Full Paper: Future Design Studio – Building a Growth Mindset and a Path to Persistence Through Improvisation and Design Fiction

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I. Introduction

This paper presents the initial results of an orientation workshop for underrepresented and/or at-risk first year science, medical technology, mathematics, and computer science students. Nearly fifty percent of students entering STEM fields leave their majors after the first year, with lack of confidence in their ability to succeed and a sense of isolation cited as major factors. Women, first generation college students, underrepresented minorities and students from low-income families are most at risk for leaving STEM fields [1]. One way to address non-persistence among the above groups is to equip students with the psychological tools needed to succeed. One such tool is the growth mindset, a conceptualization of one's own learning ability and intelligence as a fluid quality capable of growing through work, failure, and iteration [2]. For underrepresented groups in STEM this vision of intelligence as fluid runs counter to the myths (implicit theories) many students internalize that they are either naturally talented or not in math, good at biology or not, capable of being engineers or not. The development of a growth mindset requires experience with challenge, ambiguity, false starts, and eventual success which is praised on the value of the work done, and the processes engaged in, rather than perceived inborn traits [3]. One of the specific education policy recommendations surrounding the growth mindset is to "Integrate validated academic mindset programs and practices into existing school programs." [4]. In this paper, we present the early stage results of one such academic mindset program.

Future Design Studio (FDS) is a multidisciplinary workshop combining science, technology, history, improvisation, design, and making. During the workshop, professional improvisational performers introduce students to improvisation through a series of warm-ups and games. Facilitators then lead a discussion of how science and technology have changed in the past 100 years, followed by a group activity in which they build an artifact from 100 years in the future. The workshop culminates with a performance during which the students work with the performers to envision the ways their designed artifacts might impact future societies.

One of workshops primary learning goals is to help students develop a growth mindset, thus, potentially enhancing retention in STEM. Part and parcel to building a growth mindset is enabling students to confidently and effectively communicate with their peers and instructors. This is accomplished by providing an environment where students build community, foster collaboration, and practice communication skills, while at the same time, developing critical thinking by examining scientific and technological progress over the last hundred years and developing their own ideas about how science and technology will change over the next 100 years. Students are also invited to use design and improvisation to reflect on the ethical and societal issues surrounding science and technology.

FDS was initially trialed as a faculty retreat to receive feedback about the educational value and format. Additionally, two truncated versions, omitting the rather expensive professional improv actors, were performed. First for a group of almost 100 undergraduate teaching assistants and then for approximately 30 students who were members of INQUIRE (INstilling QUantitative and Integrative REasoning) an onboarding program, described below, to help students succeed in

STEM fields. The feedback from these events was used to create a two-day orientation workshop, the focus of this paper, for a cohort of approximately fifty students in INQUIRE.

INQUIRE is for students who want to enter STEM fields but lack the prerequisite math skills for the curriculum. Often these students come from underrepresented populations in STEM or from underserved locations. Although none of the participants in the workshop had declared engineering majors, the challenges faced by students in science, technology, math, and computer science are similar to those faced by engineering students. The premise of INQUIRE is that these students lack only mathematic training and the confidence to succeed. INQUIRE acts as a student peer group, a mentoring group, and colloquium for students during their first year. Women, first generation college students, underrepresented minorities and students from low-income families are most at risk for leaving STEM fields [1]. The INQUIRE program is composed of 70% women, 38% first generation students, 48% underrepresented minority students, and 47% of students are of High-Need financially. The experience gained in FDS is also relevant to several of the stated accreditation goals related to engineering. Specifically, ABET Student Outcomes 3-5: 3 – communicate effectively, 4 – consider the impacts of solutions in a societal context, 5 – function effectively on teams [5].

II. The Future Design Studio

The goal of FDS is to provide participants with a chance to imagine future technologies, build prototypes of such artifacts, and deeply engage with the broader impacts and societal interactions that might occur in such a technological future. Part of this deeper engagement occurs when participants are faced with how their creation plays out in an imagined world, created on the fly, by a professional improv team trained in how to think critically about sociotechnical interactions. This allows the students to explore the unintended consequences and possibly beneficial uses of their imagined technology outside of the initial scope of their creation. Much like real how real world technological uses and societal interactions eclipse the uses initially imagined by their creators. The main components of Future Design Studio are summarized in Figure 1 below.

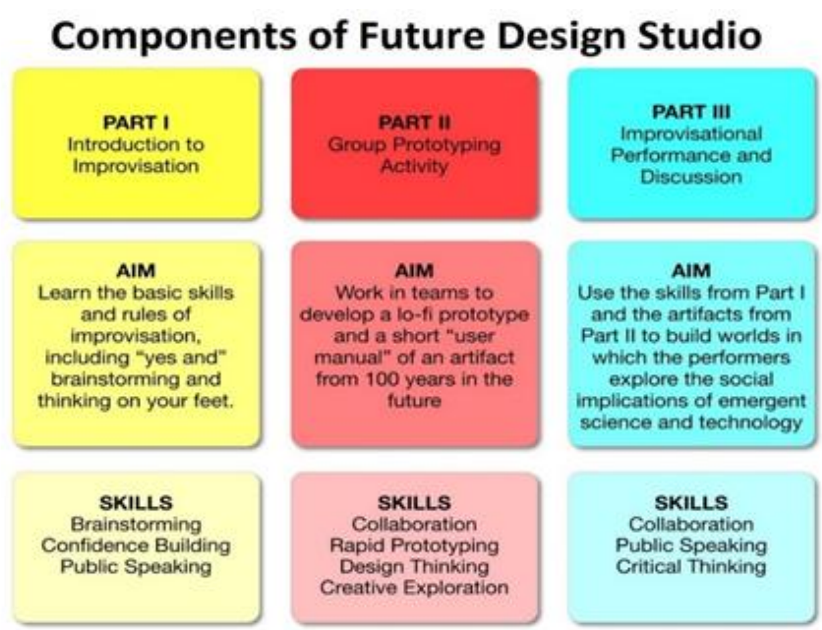

Figure 1 - Learning Outcomes of Future Design Studio

Students first engage in guided improvisation exercises. These exercises are designed to help form teams rapidly, encourage students to build on one another's ideas, and celebrate mistakes. Similar improvisation training is being used by groups like Improv Science and the Alan Alda Center to help both student and professional scientists work better on teams and communicate more clearly to the public [6], [7]. Core tenants of improv include building on one another's ideas by always saying yes and adding to the original idea, celebrating mistakes by treating them with humor, and paying close attention to what your fellows are doing and saying.

Following the improvisational training, students are given prompts in the form of custom fortune cookies. For example, "What does medical care look like in the future?", "What does farming look like in the future?", and "What does sharing look like in the future?". Students discuss what the future might look like for their prompt 100 years from now and build low fidelity prototypes of an object from that future. During the building process, despite the use of low-tech materials, students discuss and reflect on what their object's place in the world may be, and how the object could affect the world around it. In this process of critical and reflective making, students simultaneously build an object and explore how it comes into being, and in the case of a future object, the paths taken to reach such a future [8], [9].

After building a prototype, the students then write an "Abridged User Manual" for their object, explaining what it is and how to use it. The professional improv actors pick a half dozen of the objects to present to the audience. Then, the audience chooses, by round of applause, which objects the actors will use in their performance. The actors then perform a series of long-form scenes that take place in the world in which the object might exist. By creating a "design fiction" using the objects, ethical issues, technological and social infrastructure requirements, and societal changes can be explored via the actors' interaction with the imagined objects. Design fiction offers a rich lens into understanding the real world intersection between society and technology by the exploration of fictional items and situations [10] [11] [12].

Prior to the workshop, the actors are trained by the facilitators in how to critically analyze interactions between technological artifacts and society. The actors read, and discuss with the authors, one journal article and one book highlighting the societal structure within which technologies exist and the results of political interactions between them [13], [14]. This prepared the actors to lead a wrap-up discussion with the student audience on how the performances impacted them and their understanding of ethical and social interactions with their artifacts. This final discussion portion of the workshop gives students a chance to reflect on what the broader world might look like with the existence of their imagined technology. The discussion also serves to introduce students to several friendly faculty members before courses begin.

III. Methods and Analysis

Data collection: During the two-day orientation workshop, Future Design Studio workshop students engaged in a pre-workshop freewriting exercise where they imaged what the future might look like in 100 years. Audio and video recordings were taken during the improv, artifact design, performance, and final discussion portions of FDS. At the end of the event, a closing survey was filled out where the students reflected on the event, what they had learned, and how their vision of the future had changed since their initial freewriting exercise on the first day.

Two months after FDS, students gathered for an hour-long follow-up activity. During this time, the students participated in additional improvisation activities, expanded on their discussions surrounding the ethics and societal interactions of science and technology, and reflected on their experiences during the workshop in a focus group style atmosphere. Finally, at the end of the semester (four months from the workshop), a second follow-up meeting was held. During this time, students reflected on the onboarding program as a whole as well as answering specific questions about how impactful FDS was for their first semester. Some examples of these questions include: “What aspects of the workshop were helpful in other classes?”, “Had they maintained social groups formed during FDS?”, “Had their experience interacting with faculty during FDS improved their relationships with their instructors?”, etc.

Data analysis: All of the data collected during FDS and the follow-up meetings was entered into Atlas.ti, a mixed methods analysis suite, including audio recordings, video recordings, student writings, and researcher participant observation notes. This qualitative data was inductively coded with a focus on learning objectives, thematic types for artifacts, student design methods, and discussions on the interface between science, technology, and society [15], [16]. Codes were then grouped by theme and explored in more depth to present student experiences and outcomes from both the workshop and follow-up meetings. Example quotes, codes and code descriptor phrases are shown in Table 1.

Table 1 - Initial Coding and Representative Quotes

Code	**Examples**
Community Building (I have friends here)	“It also helped me make new friends before classes started.” “I met people at the INQUIRE that I know and talk to almost every day.”
Sense of Belonging (I belong in college)	“I really enjoyed the design studio, and it was helpful in getting me to feel more comfortable in class.”
Team Building (I can work with others)	“I learned that there are great skills and many different outcomes when you add an entire group’s thoughts together on one thing.”
Communication Skills (I can express myself)	“The future design studio taught me how to think more quickly about things. It has helped me participate in my classes more.”
Self-Confidence/Growth Mindset (I can learn through effort)	“Whenever there is something I don’t feel comfortable doing, I think back at the future design studio and think about how proud I was when I was done.” “It sort of taught me to roll with the punches and IMROVise”
Sociotechnical Reflection (I care about exploring technology and society)	“I feel more aware of tech social interactions. Now friends put their phones down when we go out to eat.” “It scared me because it was logical for what might happen in the future where people choose everything about their babies.” “Just because we can doesn’t mean we should”
Creativity (“Yes, and”) (I can come up with creative solutions to problems)	“Do not shoot down ideas, but rather, expand on them and see where these ideas go.”

Initial Results: Our initial analysis shows positive self-reported results among the students with regards to developing a growth mindset. Students reported the creation of supportive relationships, an increased appreciation for the complexity of sociotechnical interactions, and a greater sense of confidence when approaching course materials and in class communications. Students also reported feeling more self-confidant speaking up in class after experiencing the improvisation training at FDS. Students felt that, after engaging in improv exercises, they realized that they didn't have to be afraid to speak up in classes or with other students in less formal situations. They reported that the experience of communicating with other students and faculty in a way that encouraged openness, vulnerability, fun, and collaborative storytelling encouraged the students to be more open in academic and social settings more broadly.

In terms of examining the interactions between science, technology, and society, students found themselves engaging in more critical analysis of their own visions of the future as well as the ethical complexities of technological artifacts when they encounter a broader society that doesn't always use or develop the technology in the ways the creator first imagined. For example, one student reported that after FDS their social group became more reflective of their technological use in social settings and began to consciously put their phones down during shared meals. Another student, who had been part of a team that imagined a 3D baby printer where parents could choose their child's traits, became much more interested in the ways 3D printing is being used now for prototyping, medicine, and construction.

IV. Conclusion

Future Design Studio has shown promising initial results with students experiencing a perceived increase in their comfort in communicating in classes, a greater sense of community via a shared orientation experience, enhanced creative ability in teams, and the ability to apply a more critical lens to the technology they see around them on a daily basis. In short, students are developing the foundations of a growth mindset through their experience in Future Design Studio. Instead of viewing their own intelligence as fixed, that is, seeing themselves as students in need of remedial training, they are instead seeing themselves as capable of academic growth. The development of such a mindset could be vital to these otherwise at-risk students succeeding in their chosen fields.

One of the most striking outcomes was that students reported greater comfort in communicating in classes, both with their peers and their instructors. This greater willingness to engage, even with the possibility of fielding an incorrect answer, connects solidly to one of the core aspects of a growth mindset, the desire to learn instead of a desire to appear intelligent. Similarly, the students show signs of seeing learning as a team activity, one which requires false starts, ambiguous paths, and interaction with others as a means of gaining deeper insights. For example, one group of students reported that they gathered regularly after being on a design team during FDS. They studied together, played together, and often discussed what was being taught in their classes within a broader societal context. Likewise, other participants reported being more comfortable working in teams even when the other team members had not attended FDS.

Anecdotally, one of the chemistry instructors also reported that students in INQUIRE who had attended FDS seemed more willing to work across lab groups, helping other students with their work and functioning as community forming members by their willingness to interact outside of the usual norms of lab groups. While this is only one data point, it is worth exploring further to see if this is a broader trend among students who participated in FDS.

Looking forward, FDS will be used as an orientation exercise for the 2018 year as well, which will afford an opportunity to collect additional data on another incoming freshman class. Further assessment of FDS's impact, particularly with regards to persistence in STEM, will require additional tracking of students' experiences and reflections over years to come. As the INQUIRE program goes forward with their longitudinal tracking, additional data on FDS's impact should become available. In addition to FDS's role in enhancing students' ability to thrive in higher education, additional analysis may provide useful data on how students navigate ethical issues surrounding science and technology as well as students approach to the technological design process. These areas will be explored more fully in future papers.

References

[1] X. Chen, "STEM Attrition: College Students' Paths into and out of STEM Fields. Statistical Analysis Report. NCES 2014-001.," *Natl. Cent. Educ. Stat.*, 2013.

[2] C. Dweck, *Mindset: The new psychology of success*. Random House, 2006.

[3] D. S. Yeager and C. S. Dweck, "Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed," *Educ. Psychol.*, vol. 47, no. 4, pp. 302–314, Oct. 2012.

[4] A. Rattan, K. Savani, D. Chugh, and C. S. Dweck, "Leveraging Mindsets to Promote Academic Achievement Policy Recommendations," *Perspect. Psychol. Sci.*, vol. 10, no. 6, pp. 721–726, 2015.

[5] ABET, "Accreditation Changes | ABET," 2018. .

[6] B. O'Reilly, "Alan Alda Promotes Improv As Means To Better Science Communication," *The East Hampton Press & Southhampton Press*, 2016. [Online]. Available: http://www.27east.com/news/article.cfm/East-End/481096/Alan-Alda-Promotes-Improv-As-Means-To-Better-Science-Communication. [Accessed: 01-Dec-2016].

[7] R. Bernstein, "Communication: spontaneous scientists," *Nature*, vol. 505, no. 7481, pp. 121–123, 2014.

[8] P. Agre, "Toward a critical technical practice: Lessons learned in trying to reform AI," *Soc. Sci. Tech. Syst. Coop. Work Gt. Divide Erlbaum*, 1997.

[9] M. Ratto, "Critical making: Conceptual and material studies in technology and social life," *Inf. Soc.*, vol. 27, no. 4, pp. 252–260, 2011.

[10] A. Dunne and F. Raby, *Design noir: the secret life of electronic objects*. Basel: Birkhäuser, 2001.

[11] B. Sterling, "Design fiction," *interactions*, vol. 16, no. 3, pp. 20–24, 2009.

[12] J. Bleecker, "Design Fiction: A short essay on design, science, fact and fiction," *Future Lab.*, vol. 29, 2009.

[13] L. Winner, "Do artifacts have politics?," *Daedalus*, pp. 121–136, 1980.

[14] P. R. Josephson, *Fish sticks, sports bras, and aluminum cans: the politics of everyday technologies*. Baltimore: Johns Hopkins University Press, 2015.

[15] J. Corbin and A. Strauss, *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications, 2014.

[16] G. Guest, K. M. MacQueen, and E. E. Namey, *Applied thematic analysis*. Sage, 2011.