

Abstract

This chapter examines the University of Oregon's math homework help program, which is entirely staffed by students working for the Libraries. These student employees, called Mathletes, provide drop-in homework help for all underclass mathematics courses in the reading room of the Math Library. The program has proved successful, with patron participation far exceeding initial projections. However, the real success of the program has been what the Mathletes themselves have gained as peer to peer instructors, through meaningful work experience and a supportive community. We will describe our training process, which emphasizes leadership, mentoring and problem solving throughout. In order to ascertain the benefits of peer-assisted learning on the Mathletes, we conducted a qualitative and quantitative survey assessment of our program. Results of this assessment reveal that the work has meaning above and beyond the amount that students earn as an hourly wage. Finally, providing this program has been a wonderful way to connect to both an academic department that can be difficult to serve and the greater UO community.

Institutional Context

University of Oregon is the flagship school for the state of Oregon. It is a residential campus, home to approximately 20,000 undergraduates and 3,500 graduate students. Located in Eugene, Oregon, long considered a hotbed of counter culture activity, today the campus has a popular athletic program and an active fraternity and sorority scene. In 2015, the school was in the top twenty for both the "Reefer madness" and "Students pack the stadiums" categories in the *Princeton Review* rankings. The library system at University of Oregon consists of the Knight

Library which serves as the main administrative hub and social science and humanities repository, as well as the Art and Architecture, Law, Science, Marine Biology and Mathematics Branches. We are the only ARL library in the state and we support both undergraduate learning as well as the rigorous research expected of an Association of American Universities (AAU) institution.

The Mathematics and Science Libraries, while housed in separate buildings, share management, staff and student employees. However, while the Science Library was seeing steady use, the Math Library was not. Math is housed in one of the oldest buildings on campus. In 2009, a seismic retrofit of the building prompted a redesign of the Math Library. It reopened in 2011 with many space enhancements, but without a clear purpose for the new space. We knew we wanted to build a student-centered library that reflected the Libraries' Mission Statement and Strategic Plan, as well as take advantage of the building's central campus location. The head of the Science and Math Libraries was supportive of new ideas and gave the Math Librarian and Library Manager free rein to explore options for the new Library. Initially, we considered offering needed services, such as student computer support or staffing it with a math department graduate student teaching assistant. However, these options were determined to be too difficult to fund or operate and they did not meet the greatest need of the students at UO. We considered the following when we looked at our options. Math classes – college algebra, general university math, and first-year calculus —are among the most failed courses at the UO. Math requirements are important for all majors and are especially important for retention in science-related fields of study. When we reopened the Math Library, there were limited options for math homework help

on campus for students who were not athletes. Thus, the decision was made to focus our new space on peer-to-peer math tutoring. While the program has become one with countless benefits for the peer mentors we used this model initially for financial reasons.

Background of Program

Prior to the Math Library redesign, students working at Science were assigned to work at Math as well. They had no particular background in Math and were sent to keep the space open, but with little to do and minimal supervision. Even when we knew the students weren't reporting for their shifts promptly, we didn't have the staff to fix the issues. In order to solve this problem as well as provide a useful service, we considered how to provide leadership opportunities for our student employees. This would be work that was tied to helping other undergraduates while giving full time library staff the opportunity to grow by developing the program for our student employees. When the Math Library re-opened in 2011, we focused on three main outcomes. We wanted to provide meaningful work for student employees. We hoped to help undergraduates with the classes that they struggle with. In the process, we also improved our relationship with the math department and the campus community. The math homework help program, with peer tutoring, was our opportunity to address all of these possible goals.

We hired a group of undergraduates with sufficient math coursework and an interest in peer to peer instruction to provide homework help to their fellow students with 100- and some 200-level college math. Because of the funding model we use for most of the student staff and the specific requirements for these new positions, most of the peer tutors were recruited and hired specifically for this work. When we started, we hired only Math undergraduates, most of whom

were also prepared, via a training course in the Math Department, to help run discussion sections for the large introductory 105, 106, 107 Math sequence. Working around their schedules required that we also hire at least one non math major, from the very start. When we could no longer count on getting the majority of students from the math department, we asked other departments and specific professors to recommend students looking for on campus work to fill our student ranks. Interested students must have succeeded at college-level calculus and/or discrete math and are from a variety of majors. By providing math help in a dynamic and welcoming space, the Mathletes get an increased understanding of the math as they explain to others in addition to leadership opportunities, communication skills and many chances to learn about problem solving. With so much to do and so many students requiring help, the Mathletes are given a great deal of autonomy to shape the work they do while being held accountable for their work by their fellow Mathletes as well as the patrons who are counting on them.

In order to become a Mathlete, students need to fill out an application and take part in a lengthy interview process. The length of the application and interview emphasizes the communication skills and need for planning that characterizes the job they are being hired to do. Starting with the application which includes information about their coursework, schedule availability, and four short-answer questions about libraries and helping with math homework. We start working on written communication and the articulation of tutoring principals. Most students who complete the application have the chance to interview for a position. The interview takes about an hour and involves a short tour, then a lengthy conversation about the Library, the patrons, and our expectations. During this hour we discuss the importance of communication and what we expect

from them as Mathletes in terms of leadership skills and the need for problem solving in the workplace. The interview concludes with a demonstration of how the student would explain a math problem to the librarian, who plays the role of a confused student. (While this is a different kind of problem solving, it is also important in this position.) The interviewees get a list of math problems and they decide which one to solve as a way to demonstrate their tutoring skills. Most choose the problem that seems easiest to explain, but very few applicants reach the correct answer for one reason or another. It is always interesting to see how they go about asking for background information, how they involve the pretend student, and which problem they choose to solve, and in fact, this is the primary purpose of the exercise; the job is mostly about explaining math problems. Many applicants do a good job showing us they understand the material and know something about teaching it. Most of the students who have made it this far through the process are eligible for hire. In cases where we don't hire a student, and there have been a few, there was either a problem with their ability to explain the math clearly or they were simply too nervous for us to get a sense of how they would interact with patrons.

By striving for diversity amongst our student employees, we are creating an altogether more inclusive space. Due to the unique skills needed for these positions, we are authorized to hire students even if they don't have a Federal Work Study award as part of their financial aid package. In the rest of the library system it's unusual to be able to hire a student employee unless they have Federal Work Study to help pay their salary. As a result of our relative flexibility, our Mathletes represent a diverse range of students. Our Mathletes have been fairly evenly divided along gender lines. We have had international students, all of whom have extremely strong

English language skills. We have also had a large number of what our campus calls non-traditional students. Most of them are in their mid to late 20s (or older) and they did not come directly from high school. At one point over half of the Mathletes working for us had dropped out of either high school or college before returning. We found that this population was hard working and sympathetic to the students seeking help, in part because they were representative of the students they were helping.

Over time, the popularity of the Mathlete services meant that we needed to hire more students than we originally anticipated and our original student budget was wholly inadequate. While library administration was able to increase our student budget to an extent, eventually the program outgrew even these additional funds. Library administration suggested we talk to the Math department. Our administrators joined us in presenting the data we had gathered about why we needed more student helpers to the chair of the Math department. At the time, our choices were to limit the number of students we helped or employ more students, but only if the Math department were able to fund the additional positions. Since that meeting, we have been partially supported by the Math department financially. Each year we to ask them for the supplemental funds and see if they have the resources to commit to the program. If they change their level of support for financial reasons, we would have to consider how to restrict the amount of help available to students that come to the library.

Training

Our training program emphasizes the importance of communication with a longer than normal application and is followed by in-depth interview process which addresses the need for

leadership and planning. Qualified students are identified by recommendations from classmates and professors and in class presentations. If they are interested they fill out an application and then bring them to us in the Math and Science Library in paper form. Because we are working with student and staff schedules, setting up an hour long interview usually involves a lengthy email exchange setting the tone for appropriate tone, prompt replies and proper protocol (i.e. when to reply all). The interview itself, with the feedback we provide to students as they consider the problems and issues that the program demands, as well as the first math problem they do with us, emphasizes communication with us and their co-workers.

The patrons learn from the Mathletes, and the Mathletes learn from the process of tutoring. But, they also have the opportunity to teach and learn from each other. One of the first things we do for training is ask the newer employees to observe a more experienced co-worker for an hour. This requires the new student to take control of planning and reporting back to their supervisors. It also requires that the more seasoned students mentor the new hires. This is a flexible activity and can be done at any time, but we encourage students do this soon after starting their work for us. The bulk of them are done at the beginning of the school year, when we typically hire the most new students. At the fall term meeting we announce or remind students about this task and send an email to the returning Mathletes confirming that they are now expected to serve as a role model and trainer. The new employees arrange a time when they can shadow the other Mathlete. The observer is paid for their time and they are expected to watch what happens, but not help the patrons. After the observation, they send the Math Librarian an email outlining something they observed that they liked, something that could be improved on, and something they saw that they

might incorporate into in their own practice as a Mathlete. We keep track of who has done this and who still needs to complete this task using a spreadsheet. While the returning student gets the experience of being a leader, the new student must plan for the observation and reflect on the lessons learned.

Mathletes must depend on each other to keep the program running smoothly. We build in chances to build this trust through mentoring and meetings. When the new students start, they are usually paired with our most senior Mathletes for the term. We talk to both the new employees and the more seasoned ones about the need to support each other from the in person interview on. Early on in the Fall and Winter term, all of the Mathletes are required to attend a quarterly meeting to reinforce these lessons. The hour long meetings are mandatory and paid. They provide a chance for all of the students to be in one room at the same time. The first meeting in fall term gives the new hires a chance to learn who the more experienced students are and to meet all of their colleagues, and the second meeting in winter term allows for training, debriefing, and discussion of ongoing challenges. When appropriate, these meetings can also be used to reinforce library values around patron privacy, the value of our material and how to use our collection. If we have gotten feedback from patron comments, our observations, conversations with the Mathletes and a number of other possible sources, these meetings are good places to address any issues as a group. We try to keep the meetings student led, guided by the Math Librarian to keep to the agenda, track time and provide follow up, where needed. The final meeting of the school year, towards the end of spring term, is held at the Math Librarian's

house. Offering a home-cooked meal and inviting the Mathletes who have graduated to join, creates a sense of community and continuity among the library student employees.

We also have new students complete library specific readings. In the beginning, we asked them to read some of the selections we had prepared for the reference desk assistants about general library operations and organizational theory, including classics like Ranganathan's laws of library science and Michael Gorman's words of wisdom about interlibrary loan and problem patrons. There are also several readings about the principles of good reference interview, starting with the importance of the greeting. All of which are transferrable to working with their peers doing homework. We asked the students to let us know what they liked about the readings and if they thought they were worth assigning to the next group of students. The replies were always positive, but over time, the likelihood they will answer reference questions has declined and we stopped using this in training. Although we were reluctant to leave out the readings that reinforced core library principles, we want training material that is relevant and interesting as well as practical. With this in mind, we asked graduating Mathletes to write down what they considered best practices for staffing the room and developed a 2 page document with the specifics [Appendix?]. Periodically we ask the current Mathletes to re-read the document to see if it needs updating. We also have the new Mathletes to read this document and comment on it since it is full of practical advice from seasoned colleagues. All of this training uses written forms of communication to pass along useful lessons from mathletes and staff that help keep the space running well.

Lastly, in the past year, we have begun requiring the Mathletes to attend a Math Department lecture or event to expand the student's training in mathematical thinking. We were able to secure gift money to pay for this additional expense. Although this is not necessarily directly work-task related, we ask that the students attend a talk and let us know what they think. The Math Librarian sends out emails about appropriate venues and opportunities. In addition to the educational value of the events we hope that by having our students participate in the departmental functions we will foster stronger ties between the students, the Math department and the UO Libraries. Another goal of the program is to give our Mathletes the opportunity to enrich themselves by being part of the culture of mathematics at a university.

To reinforce their training and to provide ongoing support to the returning Mathletes, the Math Librarian meets with each of them, usually informally, to discuss setting goals for the term. The requests have run a rather wide range of possibilities, far beyond the scope of daily work assignments. Guidance takes many forms; reminding students to get more sleep, encouraging them not to smoke cigarettes, helping them correspond with faculty members doing work that they are interested in, and checking in on their progress towards studying for the GREs. Some of the Mathletes respond enthusiastically to this offer, while others would rather be left alone. The goal setting is entirely optional, but are an additional facet to the ongoing community building and mentorship we provide.

Whenever possible, we conduct exit interviews with students who leave. We will do these interviews at the library or off campus at a nearby coffee shop. All of the supervisors are invited

to participate, usually this is a one on one conversation with open ended questions that ask the student to reflect on what worked, what could be improved and their final thoughts. We have gotten a great deal of useful information out of these conversations for us. These exit interviews also model several important aspects of employment. They provide the students a chance to consider their experience, it shows that their employer is interested in their ideas and the lessons they have learned. It also provides a sense of closure and a way to say farewell on good terms. Finally, we hope that by showing students how to leave gracefully that they will return when they can and remember us fondly.

Implementation

Mathlete tutoring is provided on a drop-in basis, meaning that the tutors cannot know what material they will be responsible for on a given day. Help is provided on a first-come, round-robin basis; a Mathlete sits with a student for approximately 3-10 minutes, the length of time to answer a single question, before moving on to the next student, who may be in a completely different class in addition to having a different learning style. Rapidly switching between material and presentation style requires a high level of flexibility on behalf of the Mathlete. While juggling the above tasks, Mathletes are still responsible for all regular Library circulation and organizational duties.

From almost the beginning we have needed to expand as much as possible to meet the need for help. Originally, we anticipated that 10 student work hours per day would suffice during the

fall, winter, and spring terms with a decrease to perhaps 4-6 student work hours per day during the summer term. At the Math Department's request we initially concentrated on helping specifically with 100-level (and lower) classes. However, we quickly have found an incredible demand for more help than we expected to give. Outside of instructor office hours and private tutors, there are very limited resources available on campus for students at the 200 level. The class series we meant to specialize in, University Mathematics: Math 105, 106 and 107 is a large lecture class for students who are not ready for college algebra or do not intend to take any further math. This class does not have any coverage at the only other tutoring center on campus, the school-sponsored Teaching Learning Center (a separate multi-subject tutoring center on campus with whom we share information but are not affiliated). In order to support the demand in the room at any given time, we had to increase the number of Mathletes which in turn required us to think about and develop systems for the student employees to share tasks, communicate clearly and be responsible for keeping the peer instruction working smoothly.

Beyond the simple problem of volume, we also had another problem: nearly all higher-level math classes are scheduled in the same blocks of time. When the student employees submitted their class schedules we found that most of them were completely unavailable for some of these blocks, since they were generally taking at least one math class each term. So our first surprise was that in order to have continuous coverage we had to hire at least a few non-math majors. Since we had already encountered the volume problem, this did also alleviate another concern, which was that there would not be enough interested math majors to staff our space if we needed many of them.

Scheduling has been a place where we help students learn the importance of following directions and organizing their time, both of which are important job skills post-graduation. Students submit their term schedules to the Math and Science Library manager towards the end of the previous term, or near the start of Fall term. She carefully develops a 10 week schedule that has Mathletes working at least one 2-3 hour shift at Science as well as time at the Math library. All students must also sign up and work some part of finals week. The schedules reflect both student preferences and their availability. Therefore there is a tremendous amount of variability in terms the number of hours, length of their shifts and more, as long as the spaces are adequately staffed. One of our challenges has been communicating clearly to each student how important it is to work within the rules of our system. After a few difficult students, we found that dismissing students quickly if they could not work with us was important for our sanity and for morale for everyone else as well. While these skills are more mundane, we are confident that they are important for the long term success of the program and the Mathletes.

Upon arriving for the start of a shift, the Mathlete will check-in with whomever they are relieving of duty or who they'll be working with that day. The check-in involves making sure circulation requests have been met, determining if there is something in the academic calendar of note- such as when a 500-person lecture class has a calculus midterm, we can expect a serious spike in requests for help- and assessing the needs of the students awaiting help and strategizing for the shift ahead.

The Mathletes work together to figure out the best approach for dividing up the duties of a given shift. Some Mathletes are stronger in a particular area, some are more comfortable working in a more lecture style setting when there are large groups all working on the same problems. It is easy to get caught up in providing help to patrons, but there is still the need to attend to circulation, shelving, and light cleaning duties.

When answering other students' questions, the first step the Mathlete takes is to listen.

Pinpointing precisely where the student is having trouble allows the Mathlete to better explain the problem and alleviates possible frustrations down the road. Typically, guiding questions are asked to steer the student to the solution of the problem, rather than just giving them the answer or working the problem out for them. While this approach takes a bit longer, it is more effective in teaching students how to approach problems independently. Over time, the patrons learn the questions they should be asking themselves.

Throughout their time in the library Mathletes develop skills in the importance of communication, leadership and problem solving. All of these constitute best practices for peer to peer tutoring in STEM (Bowling, Doyle, Taylor & Antes, 2015). We are confident that in addition to fostering the community that supports the students needing help and the students providing the help, these skills are transferrable to whatever work or school they may undertake after leaving employment with us.

Evaluation

"The power of tutoring derives from two of its main features: adapting to the individual learner's cognitive needs and the emotional benefits of the tutor-tutee relationship" p.2
Karsenty, 2010

Earlier studies about tutoring centers, specifically in math, suggest that the students who use them aren't usually doing particularly well in the classes. Therefore, evaluating how much math tutoring improves grades is difficult because the final grades are not very impressive. However, it's undeniable that because the homework help improves student satisfaction, the costs of offering the help likely pays for itself in goodwill and student retention. (Gillard, 2011; Xu 2001) Moreover, we have not seen any studies that considered the benefits to the students providing the tutoring, nor the staff working with them.

While the Mathlete program collects more traditional data including patron counts and student feedback, we wanted to investigate the benefits for the Mathletes themselves. To this end, a survey was constructed that sought both qualitative and quantitative assessments of Mathletes' opportunities to learn on-the-job, satisfaction levels, and work-type preferences. This survey was developed by a graduate student, one of the co-authors, who found working at the Math Library as an undergraduate such an important part of her success that she wanted to study these implications further.

We began by simply assessing the students self-reported satisfaction level. The mean satisfaction level was significantly higher at the Math Library than the Science Library. We have the rare opportunity in this analysis to have a control group amongst employees. While all Mathletes

work at both the Math and Science Libraries, the Science Library maintains a pool of student workers that work solely there. Without exception, student employees of both libraries rated their satisfaction level with their work at the Math Library at least equal to, if not greater than, their satisfaction level with work performed at the Science Library. In the case of students employed only at the Science Library, overall satisfaction was still lower. What this does not tell us is what specifically the cause of that increased satisfaction is.

In the open ended, descriptive questions about on-the-job learning, students cited increased self-confidence and patience as by-products of the opportunity to engage frequently with foundational math skills which then led to deeper overall understanding of advanced material. There is also the benefit of working closely in one's field of study. One student employee preferred the work at the Math Library, despite a pay cut in comparison to their off campus job, in that it alleviated some of the cognitive dissonance of juggling work and school.

The survey also assigned a quantitative value to opportunities to learn while on the job, contrasting the work done at both the Math and Science Libraries. Students were asked to equate the amount they learned at work to the equivalent in credit hours. These were adjusted for the number of hours individuals worked in a term and then multiplied by the cost of an undergraduate credit hour at University of Oregon. Students felt that they had the opportunity to learn what was worth the equivalent of \$2.00 *per hour* for every hour on the job. These findings are all excellent indicators of how much these positions provided for the peer tutors themselves.

Implications and Lessons Learned

Excellent communication does not always make the situation easier. Solving problems with such a close knit community of students working in such a high profile and busy environment can be complicated. While the positions demand the use of problem solving skills and leadership, none of the Mathletes want to report on others for not doing their jobs. We have had issues with students missing shifts, showing up late, having mental health issues that prevented them from working at full capacity, and a student who had a difficult time reading patron social cues. In most cases, when the supervisors find out about the problem, we make a point of closely observing what is happening and attempt to assess it with as much neutrality as possible. Usually, we have a short conversation with the Mathlete having the problem and outline an action plan and time to check in and observe. All of the students get at least one more chance after these conversations. They are asked to correct the problematic behavior and we try very hard to help them improve. Despite our efforts, some of the students have either decided to leave or been asked to leave when they are unable to self-correct.

What we do far more often to help the Mathletes is provide regular informal check-ins. These allow for students to let us know what is on their minds and to try to address any issues before they become a crisis. We know how important this is because when we had a vacancy in the supervisor position, student morale was low and small problems with job performance went unchecked. Since then, our new student supervisor has been diligent about maintaining the conditions to demonstrate best practices. With the return of regular check-ins we have seen a marked improvement with the student employees and the sense of community in the Math Library.

We know that the peer to peer model we offer is very popular. Of all undergraduate students currently enrolled in math classes at the UO, we see 20% of them for tutoring at the Math Library. Weekday homework help sign-ins indicated that there were on average 15 to 20 patrons present at any time. Keep in mind that many people sign in and remain present for hours asking questions and working with friends and classmates. One sign of our success has been the number of students who return to the Math Library for help with math related problems. Although our evidence is entirely anecdotal, we have been asked to help with math concepts in fields as diverse as physics, sociology, finance, business, biology, and psychology. Because we think of ourselves as a community of thinkers, we are willing to help when we can.

While we are pleased that this service helps so many students, we think that the real value of the program is for the students working for us. Meaningful student employment has a positive effect on retention rates, but we also see that this type of work helps student employees increase their confidence and desire to both teach *and* learn. The nature of peer-to-peer work like the Mathlete program means that these students take on greater leadership responsibilities. Students who accept this kind of employment work better independently, and allow us to offer a program that is beyond the scope of most library employees. It fosters a rich relationship between the student workers and staff, which more closely resembles post-university work environments. The mentoring relationship is rewarding for the both the student employees themselves and the library staff.

Our program has worked hardest to develop the relationships of tutor-tutor, tutor-tutee, and tutor-staff, and it is from these relationships that we amplify the benefits of a peer-assisted learning program. Creating a library position, or at least officially dedicating staff time, to developing and supporting these relationships is the most vital step forward to ensure the quality of our program is maintained and students get the most out of their jobs.

For those of you considering starting a program like this, we encourage you to hire and train the students doing the tutoring yourselves. It's a great way to show them the values that libraries consider important. If the tutors just report to work on a floor of the library, but don't also learn about our OPAC, our circulation policies and what we do to protect patron privacy, they do not truly work 'in the library' regardless of where the service is housed. Without accessing and using our collections the location is nearly irrelevant. Without mentorship, the students working with their peers are the most inexpensive instructors on campus. But, by integrating them into the library culture and helping them grow and develop as they get their own undergraduate degrees, you are cultivating students who graduate with the kinds of skills that employers are saying are important in a competitive job market. (Head, 2013; CERI, 2016)

Next Steps

One task that we would like to undertake is providing some more training for what students will do after they graduate. Aside from the exit interviews, the Libraries doesn't do as much to send students on their way as we would like. We hope that while they are working for us that they are acquiring useful real world skills, including valuable ones about communicating with their

supervisors and co-workers and learning how to be responsible for their work shifts. In order to document that, all student supervisors are trying to complete annual evaluations for the students they work with. This is a work in process and it is time consuming to do. For the students who work with us we want to work towards getting them the skills they want to have when they graduate. To make this more explicit, we just started having students write down what the student hopes a letter of recommendation from a supervisor would contain when they graduate. By knowing their end goals, we have a chance to get our students the experiences they would find valuable for getting a job or attending graduate school.

Bolstered by the success of the Mathlete program, as the Science Library completes its renovation in Fall 2016, it will embark on similar collaborations with departments within the sciences, using the newly remodeled space to house several subject specific tutoring spaces. Navigating this expansion will be an exciting challenge, though it will be of the utmost importance to ensure that these new programs do not expand so quickly that the quality of services diminishes, much less that important aspects of mentorship is lost. These new peer to peer mentors will need to learn the value of communication, problem solving and be given leadership opportunities, among other things.

What started out as a directive from library administrators to keep the centrally located Math Library open has turned into a tremendous opportunity. We expected that we would be able to help the students struggling in math classes with their homework. We also hoped that having a campus job that paid well would be useful for the students who could take advantage of the

opportunity. We didn't expect that the Mathletes would get so much more out of these jobs. We also didn't realize how much it would take from the library staff to coordinate their schedules, solve problems and help the Mathletes grow in meaningful ways. But, it has also been one of the most rewarding programs that we have been involved in. This program shows the value of an academic library as an employer who can facilitate this kind of peer to peer learning for undergraduates. We give them practical skills and teach them core library values which they take with them when they graduate. While they are students their energy and excitement helps fuel our interest in them. Ultimately, we want this to be more than a job where you show up and do math, instead we hope to foster a student led community to which you belong and a safe place to grow.

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