results on this topic are tabulated in Table 2. We also asked the mentors to prioritize the impacts they experienced while being a mentor. The results of these responses are provided in Table 3. **Maker skills** was the highest ranked impact, followed by **mentoring/teaching** and then **join a community**.

Table 2 Impact of Student Mentorship Experience Upon Several Personal and Professional Issues

#	Question	Extremely positive	Somewhat positive	Neither positive or negative	Somewhat negative	Extremely negative	Total responses
1	School work?	31.7%	41.5%	22.0%	4.88%	0%	41
2	Skills as a maker?	65.9%	31.7%	2.4%	0%	0	41
3	Skills as a mentor/teacher?	56.1%	41.5%	2.4%	0%	0%	41
4	Leadership skills?	41.5%	46.3%	12.2%	0%	0%	41
5	Preparations for a career?	26.8%	56.1%	17.1%	0%	0%	41
6	Other	50.0%	25.0%	25.0%	0%	0%	4
7	Other	50.0%	0%	50.0%	0%	0%	2

Table 3 Priority of Impact From Being a Student Mentor

Choice	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)	9 (%)	10 (%)
Maker skill	41.5	26.8	05.3	11.8	07.1	0	0	0	0	0
Happier	07.3	09.8	05.3	17.7	07.1	0	20.0	0	0	0
Improved confidence	07.3	09.8	18.4	11.8	14.3	14.3	20.0	0	0	0
Join a community	14.6	19.5	13.2	08.8	14.3	14.3	0	0	0	0
Meet people	02.4	0	29.0	11.8	14.3	14.3	40.0	0	0	0
Mentoring/teaching	22.0	24.4	18.4	14.7	14.3	28.6	0	0	0	0
Preparation for career	02.4	04.9	0	11.8	14.3	14.3	20.0	100.0	0	0
Life lesson	0	04.9	07.9	11.8	14.3	14.3	0	0	0	0

IMPACT ON SCHOOL WORK

In addition to the more qualitative type of assessment provided in the preceding, we wanted to do a cursory exploration that would inform follow on surveys of a variety of topics. One concern that has been expressed about student mentors is the time it takes away from their studies. It was possible that time away from studies could be a benefit. In the following we have provided a representative sample of comments that capture how the respondents think about this issue.

“I have infinite access to a great facility. That has helped me tremendously in my classes that require lots of fabrication”

“...being a mentor at makerworks forces me to take a break from whatever is going on and spend 2+ hours a week doing design thinking...”

“I feel like I have less time to pset with others because of training hours sometimes”

“I was able to complete assignments at a higher level.”

These open response questions are to provide insight into the way to best craft a follow on study wherein we can better quantify the impact of time away from studies. We have found this to be an important first step as MIT students shy away from long surveys that seem like “fishing expeditions.” They don’t have the time. It is better to do a draft survey, or parts of a survey in draft via open response... and then use the results to define another short, follow on survey with refined questions. We had not expected there would be a mix of ways that time away from studies could have positive benefits, but we are pleased that this will inform the preparation of the follow on study.

We also asked the mentors about the biggest impact on them and two recurring themes were **they found a great community** and that **they gained confidence**. Here is a sample of what they had to share:

“I’ve really enjoyed becoming more of a part of the maker community at MIT and meeting people with similar interests and passions.”

“I’ve become more social on campus, and I’ve also gained more confidence in making stuff”

“Seeing how excited students get when first using a new tool”

The ‘biggest impact’ responses were not all positive. One student was burned out by their involvement as a mentor, but even that student felt it was a valuable lesson to learn where their limits were and has more confidence now.

EXPERIENCE AIDING IN JOB SEARCHES

As one of the roles of universities is to prepare students for careers, we inquired as to use of experience as a mentor for resumes and job interviews. The results of their responses are tabulate in Table 4.

Table 4 Relevance of Mentor Experience to Employment Searches

#	Question	Yes (%)	No (%)	Plan to (%)
1	Added your experience as a mentor to your resume?	63.4	12.2	24.4
2	Highlighted your experience as a mentor in a job interview?	34.2	24.4	41.5

MAKER COMMUNITY

A. MAKER COMMUNITY WITHIN THE UNIVERSITY

We have provided below some comments taken directly from student responses that point to the positive perception of the mentor community and makerspace user communities.

“How awesome and connected the community is”

“Incredible community values”

“Helping other people actually make things.”

“Teaching! It’s super fun to teach other people cool things :)”

“Hanging out in the shop, getting to know people.”

“I loved watching the freshmen get so excited from building their project and how proud they were when they finished.”

From these responses we take away the need to create a follow on survey that more closely examines the specific values of community and whether or not there are any patterns or themes to the satisfaction mentors get from teaching.

B. MAKER COMMUNITY POST GRADUATION

We knew a priori that many student mentors generally found the community of a makerspace to be a highly beneficial aspect. We were curious to see if this would lead them to seek out similar sorts of communities when they leave MIT. Only 2 students responded that they would not be seeking out a maker community upon graduating from MIT. Twenty-nine students responded that they would seek out a maker community and 10 responded as maybe. This response led to consideration of how to help student mentors post-graduation. For example, there may be benefit to a system that finds spots for alumni to help out with making at a university where they are employed. If similar results are found at other universities, it may be practical to explore the creation of such a system.

MAKER COMMUNITY

A survey of MIT students on making wouldn’t be complete without asking them about the craziest things they made. We thought it would be interesting to share a few of their answers to demonstrate the wide variety of making done by these mentors:

- 250 lb fighting robot
- Deep reactive ion etching tool (for etching silicon in semiconductor devices)
- 120 foot long rideable wooden roller coast (see Fig. 1)

- Designed and build laser cut dodecahedron lamp (see Fig. 2)
- Drone controlled by hand gestures
- Medical devices
- Desktop metal lathe



Figure 1: Student-built Wooden Roller Coaster (Built in partnership with MIT EHS and Local Construction Engineer)



Figure 2: Dodecahedron lamp

CLOSING REMARKS

Although the impact of makerspaces upon makers has been studied, we thought it would be useful to better understand how student mentors benefit from the experience of providing mentoring, training and oversight. The data we've collected shows a few cases of negative impacts from being a student mentor in university makerspaces (burn out, time commitment), but overall the experience and its impacts appear to be positive. Student mentors have indicated that they improve their maker skills, add to their resume, increase their confidence, join vibrant communities and go on to be happier as a result of their time spent in makerspaces at MIT.

This data gives us more confidence that the expanding role of undergraduate mentors at MIT reaps more benefits than previously thought. The benefit scale is not lopsided, i.e., it's beneficial to the students and mentors. We plan to do more work in the future to (i) craft the follow on surveys from the exploratory questions and (ii) better understand the negative impacts, though they seem few and not widespread. We will also continue to collect data so that we can gain more confidence that this is a repeated outcome at MIT, and seek partnership with others to examine how this extends to other universities.

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APPENDIX: APPENDIX A - MIT MAKER MENTOR SURVEY QUESTIONS

We've reported on a small portion of what we overall asked our mentors. We provide below the full survey in the hopes that others might use it; in full or in part; or that this may inspire additional questions for others' surveys.

Question 01: In which makerspace are/were you a mentor/guardian?

- MakerLodge (1)
- MakerWorkshop (2)
- ProtoWorks (3)
- Edgerton Student Shop (4)
- IDC (5)
- Glass Lab (6)

Question 02: How many hours per week do you spend in a makerspace as a mentor/guardian?

- Less than 2 hr/wk (1)
- 2-5 hr/wk (2)
- 6-10 hr/wk (3)
- 11-20 hr/wk (4)
- Greater than 20 hr/wk (5)

Question 03: How many hours per week do you spend in a makerspace as a maker?

- Less than 2 hr/wk (1)
- 2-5 hr/wk (2)
- 6-10 hr/wk (3)
- 11-20 hr/wk (4)
- Greater than 20 hr/wk (5)

Question 04: As a mentor/guardian, were you a graduate or undergraduate student?

- Undergraduate (1)
- Graduate (2)
- Both (3)

Question 05: Why did you join the makerspace(s) that you were a mentor/guardian for?

- Increased access to space/equipment (1)
- To teach other students (2)
- To join the community (3)
- To learn new things (4)
- My advisor made me (5)
- To meet new people (6)
- Other (7) _____
- Other (8) _____
- Other (9) _____

Question 06: How do you feel your involvement with the makerspace(s) has impacted your:

	Extremely positive (1)	Somewhat positive (2)	Neither positive nor negative (3)	Somewhat negative (4)	Extremely negative (5)
School work? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skills as a maker? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skills as a mentor/teacher? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leadership skills? (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparations for a career? (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 07: Explain the impact being a mentor/guardian has had on your school work.

Question 08: From your experience as a mentor/guardian, what has had the biggest impact on you personally?

Question 09: What has been the biggest challenge for you being a mentor/guardian?

Question 10: What surprised you the most about being a mentor/guardian?

Question 11: What did you have the most fun doing?

Question 12: Did being a mentor detract from your experience at MIT?

Question 13: Have you...

	Yes (1)	No (2)	Plan to (3)
Added your experience as a mentor to your resume? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Highlighted your experience as a mentor in a job interview? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 14: Prioritize the impacts of being a mentor/guardian

High priority	Low priority
_____ life lesson (1)	_____ life lesson (1)
_____ preparation for career (2)	_____ preparation for career (2)
_____ mentoring/teaching (3)	_____ mentoring/teaching (3)
_____ meet people (4)	_____ meet people (4)
_____ join a community (5)	_____ join a community (5)
_____ improved confidence (6)	_____ improved confidence (6)
_____ happier (7)	_____ happier (7)
_____ maker skill (8)	_____ maker skill (8)
_____ Other (9)	_____ Other (9)
_____ Other (10)	_____ Other (10)

Question 15: What was the most important for you?

Most important	Least important
_____ life lesson (1)	_____ life lesson (1)
_____ preparation for career (2)	_____ preparation for career (2)
_____ mentoring/teaching (3)	_____ mentoring/teaching (3)
_____ meet people (4)	_____ meet people (4)

_____ join a community (5)	_____ join a community (5)
_____ improved confidence (6)	_____ improved confidence (6)
_____ happier (7)	_____ happier (7)
_____ maker skill (8)	_____ maker skill (8)
_____ Other (9)	_____ Other (9)
_____ Other (10)	_____ Other (10)

Question 16: What did you get the most benefit from?

Most benefit	Least benefit
_____ life lesson (1)	_____ life lesson (1)
_____ preparation for career (2)	_____ preparation for career (2)
_____ mentoring/teaching (3)	_____ mentoring/teaching (3)
_____ meet people (4)	_____ meet people (4)
_____ join a community (5)	_____ join a community (5)
_____ improved confidence (6)	_____ improved confidence (6)
_____ happier (7)	_____ happier (7)
_____ maker skill (8)	_____ maker skill (8)
_____ Other (9)	_____ Other (9)
_____ Other (10)	_____ Other (10)

Question 17: After you leave MIT, will you seek out a maker community (or did you)?

- Yes (1)
 Maybe (2)
 No (3)

Question 18: What is the craziest thing you built at MIT?

Upload a photo if it is easy.

Question 19: How much has being a mentor/guardian helped with your

	A great deal (1)	A lot (2)	A moderate amount (3)	A little (4)	None at all (5)
confidence (1)	<input type="radio"/>				
happiness (2)	<input type="radio"/>				

skills (3)

Question 20: Has being a mentor helped you better appreciate the value of "mens et manus" as part of the MIT ethos?

Yes (1) Not sure (2) No (3)

Explain

Question 21: If you were not spending time being a mentor, what would you be doing?

Question 22: Email address to receive \$10 Starbucks gift card. We will disassociate your responses from your email address.