Increasing Inclusive Access to Makerspaces Using Digital Badges

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Introduction

Academic makerspaces are becoming commonplace in education and are found in grade schools, high schools, and on college campuses. The structure of a makerspace varies widely: they can be found tucked away in a corner of a library, stuffed into a repurposed storage room, sprawled across an entire floor of a housing complex, or as a thoughtfully designed facility that becomes a campus focal point. Regardless of the type of space a makerspace inhabits, there is a shared responsibly to ensure all students feel invited into these spaces and are provided with adequate introductory information and equipment training. To achieve these goals, we must provide students with flexible, adaptable learning opportunities that take the diverse array of student backgrounds, learning attitudes, skills, and prior knowledge into consideration.

This work shares the experience of developing an open-access training structure designed to introduce students to a makerspace environment focused on inclusive and accessible structural elements. Utilizing a digital badging structure, the Western Washington University (WWU) Engineering & Design Makerspace created a series of project-based training modules that provide introductory information, safety protocols, and detailed instruction on how to use makerspace equipment. Badges also include information about makerspace norms followed by individualized in-person instruction and support. This method of training presents an opportunity to reduce barriers to access, support flexible learning preferences, provide educational consistency, reduce strain on staff, and promote integration of makerspace training into established courses.

What are Digital Badges?

Digital badges, which are modeled after Boy and Girl Scout badges [1], are visual representations of the competencies gained by a learner after completing an activity associated with a topic area [2] [3]. Content areas associated with digital badges focus on learning that takes place outside of traditional classroom environments such as makerspaces, labs, internships, and research experiences [4] [5]. Research has shown that digital badges increase student engagement, positively impact student motivation, facilitate goal setting, and improve the accessibility of learning [3] [6] [7]. This type of learning platform allows diverse learners with different goals and interests to tailor their education in meaningful ways. Considering the above, the authors chose to use the digital badge model to support learning in a makerspace with the goal of providing diverse student users with inclusive and accessible learning support and training.

The WWU Makerspace

Well-supported and structured academic makerspaces provide students with open access to resources that help them develop their problem-solving skills, provide opportunities for collaboration, increase self-efficacy, and develop a sense of belonging [8] [9]. The WWU Engineering & Design Makerspace opened in Fall 2021 and is supported primarily by student staff. This 1500 square foot facility is open to all WWU students and provides access to equipment, tools, and training as well as opportunities for cross-departmental collaboration. Figure 1 shows the available equipment and general layout of the space.

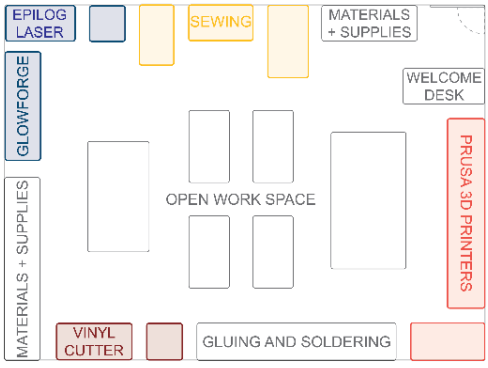

Fig.1 WWU Makerspace Layout

The makerspace is designed specifically to support lower division students who often lack access to the lab and project experiences that are so critical to the development of sense of belonging, self-efficacy, and STEM identity. There is a focus on creating a makerspace the promotes a culture of collaboration and inclusion.

The WWU Makerspace Badge Program

The WWU makerspace relies primarily on students to staff most open hours. This structure poses challenges related to equipment training, safety, and consistent oversight and supervision. Considering that the makerspace has large numbers of users who are not familiar with makerspaces and related equipment, the authors recognized the importance of developing an accessible and robust equipment training platform. The goal was to create a system that could be used

to train staff, faculty, and students who had zero knowledge of the associated equipment and would not require constant oversight or interaction from a full-time professional staff member such as a makerspace manager. In addition, the authors wanted to minimize common barriers to makerspace engagement and access such as feelings of intimidation, lack of confidence, and low sense of belonging to the space [10]. A third goal was to create training modules that had consistent formatting so users would know what to expect once they completed one of the modules. The badging system Badgr (www.badgr.com) is used to issue and manage digital badges. The WWU makerspace, having 4 equipment zones, has a digital badge associated with each major piece of equipment, as described in Table 1.

Table 1: Badges supporting the WWU Makerspace

Badge	Icon	Content Description
3D Printing Basics		Introduction to 3D printers; find and prepare a file; create a 3D printed object.
Vinyl Cutter Basics		Introduction to vinyl cutters; prepare a file; create a sticker using the vinyl cutter.
Laser Cutter Basics		Introduction to laser cutting; example of laser cut objects; prepare a file; cut and etch wood.
Sewing Basics		Introduction to sewing; prepare a sewing machine for use; operate the machine; create a sewn textile.

Badge Structure

Each badge consists of two components: 1. An online component and 2. A project-based component. The online component of every badge has the same structure and includes learning objectives, readings/media (typically videos, photos and text that introduce the equipment), safety protocols, assessments (short quizzes), and digital resources that will be useful for the project portion. After students complete the online component, they are invited to come to the makerspace to complete the project. The projects are chosen specifically to appeal to a wide variety of student interests with an intentional effort to avoid techno-centric and masculine characteristics. Projects can also be personalized to support students with varied interests and at different levels of understanding. Once students complete the project, they can then claim their badge. The badge image and associated metadata can be shared with other entities both internal and external to the institution.

Badges Earned

The WWU makerspace badge program was launched in September 2021. During the 2021-22 academic year, there were approximately 500 makerspace users per quarter with a total of 1497 users from all over campus. There have been 538 total badges earned by students, staff, and faculty. Table 2 shows the breakdown of badges earned by equipment type.

Table 2: Number of Badges Earned 2021-22 Academic Year

3D Printing	Laser Cutting	Sewing	Vinyl Cutter
155	179	125	79
TOTAL = **538**			

Successes & Limitations

Overall, the digital badging structure has been a successful way to provide makerspace equipment training to students, faculty, and staff at WWU. The self-paced, open access nature of these digital badges allows makerspace users to access the training modules at any time and from any location. The badging model provides opportunities for students to acquaint themselves with the space and available equipment prior to physically entering the space and allows them to personalize their learning experience. This is particularly helpful for students with social anxiety or those who may feel intimidated by makerspace environments. In addition, since the badges are housed within the WWU learning management system, faculty can easily incorporate the modules into their courses. Furthermore, the digital badges reduce demands on staff, allowing them to focus on supporting student project work and developing personal connections within the makerspace. And finally, the structured nature of the badges provided consistency in educational experiences which eliminates confusion due to formatting or requirement variations.

A limitation of the badge program is that the curriculum is not currently available outside of WWU, though it could be shared with others who utilize Canvas. For students who do not like to learn online, this structure may be seen as a barrier. In addition, if a student has a question or needs help while completing the online portion of the badge, they may not be able to reach a staff member right away which could negatively impact learning.

Conclusion

Utilizing digital badges as an equipment training platform can provide students, staff, and faculty with an open-access, flexible model that supports learning in the makerspace. The makerspace badges incorporate accessible and inclusive design elements that take into consideration students' varied backgrounds, prior knowledge, learning preferences, and interests. Future work will involve evaluating the effectiveness of the badging system on knowledge gained and measuring the impact of the system on students' sense of belonging to the makerspace.

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