INTRODUCTION

The Maker Hub at Elon University is an interdisciplinary makerspace located inside a residence hall. Instructional and Campus Technology, the central IT office at Elon, funds and staffs the Maker Hub, which has a strong partnership with the Office of the Provost. The makerspace is not located in an academic building and is not directly associated with a single academic program. Our sign-in data show that students of many academic majors visit the Maker Hub. This diversity of users makes it more likely that we’ll have students who are unfamiliar with a design process, are unclear how to make progress on an idea, or do not have funding for their idea.

During our first semester opening and operating the Maker Hub, we experimented with several approaches to reduce barriers to making for our student population. These included policies like not charging for filament used in the 3D printers, as well as weekly meet-ups and workshops. While these efforts helped some students, we wanted something specifically for students who had an idea but were not sure how to start. The Maker Hub introduced the Elon Kickbox in the Spring of 2016 to help students take an idea and make progress on it.

Adobe created Kickbox to give its employees a way to create something that could be turned into a viable product [1]. We modified Kickbox to meet our objectives and better fit an academic environment. Adobe licensed the Kickbox with Creative Commons BY-SA license, so we built off their work in developing a Kickbox program for Elon University.

Fig. 1 An Elon Kickbox

This paper outlines the Elon Kickbox program and the feedback we’ve received from students and faculty over the past two years. It discusses how students applied for a Kickbox and how we selected the recipients. It details the materials inside the physical red box that each student received, including a breakdown of the cost of each box. It then outlines the semester-long program that accompanied the Kickbox, including milestones, group meetings, and presentations at two public events.

APPLYING FOR A KICKBOX

Any Elon student could participate in Kickbox if he or she had an idea, a sponsor, and a completed application.

The idea could be nearly anything, from fabrication (inventing, constructing or designing) to exploration (expressing, tinkering, learning and discovering) [2]. The only requirement was the student needed to be able to make progress on it in three months (the duration of the Kickbox program).

Each student also needed to find a sponsor to support his or her idea. Any faculty or staff person at Elon could sponsor a student, so long as he or she was willing to verify that the student’s idea could become a safe and viable project. An ideal sponsor would have expertise or skills related to the idea, to fill in the gaps of the student’s skills. I’ll discuss more about the sponsor in the Sponsor section below.

The last step for students was an online application, which asked students to explain their idea and why it deserved funding, and name their sponsor. The application also laid out what the student would be expected to do if he or she received a Kickbox, and addressed other frequently asked questions. Review the FAQs on the Elon Kickbox website at www.elon.edu/makers/kickbox. The form also asked students if they would be working as individuals or a team, and if they had received any other funding for their idea.

Once the application period closed, the Maker Hub student staff (nine students), two faculty and two professional staff reviewed them. The faculty were members of Elon's Academic Technology and Computing Committee, an existing group on campus that provides technology grants to faculty. The professional staff were the administrators of the Maker Hub. Names were removed from the applications before the group reviewed them.

Each group member completed a rubric for each submission. The criteria for the rubric is in the appendix. Reviewers were given two weeks to read the applications and complete the rubric. Then, the same two faculty, two staff, and two representatives from student staff met to discuss each idea and decided whether to award it a Kickbox. The group didn't decide if the idea was good or not (the sponsor has already vouched for it). Upon identifying the recipients, the group contacted the spon-
sors for confirmation that the idea was safe and worth pursu-
ing. Once the sponsors confirmed, the group notified the stu-
dents.

CONTENTS OF KICKBOX

The physical red box that every Kickbox student received was a very important part of the program. It included several items and featured a $300 Visa gift card and a stack of cards called level cards.

LEVEL CARDS

The level cards break down a design process into actionable tasks. During the semester, students went through the level cards, completing tasks and moving through the five levels of a design process: Inception, Ideate, Make, Improve, and Present. At the Inception level, students identified their motivation for the project. In Ideate, they completed a series of tasks to help them refine or augment their idea. On the Make level, they designed, built and tested a prototype. Next, they improved the prototype and asked questions while observing it. The final level was a presentation where students prepared to share their work with a larger audience.

Nearly half of students (8 out of 18) found the level cards extremely or very useful, and five students called them slightly or not at all useful. Five students found them moderately useful. In comments, students said the cards were important in the ideation phase of their project, and one student referred to them as the most useful part of their Kickbox experience. Other students thought the cards were too inflexible, weren’t applicable to their project or started at too basic a level.

FUNDING

Students were in control of their budgets and did not need pre-
approval for purchases. The only requirements were that they could rationalize their purchases and that they kept and submitted their receipts, along with a budget sheet, at the end of the project.

Students used their funding to purchase supplies, tools, meals with their sponsor or expert in the field, fees to access a larger makerspace, professional services from websites like Fivr.com, conference registrations, etc. If they purchased a tool, like a Dremel or an iPad, they were required to donate it back to the Maker Hub at the end of the project to deter students from spending all the money on one big purchase.

Interestingly, even with few restrictions on purchases, students did not use all the money. Nine projects used all $300, six projects used approximately half of the $300, and three projects used none of the money. Projects that didn’t use their budget relied heavily on the tools and supplies in the Maker Hub or had a software-based project that didn’t require materials.

Most students (11) said they thought the funding amount was adequate. Two students suggested raising the funding to $500 or $1,000 to allow for larger projects. Another suggestion was to let teams apply for a specific budget. Then, projects that needed more money could get more. Another student suggested giving students an option to donate their unused funds to other projects. Some students discussed a few situations when the gift card wasn’t ideal. One student hired a local seamstress to sew a prototype, and she didn’t accept credit cards. Another project involved a large team and when team members wanted to purchase something for the project but didn’t have a card, they couldn’t.

OTHER ITEMS IN THE BOX

Each Elon Kickbox included supplies that related to activities in the level cards. Each box had a notebook, a smaller bad ideas notebook, a pen, post-it notes, a timer, a chocolate bar, and a gift card for a campus coffee shop, in addition to the $300 Visa Gift Card.

Each Elon Kickbox cost approximately $370 to produce. We purchased the Visa gift cards from our local credit union and each card cost a $2 fee. Also, because we bought the gift cards with a University credit card, the card added a 3% finance charge to the transaction. Purchasing Visa gift cards from a reseller might be cheaper, but be aware that they usually have stiffer penalties if the card is not used within a year. Because
we had several cards that were not fully used during the semester, we wanted to be able to use the cards the following year.


Table 1 Cost of Elon Kickbox

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISA Gift card</td>
<td>$300 + $2 fee + 3% finance charge when using a University credit card to pay = $311</td>
</tr>
<tr>
<td>Gift card to coffee shop</td>
<td>$20</td>
</tr>
<tr>
<td>Chocolate bar</td>
<td>$5</td>
</tr>
<tr>
<td>Office supplies</td>
<td>$15</td>
</tr>
<tr>
<td>Boxes, printing, etc.</td>
<td>$20</td>
</tr>
<tr>
<td>Total</td>
<td>$371</td>
</tr>
</tbody>
</table>

THE PROGRAM

While the students could work through the Kickbox alone, we found that integrating the box in an intentional program that included interactions with fellow Kickboxers, meetings with sponsors, and other milestones helped students stay on task and complete the program.

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(3 weeks after the kickoff meeting) - questions and answers, value of prototypes</td>
</tr>
<tr>
<td>3</td>
<td>(8 weeks after the kickoff meeting, after spring break) - copyright and licensing primer</td>
</tr>
<tr>
<td>4</td>
<td>(10 days before showcase event) Preparing for the showcase events and developing an elevator pitch for your project</td>
</tr>
</tbody>
</table>

SPONSOR

In addition to vouching for their idea on the Kickbox application, sponsors were also required to meet with their students at least three times throughout the semester. We provided suggested topics for those meetings, but the students were free to discuss whatever they needed with their sponsors.

Students reported a variety of involvement of sponsors. Some sponsors were used as mentors, providing advice on how to proceed and identifying others on campus who could help. Some sponsors were in an assistant role, helping with the technical side of the project. Other sponsors provided inspiration and encouragement. Most students reported meeting with their sponsors early in the semester to help develop a plan for the project. For some students, that was their only meeting with their sponsors. One sponsor was not involved at all in his student's project while another met with his student every week. The frequency of most sponsor meetings was somewhere in between those two.

The Maker Hub gathered feedback from sponsors with an online survey. While only 11 of the 16 sponsors completed the survey (one faculty member sponsored three projects), seven of them said they would sponsor another Kickbox student again, and three said maybe. When asked how they were involved in their student’s project, they said they helped pick out and order parts, mentored on the fabrication approaches, vetted ideas and provided encouragement. We asked them to estimate the time they spent with their Kickbox students. Four sponsors spent 0-1 hour with their students, four sponsors spent 2-4 hours, two sponsors spend 5-7 hours, and one sponsor spent 8-10 hours.

MAKER MENTOR

Each Kickbox student was assigned a Maker Mentor, a student staff member who worked in the campus makerspace. The Mentor's main purpose was to help the Kickbox student identify maker resources available on campus. Students reported the Maker Mentors were helpful in pointing them in the right direction. One student commented it would have been helpful if the Mentor had skills to help with his specific Kickbox project. Some Mentors had expertise that was helpful to individual Kickbox projects, but that wasn't possible for
every project, given our staff skills and the variety of Kickbox projects.

**KICKBOX HQ**

Kickbox HQ is a Moodle page that served as the information repository for Kickboxers. Students used it to track their progress on the milestones, and administrators used it to post the Kickbox Participation Agreement, a budget template, announcements, details on where to look for technical help, and links to the FAQs, as well as to accept anonymous questions.

**MILESTONES**

Kickboxers had a series of milestones they were expected to complete each month. The milestones coincided with the level cards and were designed to help keep students working on their projects throughout the semester. When a student completed a milestone, he or she checked it off on Kickbox HQ. The administrator used this information to find students who were falling behind and contact them for a quick meeting. The milestones for February are in the appendix.

89% of the students found the milestones to be reasonable (16 out of 18). Students liked the structure the due dates provided to "keep us on track for what needed to get done." Another student commented that the flexibility of the due dates encouraged procrastination - "it was easy to put the project on the back burner for large chunks of time." Another student commented that it was stressful trying to finish all the milestones at the end of the project. The deadlines were soft and students who didn't meet the milestones within the month were not penalized. Adding repercussions for missed deadlines might help some students stay on task.

**Table 2 Timeline for students**

<table>
<thead>
<tr>
<th>Month</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>Identify and talk with a faculty or staff sponsor. Complete online application.</td>
</tr>
<tr>
<td>January</td>
<td>Reply to email with availability for kickoff workshop.</td>
</tr>
<tr>
<td>February</td>
<td>Meet with Kickbox sponsor. Meet with Maker Mentor. Attend kickoff workshop. Work through levels one and two in the level cards. Create a project web page and write a journal entry. (Full list of February’s milestones are in the appendix).</td>
</tr>
<tr>
<td>March</td>
<td>Meet with Kickbox sponsor a second time. Complete level three and begin level four in the level cards. Attend March workshop. Write a journal entry on the project web page.</td>
</tr>
<tr>
<td>April</td>
<td>Meet with Kickbox sponsor a third time. Complete level four and five in the level cards. Create a flyer for the project to give out at showcase events. Display work at campus showcase event and a community Maker Faire. Write a journal entry on the project web page.</td>
</tr>
</tbody>
</table>

**May**

<table>
<thead>
<tr>
<th>Responsiblities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post flyer on the project web page. Complete online survey. Attend wrap-up meeting. Return receipts and unused VISA card to Kickbox administrator.</td>
</tr>
</tbody>
</table>

**Important: Elon’s spring semester starts in February. An earlier spring semester may require moving the timeline up a month.**

**JOURNALS**

Students were required to do six reflective writings throughout their projects. The journals helped the students reflect on their progress and helped the administrators identify the learning taking place. Topics for each journal entry were suggested but not required, and usually coincided with a project event, like meeting with a sponsor, creating and testing a prototype, etc. Students were encouraged to include photos and videos of their progress and required to post a link to their writings in Kickbox HQ so other students could follow their progress. We used the website Hackaday.io for the journals. The website worked well, but most students didn't leverage the additional features or community of the Hackaday.io website. A blog would likely be adequate for these reflections.

According to comments on the survey, some students found the journal entries cumbersome. While they saw the need for them, they felt the number of required reflections was too high. The journal milestones were indeed the most frequently missed milestones. Instead of required reflections twice a month, once a month might be sufficient.

**SHOWCASE**

At the end of the semester, Kickbox projects were showcased in two ways. The Maker Takeover at the Moseley Center was an on-campus event for Kickboxers to show their work and get feedback from students, faculty and staff members. This event, held in the campus dining hall, was covered by campus media outlets and led to several conversations beyond the event. Kickboxers also displayed their progress at the Burlington Maker Faire, the largest Maker Faire in North Carolina. Both events were opportunities for students to show off their work and get feedback from the campus and broader communities.

Students showed genuine enthusiasm at the showcase events. Many of them used the showcases to gather feedback on their ideas or designs. One group gathered survey data from Maker Faire attendees to strengthen the case for their idea.

**OUTCOMES**

In the two years of running the Elon Kickbox program, we've awarded 22 Kickboxes. Of those, 18 completed the program. Those students were from 14 different majors, ranged in academic standing from first-year students to a doctorate-level in the School of Health Sciences, and were comprised of seven females and 11 males. We attribute this diversity of academic programs, grade level, and gender to the Maker Hub's interdisciplinary approach. Several first-year students and non-
STEM majors told us they likely wouldn't have made progress on their idea if not for Elon Kickbox.

The 18 projects ranged in purpose and level of completeness. Some projects ended with a wireframe of an app, a 3D printed model of a possible solution, an initial prototype or a working prototype. The purpose or goal of each project also varied.

The Kickbox projects highlighted below show the range of projects. More details on these projects and the 14 others are available at www.elon.edu/makers/kickbox.

Sweat EZ Tee  
Lead investigator: Brittni N Bly, Physical Therapy student  
This idea was for an inexpensive and reusable undershirt to prevent sweat dampness and stains from showing through any color clothing. The goal of this product was to eliminate stress over sweat stains and help people live more clean and confident lives.

Sound reactive LED guitar  
Lead investigator: Sarah Hennenkamp, Computer Engineering, Music Production and Recording Arts student  
By merging computer science, music, and visual arts, Sarah Hennenkamp designed and created a 3D-printed guitar with LEDs that change color while being played.

Stoichiometry board game  
Lead investigator: Alexandra Strelow, Masters of Education student  
A high school chemistry teacher working on her master's degree, Strelow created a board game to help her sophomores better understand one of the gnarliest chemistry concepts, stoichiometry.

Food Driver  
Lead investigator: Tyson Glover, Strategic Communications, Entrepreneurship, Leadership Studies  
Food Drivers is a program that partners drivers-ed programs with local food banks so soon-to-be drivers will deliver food to pantries during their driver training.

DISCUSSION  
Elon Kickbox will continue to evolve as we incorporate additional elements based on feedback from participants. We plan to reduce the number of reflective writings to make it less burdensome and increase the penalties for missed milestone deadlines to hold the students more accountable throughout the semester, not just at the end. We still need to identify a solution to make the sponsor involvement more consistent across projects, so all students get the mentorship and technical guidance of their sponsors.

We’re also exploring ways to give students more time to work on their projects. Elon students have a lot of curricular and co-curricular responsibilities so fitting in another task can be challenging. We could start the program in the fall, but additional time wouldn’t improve its prioritization.

One idea to overcome this prioritization problem is to offer Kickbox as a for-credit class. This way, students would have class time dedicated to meetings and work time. They would have the additional motivation of a course grade to help with the prioritization. The downside of that idea, however, is that many Elon students are taking full credit loads and wouldn’t be able to add another class. It would also complicate the relationship between the sponsors and Kickbox. If Kickbox becomes a class and not an extracurricular activity, one could argue that sponsors should be paid for their time.

CONCLUSION  
Elon Kickbox has had several positive side effects for making on campus. The Kickboxer students became familiar and comfortable in the Maker Hub, making them de-facto ambassadors for making on campus and in their social and academic circles. The faculty sponsors had a raised awareness of the resources available on campus. Kickbox projects gave the Maker Hub really interesting projects to talk about with other campus community members.

When reflecting on their Kickbox experiences, students pointed to the supportive community. The community provided by their fellow Kickboxers, their Maker Mentors, their sponsors and program administrators gave them confidence to take on challenging projects that they wouldn't normally attempt.

When asked to give future Kickboxers advice, student participants were encouraging, telling future Kickboxers not to get discouraged “if things don’t seem like they’re going as you planned.” One student suggested, “make as many prototypes as you can” and be flexible because the “final product may take many twists and turns.” Other students urged their classmates to start early because ideas need a lot of refinement. Another student said: “Even when everything is going to pieces and your plan isn't working, keep banging your head against the problem and you'll eventually get something out of it.” Other students suggested doing a lot of research and looking for help on campus. These are all great suggestions and tie directly into the characteristics of a maker mindset that we try to foster at Elon University [3].
ACKNOWLEDGEMENTS

The author would like to thank the following colleagues and students for their work on the Elon Kickbox project and help analyzing the survey results.

- Michael Vaughn – Elon University
- Jessica Gore – Elon University alumni
- Jordyn McAtee – Elon University student

REFERENCES


APPENDIX

RUBRIC FOR EVALUATING APPLICATIONS

Members of the review group and Maker Hub student staff were all asked to complete the rubric for each idea. The rubric was an online survey in Qualtrics. For each Kickbox idea, reviewers answered the following questions with Yes, Maybe, No, or I don’t know.

This idea:

- Supports the work of the Maker Hub and Elon's mission.
- Clearly identifies a problem to solve.
- Progress is doable in three months.
- Would you give this idea a Kickbox?

A text box was available for each idea so reviewers could leave comments, ask questions and offer their strong support or skepticism for ideas. Scores were shared with members of the review group who made the final decision.

AGENDA FOR KICKOFF MEETING

- Student interviews and introductions - students pair up, interview each other about their projects and tell the rest of the group what they've learned.
- LEGO activity where everyone uses 7 LEGO bricks to create simple structure of something meaningful to you. Then the person next to you destroys it. Debrief explains not to get attached to what you’re making because it'll go through many iterations.
- Motivations activity where students identify the what, how and why of their Kickbox idea.
- Distribute boxes one at a time and take pictures of each student with his or her box. Students wait to open the boxes as a group.
- Open boxes as a group and everyone explores the contents of the box individually.
- Discuss the contents of the box as a group and verify everyone has the correct materials.
- Discuss the expectations and rules of Kickbox. Before the kickoff meeting, all students are required to review and sign-off on Kickbox Participation Agreement where they agree to the terms of the project. Remind them of key points of the program, like acceptable purchases, keeping receipts, and meeting milestones.
- Introduce Kickbox HQ; the Moodle site used to administer the program.
- Students complete the first activity in the level cards.

MILESTONES FOR FEBRUARY

- Get a Kickbox.
- Complete the Kickbox Participation Agreement.
- Create a Hackaday.io profile and project page.
- Post the link to the project page in Kickbox HQ.
- Complete level 1 on the Kickbox level cards.
- Complete level 2 on the Kickbox level cards.
- Post your first journal entry.
  - Possible topics: Reflect on Kickbox levels 1 and 2; summarize research you’ve done any initial thoughts about this experience.
- Meet with your Kickbox sponsor and maker mentor
  - Possible topics: Discuss your idea after completing cards 1 and 2, discuss your plan for the project, additional resources or help you may need, whatever else is useful for your project.
- Post your second journal entry
  - Possible topics: Recap the meeting with your project sponsor and/or mentor and lay-out your plan for the project.