2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
Paper ID #53188

Making with Purpose: Faculty Development in Inclusive and Equitable Making

Dr. Erin Henslee, Wake Forest University

Dr. Erin Henslee is a Founding Faculty and Associate Professor of Engineering at Wake Forest University. Her research spans biomedical engineering, STEM education, and Makerspace pedagogy. Prior to joining Wake Forest, she was a Researcher Development Officer at the University of Surrey where she supported Early Career Researchers working in the area of inclusive researcher development. She has taught over 20 different engineering courses across a variety of institutions and departments.

Making with Purpose: Faculty Development in Inclusive and Equitable Making

Abstract

This Evidence-Based Practice paper describes the faculty development component of a larger NSF-supported project on integrating inclusive "Making" pedagogy in higher education classes. While the literature into the use of Makerspaces has increased over the last decade, Making pedagogies are still an understudied area, particularly with respect to higher education. This work aimed at supporting faculty in developing intentionally inclusive and equitable Making activities and describes the faculty development and outcomes of the project.

Eight faculty were recruited to the project including 3 Engineering, 2 Education, 1 Math, 1 Physics, and 1 Law School instructors. The faculty cohort participated in a series of three summer workshop sessions and summer reading. The sessions were organized for faculty to plan and iterate their Making activities, adding layers of inclusive practice and intentional assessment as well as identifying barriers to their implementation. Another underlying goal of this faculty cohort was to start to establish an institutionally inclusive definition of "Making" and maker-learning to better support future faculty in including Making in their pedagogy.

In addition to equipment training and supply identification, assessment of making activities and supporting student autonomy in Making projects (providing them choice in the type(s) of Making they could engage with rather than prescribed) were the primary knowledge gaps faculty identified as summer development goals. Maker learning was defined by the cohort in several knowledge, skills, and attitudes (KSA) areas as well as in broader terms. From this, each faculty developed assessment plans that linked their course learning goals to their Making activities and their definitions of maker learning. Faculty barriers to implementing Making in their classrooms included resources, time, and staff support. Discussions centered around removing barriers included alternative materials procurement, thinking about sustainable design (low-tech options), and Makerspace training (for faculty and provided TAs). The cohort also created pre-questionnaires to invite their students to share any accessibility needs for using the spaces.

Faculty also completed a pre-post Likert survey that aimed to gauge their efficacy in inclusive Maker learning and to help us determine if the faculty development process assisted in positively impacting faculty efficacy in these areas. The faculty pre-survey indicated faculty were not confident in creating inclusive learning spaces or in articulating the vision of maker learning on campus. Though not statistically significant, given the small cohort, post survey results indicated an overall increase in faculty efficacy in creating inclusive learning environments as well as articulating/implementing Maker learning. From student data, it seems more effort (by the faculty and assignments design) should be spent linking the Making activities to student learning of course concepts so students can better articulate and connect to the value of the learning experience.

The preferred presentation format is a talk.

Introduction

Current literature supports the value of implementing Making pedagogies to improve student outcomes [1-4]. However, disciplinary differences, minority social identities, and the ways in which Making is implemented may all have compounding effects that could ultimately lead to inequitable, and in some cases, negative outcomes [4-6]. The goal of this work was to support a University faculty cohort in implementing and assessing Making as an active learning approach, in an informed, effective, and inclusive way. The goals of the faculty development cohort were to:

- Implement and assess intentional, inclusive Making practices in courses at the University.
- Co-create assessment tools appropriate across academic disciplines for mapping student learning outcomes to activities, student self-efficacy, and student character development (including creativity, curiosity, motivation, and teamwork).
- Collect student data on learning outcomes attainment, student self-efficacy, and character development.
- Collect student counter-narratives on student experiences with Makerspaces, Wakerspace, Innovation Studio, and course activities.
- Inform future faculty development on Making practices.

This paper describes the faculty cohort model that was informed by literature best practices in inclusive Making, and key outcomes including faculty experience as it relates to student outcomes and the pilot of pre-post cohort participation survey on efficacy in designing inclusive Making experiences.

Methods

Faculty Cohort and Courses

An open call for participation was sent out to faculty via the campus Makerspace. Eight Wake Forest faculty were originally recruited to the project including 3 Engineering, 2 Education, 1 Math, 1 Physics, and 1 Law School instructors. The courses that were used to pilot the project included: Introduction to Engineering Design, Materials and Mechanics, Underwater System Design, Issues and Trends in Education, Learning & Cognitive Science, Explorations in Mathematics, Mechanics, and Artificial Intelligence and Regulatory Disruption.

Faculty Development and Inclusive Making Pedagogy

Prior to the Fall 2023 semester, the faculty cohort participated in a series of three summer work sessions:

Session 1- Planning and Background. Faculty submitted their proposed project plans, goals and questions to a shared Canvas site. They were also provided copies of four books (Re-making the Library Makerspace Critical Theories, Reflections, and Practices, Makerspaces for Adults: Best Practices and Great Projects, Creative Acts for Curious People: How to Think, Create, and Lead in Unconventional Ways, The Maker Playbook: A Guide to Creating Inclusive Learning

Experiences [4-9]) and instructed to read certain sections of each (with optional reading assignments to choose from) to prepare for the next session.

Session 2-Defining Maker Learning and Inclusive Making. Faculty participated in an in-person workshop responding to the following prompts:

- Maker Learning is...concepts or terms that are essential to maker learning or makerspaces.
- Barriers to inclusive Making/Maker culture...in general, at the University, in your course/department.
- Refine definition(s) from prompt 1 to include words/phrases that increase inclusivity based on prompt 2. Maker learning is...

Session 3- Based on Sessions 1 and 2, each faculty member was tasked to iterate on their Making pedagogical approach and share final plans and project needs with the project coordinators. This included timeline of Making activities, space, consumable and staffing needs, and proposed assessment plan.

Faculty also completed a pre-post survey that aimed to gauge their efficacy in inclusive Maker learning and to determine if the faculty development process assisted in positively impacting faculty efficacy in these areas. The Likert scale (1-5) questions, which came from the Wake Forest University's Inclusive Teaching Conference Faculty Pre-survey (2021) and the Maker Playbook [10] included:

1. I am confident in my ability to create inclusive learning spaces and experiences to a diverse audience.
2. I update my syllabus and course practices regularly to enhance inclusion.
3. I collect student feedback (formal or informal) regularly and in an equitable way.
4. I am proactive about including texts and examples from diverse sources.
5. I do not know the vision around maker learning or how it relates to our university missions and vision.
6. I know the vision but am not sure how to bring it about in department/classroom.
7. I think I know what maker learning is and why it is important but I am a little skeptical.
8. I have a clear understanding of and can articulate our vision around maker learning and why it is important.

The pre-survey was administered prior to Session 1 work. The post-survey was conducted at the end of the semester in which they implemented their project.

Results & Discussion

Outcomes from the faculty development sessions

From Session 1, five of the eight faculty identified course projects (cumulative or stand alone) as the goal for their Making activities, while three of the five aimed to use Making throughout the course. When asked about their goals for the faculty development, six identified equipment training as a goal, three listed help with supply identification, three listed assessment of making activities, and two listed curriculum design. Several faculty were interested in how to support student autonomy in Making projects (providing them choice in the type(s) of Making they could engage with rather than pre-prescribed).

From the Session 2 workshop, Maker learning was defined by the faculty in several knowledge, skills, and attitudes (KSA) areas as well as in broader terms (Figure 1). Words used to describe knowledge areas included: problem-solving, communication of concepts, design process, and transferability. Skills areas included: safety, training, teamwork, and tool proficiency. Attitudes received the most attention (the most post-it notes were shared mapping to this) and included: grit, exploration, creativity, autonomy, and growth mindset. As a group, faculty defined three "domains/modes of Making pedagogy": Making that leads to technical, conceptual, or dispositional competencies. From this, each faculty member developed assessment plans that linked not only their course learning goals to their Making activities but also used their definitions of maker learning to assess the Making activities. For example, to foster creativity and autonomy, a creativity rubric was created to assess student creativity- independent of student submission type (i.e. they could submit an artifact of choice).

Figure 1: Digital replica of the post-it share-out during Session 2.

Following activities outlined in The Maker Playbook [9], Session 2 also guided faculty to reflect on barriers to inclusive Making/maker culture and potential solutions in the context of their courses and how they defined Maker learning (Figure 2). Key outcomes indicated accessibility (the physical space as well as inconvenient location(s) on campus), cost of materials, time, and previous Making experiences as the primary barriers faculty felt they and their students faced when thinking about integrating Making into their courses.

As a result, Session 3 centered around removing barriers and practical planning. First, an NSF-supported grant provided project materials for any courses where the department did not grant the faculty a course budget. For sustainability of the projects, faculty focused on projects that could support reusable consumables such as Arduino boards, and low-tech options such as cardboard. Next, the group worked with both campus makerspaces to coordinate time and training for all students during class times (to remove the burden of out of class training) and created pre-questionnaires to invite students to share any accessibility needs for using the spaces. Finally, student TA support was also provided by the grant to assist students in and out of class with their project needs as well as remove the barrier of faculty efficacy with certain equipment ("expert" TAs were assigned to faculty with less experience).

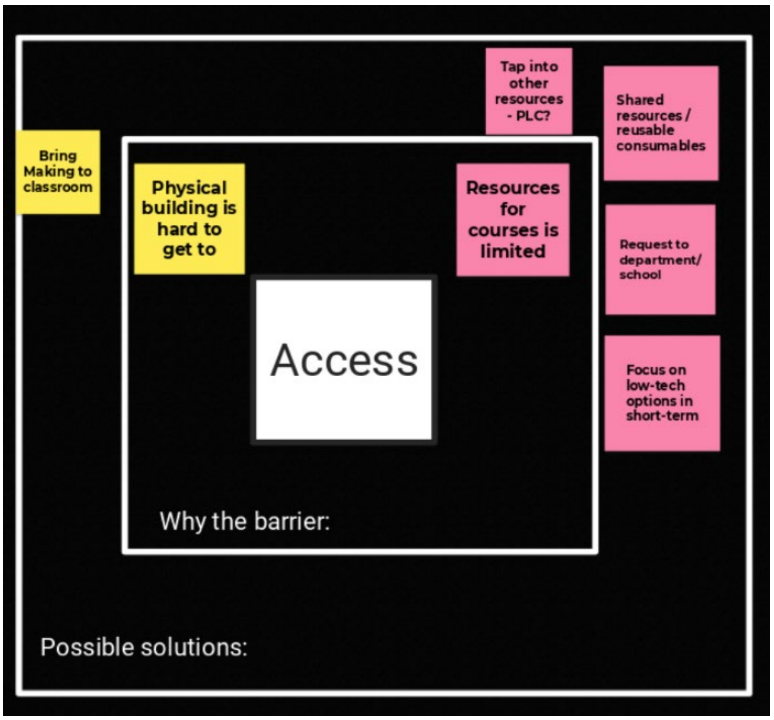

Figure 2: Digital replica of post-it activity completed in Session 3.

Faculty Data

The faculty pre-survey indicated faculty were not confident in creating inclusive learning spaces or in articulating the vision of maker learning on campus. Though no statistically significant results, given the small cohort, post survey results indicated an overall increase in faculty efficacy in creating inclusive learning environments as well as articulating/implementing Maker learning

(Table 1). Though this data is based on a small cohort (n=8), it suggests the utility in the faculty development programming and creating a cohort definition of Maker learning on campus.

Table 1: Faculty Pre and Post Efficacy Survey on creating inclusive maker learning experiences. Responses are means (n=8) on a 1-5 Likert scale.

	Pre	Post
1. I am confident in my ability to create inclusive learning spaces and experiences to a diverse audience.	3.7	3.9
2. I update my syllabus and course practices regularly to enhance inclusion.	3.9	4.1
3. I collect student feedback (formal or informal) regularly and in an equitable way.	3.6	3.8
4. I am proactive about including texts and examples from diverse sources.	3.9	3.9
5. I do not know the vision around maker learning or how it relates to our university missions and vision.	4	3.7
6. I know the vision but am not sure how to bring it about in department/classroom.	2.1	1.8
7. I think I know what maker learning is and why it is important but I am a little skeptical.	3.7	2.4
8. I have a clear understanding of and can articulate our vision around maker learning and why it is important.	3.1	3.8

Faculty comments about the development plan and project implementation included:

- *I could not have run my course without this opportunity. Every barrier was removed and I could teach the way I wanted to teach!*
- *There were issues of inclusion I hadn't thought of (like low distraction environments). This really helped me be more intentional in my project designs.*
- *I had no idea how to assess different projects, and now I feel confident to give students choice!*
- *I am unsure how this would be sustainable without substantial support from staff (Makerspace staff and students) and funding (for supplies).*
- *Though I have a better understanding of how to and why I should implement making into my courses, I still don't know what the university goals are for the space (or what they find valuable).*

Recommendations and Future Work

Our two campus makerspaces were opened in 2017 and 2021. There was expressed need to be more intentional in our campus efforts of inclusion, as well as equitable access and opportunities for engagement with the spaces. The goal of this work was to support faculty in implementing and assessing Making as an active learning approach, in an informed, effective, and inclusive way to meet the needs of our students in the 21st century. The student data collected as part of the larger NSF project suggested that more effort should be spent linking the Making activities to student

learning of course concepts (either in the project design or in the communication of that link to students) so students can better articulate and connect to the value of the learning experience. Timing of the projects also impacted student engagement with the activity, particularly having a negative impact on open-ended projects that coincided with exam periods.

As PI on this project, the major recommendations to other faculty developers in this space include:

- Many faculty are not aware of the institutional mission of the Makerspace
- Two major factors influence faculty decision-making on the use of Making as a teaching tool: their efficacy in the Makerspace and financial support/sustainability (from the Makerspace or department)
- Faculty need support on assessment of Making activities. This includes *how* to assess, but also support in the assessment itself (time, effort, capacity)
- Careful consideration of linking the Making to student learning should be made in the design of the activity(ies) and articulated to the students (and have the students articulate it back in some form of reflection)
- Faculty would like more ideas for shorter, low tech options to reduce barriers of entry (for them and their students)

References

[1] Rayna, T. and Striukova, L., 2020. Fostering skills for the 21st century: The role of Fab labs and makerspaces. *Technological Forecasting and Social Change*, p.120391.

[2] Lagoudas, M.Z., Froyd, J.E., Wilson, J.L., Hamilton, P.S., Boehm, R. and Enjeti, P.N., 2016, June. Assessing impact of maker space on student learning. In *Proceedings of 2016 ASEE Annual Conference and Exposition, New Orleans, LA*.

[3] Saorín, J.L., Melian-Diaz, D., Bonnet, A., Carrera, C.C., Meier, C. and De La Torre-Cantero, J., 2017. Makerspace teaching-learning environment to enhance creative competence in engineering students. *Thinking Skills and Creativity*, *23*, pp.188-198.

[4] Masters, A.S., 2018. How making and maker spaces have contributed to diversity & inclusion in engineering: A [non-traditional] literature review. In *Collaborative Network for Engineering and Computing Diversity Conference, Crystal City, VA*.

[5] Melo, M. and Nichols, J., 2020. *Re-making the Library Makerspace*. Library Juice Press. Sacramento, CA.

[6] Tan, M., 2019. When makerspaces meet school: Negotiating tensions between instruction and construction. *Journal of Science Education and Technology*, 28(2).

[7] J., Hicks and J., Long J, *Makerspaces for adults: Best practices and great projects*. Rowman & Littlefield Publishers, 2020.

[8] S.S., Greenberg, *Creative acts for curious people: How to think, create, and lead in unconventional ways.* Ten Speed Press, 2021.

[9] C., Haebig. *The Maker Playbook: A Guide to Creating Inclusive Learning Experiences.* International Society for Technology in Education, 2022.