Increasing Student Empathy Through Immersive User Empathy Experiences in First-Year Design Education

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Introduction

The Introduction to Design (ITD) program at the Colorado School of Mines introduces open-ended problem-solving to all first year students. Around 600 students take the course each semester. These classes of 25 are taught by a professor who serves as both "manager" of the teams as well as course instructor. Students are divided into 5-person teams to understand, define, then solve and refine solutions for a single broad "messy" problem. To define "messy problems," ITD leveraged several of the components established by Rittel and Webber [1] for "wicked problems:"

- No existing solution precedent
- Poorly constrained
- No one right solution
- Conflicting user needs

These big, messy problems force the students to make difficult decisions around their solutions, which is best done with input collected from a variety of stakeholders. One of the core objectives for the course is to embed a sense of user empathy into the students' problem-solving endeavors so that they will regularly think to seek and incorporate the perspectives of others who have a stake in the problem. The relevant course-level learning outcome is to be able to "research the context and background of problems and solutions, through a variety of scholarly and authoritative sources." The specific lesson-level learning outcomes to achieve this are to be able to:

1. "Identify stakeholders and analyze their relevance to the problem."
2. "Interview Subject Matter Experts (SMEs) and other stakeholders of the project to understand the problem."
3. "Analyze the problem from a user's and stakeholder's perspective."

The first lesson-level outcome is a matter of applying idea generation techniques to think of a dozen or more possible stakeholders, and then introducing a 2 X 2 framework adapted from Chevalier and Buckles' rainbow diagram [2] to help students prioritize their list to those most affected by the problem and those most influential. The second is a matter of wearing down generally introverted students' reticence to "talk to strangers" by including a basic and non-threatening interview assignment at the start of the semester. The third, however, is difficult to teach as well as to learn. Starting in Spring 2015, the ITD program created new class activities to help students understand the difference between their perceptions and experiences of a problem, and those of the people actually affected by that problem.

These activities include:

- Subject Matter Expert (SME) Talks: Experts present on various aspects of the problem, followed by a 20-minute Q&A session.
- User Empathy Experience: Re-creation of the problem context on class premises, where students execute project-relevant tasks.
- Stakeholder Engagement Experience: Students are sent off campus to observe and interact with users/stakeholders.
- A reflection assignment: Analysis of what they *thought* were problems for the users compared with what they discovered were *actually* problems; why this might be the case; and why this matters for their future problem-solving careers.

To understand the effectiveness of these activities, the authors examined the specific approaches in each of seven semesters (Fall 2014 through Fall 2017) to answer two questions:

1. What is the most effective way for design students to develop empathy?
2. How does developing empathy affect quality of student projects?

What is Empathy?

Unlike sympathy, which is a reaction to the unfortunate circumstances of others [3], empathy is rather a sense of similarity between the emotions of two people [4]. While feeling sympathetic is an expression of care, concern, and/or a longing for the other person to do better, to feel empathetic one must make a connection to those feelings at a deeper level; it is to feel *with* the other person, not to feel *for* the other person [3]. For example, when observing a child cry after dropping her ice cream cone, feeling sympathetic would mean wishing she still had her ice cream cone and hoping she would feel better, while feeling empathetic would mean recalling a time of similar experience, and feeling sad with her while recognizing the similarities between each other's plights. The personal connection and deeper understanding make empathy so valuable. As Decety and Moriguchi point out, there are many ways in which empathy can be invoked, including seeing another person's distress or discomfort (as in the ice cream example), by imagining someone else's behavior (as with visualization or role playing), or by consuming materials (such as reading text or watching a video) that bring about an emotional response [5].

The Importance of Empathy to Design and Technical Problem Solving

The first mention of empathy in relation to design was in the late 1990s when companies began realizing that in order to design solutions that better met end users' needs, they needed to be more in tune with their users' experiences. They found that they could do this by understanding and empathizing with the user's situation, instead of taking the typical approach of designing solely towards a list of fixed specifications [6]. Since then, companies and universities alike have been striving to pinpoint methods to help their employees and students develop these empathetic, need-finding skills [7].

Compounding the issue, many of these challenges stem from the increasingly global nature of business. Since companies and designers are creating solutions and solving problems for a global audience, it's more critical to be able to empathize with the user, as it is nearly impossible in most circumstances to rely on personal experience alone [8]. Invoking empathy when approaching these global, wicked problems helps to place the emphasis on intercultural awareness, which can strongly aid communication between different groups [9]. Tapping into the emotional as well as cognitive aspects of perspective-taking opens up a more nuanced, critical understanding of the multiple perspectives which characterize contemporary engineering problems" [10].

The increasing need in industry for engineers who can "recognize their inherent role within these complex socio-technological systems" [10] is influencing an educational shift in philosophy. Across universities, traditional engineering education eschews reflection, therefore developing future engineers who "both lack and do not appreciate" the skill [11]. Since reflection is a critical component of invoking empathy, this is problematic and could lead to less success across both projects and overarching careers. Increased teamwork leads to greater organizational success and higher levels of collaboration, which has been identifies as the key to answering many of today's most pressing challenges [12]. Therefore, promoting the types of experiences that allow students to "transition from considering themselves to be separate from their work and stakeholders to considering themselves as being within their work" are paramount to developing successful, empathetic problem solvers who are equipped to tackle the world's most difficult problems [10].

Empathy in the Classroom

It is now widely accepted in engineering education that communication, teamwork, and interdisciplinary collaborations are needed; however, the explicit teaching and incorporation of empathy has not yet been as widely adopted due largely to a lack of specific frameworks upon which professors may lean [13]. In the programs where empathy is being recognized as one of the many essential skills for becoming an impactful, well-rounded engineer [14], educators are just beginning to experiment with and share their techniques and frameworks for better educating students in this skill to help fill the gap.

Empathy is very much a learnable skill, so the lack of educational frameworks may be due more in part to the newness of the concept, rather than the difficulty in teaching it. In fact, teaching empathy has been a key aspect of educating social workers for many years [15].

When specifically looking to implement empathy-building exercises into design and engineering education, Reimer recommends a variety of techniques, including implementing elements of self- and context-awareness, decision-making and action planning, research and analysis, communication skills, and, arguably most importantly, critical reflection, as reflection is one of the easiest and most effective ways to introduce empathy into education [7]. Since the

connection between the self and the other is critical to empathy, this reflection component helps students to enter the user's world, see the problem through their eyes, then step back out into their own world for processing and decision making.

For specific teaching recommendations, Goleman goes a step further and says that "experiential approaches, which involve the student in the actual experience of communication, with opportunities for debriefing and re-application" is highly important. From this we can extrapolate that the more authentic the interactions with the user, the better the data. Furthermore, Goleman likewise highlights the importance of reflection, as well as recommends that empathy should be integrated across curricula, instead of existing as a standalone subject [10]. By having the students practice incorporating empathy throughout a project or course, they are not only developing the skill, but also seeing the direct benefits and applications to their work.

When considering potential frameworks and their effectiveness, it is also important to consider the areas in which students may acquire the most user data and impact. In their research, Kouprie and Sleeswijk have split these types of interactions into three main categories:

1. Direct Contact: meet the user in their environment
2. External Research: conducting user surveys, interpreting the data, and delivering the findings
3. Simulating the User's Condition: creating personas, exploring scenarios, creating storyboards, and role-playing [16]

Many of the curricula examples and frameworks for teaching empathy lean on role-playing, as it is often difficult for students to have direct contact with users, either in-person or through research, due to limited resources, class size, time restrictions, student reluctance/disinclination, or other barriers. While meeting a stakeholder in their own environment is preferable, recreating the environment with props and other simulations is still a valid alternative that Keller and Stappers find will elicit at least partial results [17].

Our Approach and Implementation

This paper examines the authors' experiences on the relative effectiveness of these methods as implemented in the ITD program, in an effort to enable student projects to leap beyond the superficial solutions that were historically offered up in the final weeks of the semester. By encouraging students to "pivot" throughout their process as they gathered more user data through empathetic interactions, it was hoped that teams would take an iterative approach that moved them incrementally closer to realistic and meaningful solutions, rather than a linear one that would often lead to the less sophisticated solutions.

Pivoting has long been a winning method for success in business. Often the best solutions come from iterating as new data is collected on what works and what does not [18]. Although company

founders may have spent hundreds of hours developing one particular business model, being able to objectively shift directions and leave the old model behind has led to some of today's most important innovations [19]. One of the more famous recent pivots happened in 2005 with podcasting company Odeo, which was not finding much success. However, after one of the engineers created an internal messaging system for employee use, the team realized that the rough new platform had more potential than the actual company itself; they pivoted, and became what the world knows today as Twitter [20]. When students learn to objectively pivot and iterate in their projects through the information they gather via empathy and stakeholder engagement, their solutions likewise can become more grounded and applicable.

ITD's objective in exposing the students to users and their experiences was to enable them to progress deeper in the Engagement Levels pictured in Figure 1, and described in more detail below.

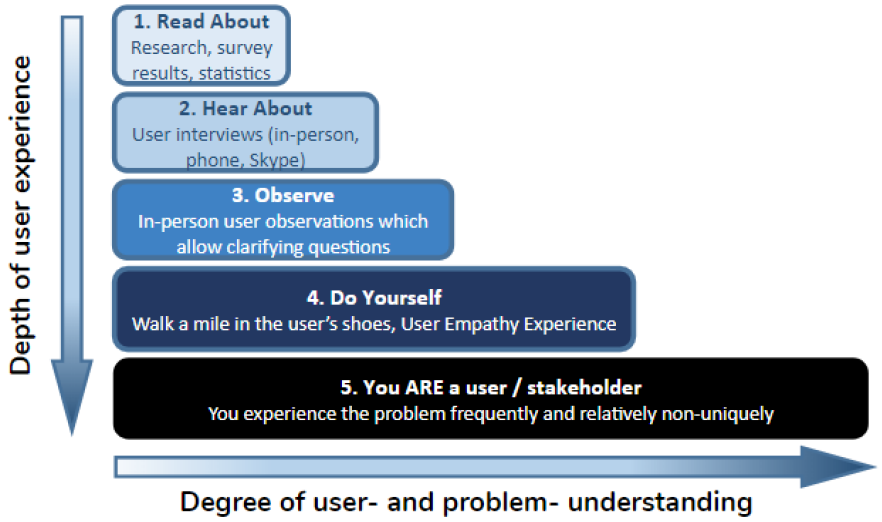

Figure 1: Relationship between depth of User Engagement and Problem Understanding

As Kouprie and Sleeswijk noted, there are several different levels of engagement with users and stakeholders [16]. At the most superficial level, students can conduct research and read about a user group's experience with a problem. Reading statistics, survey results, online videos, or even articles by individual users fits into this category. In the ITD course, this is often the first step students take to get their bearings in a given project challenge.

Slightly deeper and more substantial than reading about user experience is hearing about it first hand in a stakeholder interview, whether over the phone, through Skype, or in person. This type of engagement allows students to respond to what they hear or read, and to ask deeper questions. If needed, online videos by stakeholders describing their experience can supplement this level. Since the purpose of user engagement is to uncover unknown or unexpected things, students are taught to ask, *"Will you please tell me more about that?"* when they hear something that is so unexpected that they don't know how to follow up.

For the next level, instead of simply talking with a user about their experience, students are encouraged to observe that user's experience. ITD students are taught to set up observations where they may watch the user in the context of the problem, which can lead to more in-depth questions, and even lead to important discoveries of dissonance between what a stakeholder says and what he or she actually does, often uncovering important insights about that problem. For example, when ITD students toured a medical waste treatment facility they observed that the machinery in use had many crude alterations to enable it to get the job done, despite hearing that the machinery worked well. This lead to a conversation that uncovered many more opportunities for improvement.

Finally, perhaps the deepest level of stakeholder engagement for a student is immersing in the user's experience, or "walking a mile in the user's shoes." While not always practical, and not always extensive enough, when this can be done it is a powerful complement to user observations with questions. For ITD students, using wheelchairs off-road themselves, for instance, made the abstract lessons and talks about challenging balance, lack of traction, and bumpy going crystal clear as they struggled to stay in their seats.

Figure 2: ITD students in their Spring 2015 user empathy experience

Over the past three years, the ITD program has implemented a variety of stakeholder engagement deliverables in an effort to push the students as far down in Figure 1 as possible, in order to maximize the amount of empathy experienced. However, depending on the nature of the project, it is not always practical or desirable to reach the same level; we are continually working to find a balance between the ideal experience and our constraints. For example, in Spring 2017 the challenge was selected because of the familiarity of students to the user experience (biker/pedestrian safety). Table 1 documents the history of the introduction of subject matter experts (SMEs), empathy simulations, and stakeholder engagement activities, with the semester problem as context, and the engagement levels from Figure 1 achieved. For more details about how we designed and implemented each stakeholder engagement experience, as well as the relative merits of each, see the Appendix.

Table 1: Timeline of Projects and Activities

Semester	Problem	Subject Matter Experts (SMEs)	User Empathy Experience	Engagement Levels
Fall 14	Foreign Language dorm	Architect, Green builder, sociologist	Visit the proposed lot (walking distance)	1, (5)
Spring 15	Retrofit donated wheelchairs for	Wheelchair bound athlete, bike repairman, "Crutches 4	Wheelchair decathlon to accomplish everyday tasks in	1, 4

	Africa	Africa" director	wheelchair	
Fall 15	Remote Landmine detection	Army minesweeper, volunteer minesweeper, explosives professor	Simulated dark minefield for teams to navigate, with mouse traps, firecrackers	1, (4)
Spring 16	Remove plastic ocean debris	Sea animal rescue NGO, ocean gyres and plastics professors	Simulated polluted beach for fishing expedition	1, 2,(4)
Fall 16	Home grow systems for food desert	Food distribution NGO, families living in food deserts, charity organizations	Off campus bus excursions to food deserts to shop and make dinner	1, 2, 4
Spring 17	Pedestrian and Cyclist safety	CDOT Innovation director, Senior panel across disciplines	Off campus walking, biking, driving excursions.	1, 2, 3, 4, (5)
Fall 17	Divert a waste stream from landfill for reuse	Waste Management rep	Design-your-own off campus excursion to tour and interview.	1, 2, 3, (4)

Before ITD's implementation of stakeholder engagement exercises, the primary means for stimulating project pivots was direct professor input and feedback, which faced several drawbacks. First, data and suggestions are limited by each professor's experiences and knowledge, and second, this feedback is often lost in the sea of other information over the semester. When not a direct result of professor feedback, pivots occasionally occurred during the physical prototyping phase when a team discovered something was not "manufacturable."

Near the end of Fall 2016, the ITD program began including discussions about the benefits of pivoting in weekly staff discussions. The discussions served as initial preparation on why and how to encourage student teams to abandon unpromising directions and embrace shifts that could resolve the issues and insights uncovered. This conversation continues today.

Discussion and Results

A quick analysis was conducted to see if there was a relationship between the levels of engagements and the quality of the students' solutions, using the number of pivots as a proxy for quality. To do this, an "Engagement Level" score for each semester's stakeholder engagement experience was created by adding together the types of engagements from Figure 1, with parentheses representing "simulated experiences" and counting as half. Then a "Pivot Score" was established for each semester. Past student projects supervised by one of the authors were analyzed by the amount of "pivots" observed as results of user experience, as per the following original rubric:

- A full pivot of problem statement or solution: awarded 1 point. An example is a student team abandoning an idea to make homeless shelters from discarded construction materials after several stakeholders said they would not want their taxes to go towards such an initiative.
- A partial direction change, or a major solution improvement: awarded .5 point. An example is a student team who adapted their "under-bed vegetable grow system" to an "under-couch" system after learning that residents in active living communities use their under bed space to capacity, but there is potential for a garden system under a couch that would also increase the couch height.
- A relatively minor but authentic solution improvement: awarded .1 point. An example is a student team improving the position and shape of a bicycle turn signal button after demonstrating their prototype to several dorm mates.

Table 2: Calculated Pivot Scores and Engagement Level Scores by Semester

Semester and problem	User Empathy Experience	Engagement Levels	Engagement Level score*	No Teams taught by author	Total pivots attributed to user empathy	pivot score	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9
F14 Foreign Language dorm	Visit the proposed lot (walking distance)	1, (2), (5)	**3.5**	10	*(not recorded)*		-	-	-	-	-	-	-	-	-
S15 Retrofit donated wheelchairs for Africa	Wheelchair decathlon to accomplish everyday tasks in wheelchair	1, 4	**5**	5	0.5	**10%**	0	0	0.5	0	0	-	-	-	-
F15 Remote Landmine detection	Simulated dark minefield for teams to navigate, with mouse traps, firecrackers.	1, (4)	**3**	5	*(not recorded)*		-	-	-	-	-	-	-	-	-
S16 Remove plastic ocean debris	Simulated polluted beach for fishing expedition	1, 2, (4)	**4**	5	0.6	**12%**	0	0	0	0.5	0.1	-	-	-	-
F16 Home grow systems for food desert	Off campus bus excursions to food deserts to shop and make dinner	1, 2, 4	**7**	5	1.5	**30%**	0.5	0	0.5	0.5	0	-	-	-	-
S17 Pedestrian and Cyclist safety	Off campus walking, biking, driving excursions.	1, 2, 3, 4 & (5)	**12.5**	4	3.1	**78%**	0	1.5	1.1	0.5	-	-	-	-	-
F17 Divert a waste stream from landfill for reuse	Design-your-own off campus excursion to tour and interview.	1, 2, 3, (4)	**8**	9	7.2	**80%**	1.1	2	1	1	0.5	1	0.6	0	0
** Sum of engagement levels. Parentheses counted as half.*															

Points were only awarded if changes were attributable to stakeholder input, as observed by the instructor. Points were not awarded for design changes that resulted from lab testing or in the course of prototype-building. The points for a class section were totaled, and divided by the total number of teams in the class. If each team project pivoted fully once, this would result in an Average Pivot Score of 1.0. In two semesters, Fall 2014 and Fall 2015, material was not available to assess the number of team pivots. See Table 2 for the details and calculations of the scores.

In Figure 3, with an arguably meaningless sample size (5 data points), a relational pattern emerges and shows that indeed with deeper stakeholder engagement, more pivoting is observed. Exploring the data and the in-class circumstances further, the following observations were made:

- In F17, several in-class guests were invited to comment on student work during mid-semester presentations, resulting in student teams incorporating more suggestions, more significantly, than average.
- Conversely, in F16, although ITD students had ample opportunity to understand the problem from the perspective of the users, the lessons failed to make an impact, possibly due to:
    - Variable depth of engagement and willingness to engage amongst students,
    - The quality of feedback provided to teams regarding their need to pivot, as program discussions on the benefits of pivoting had just begun.

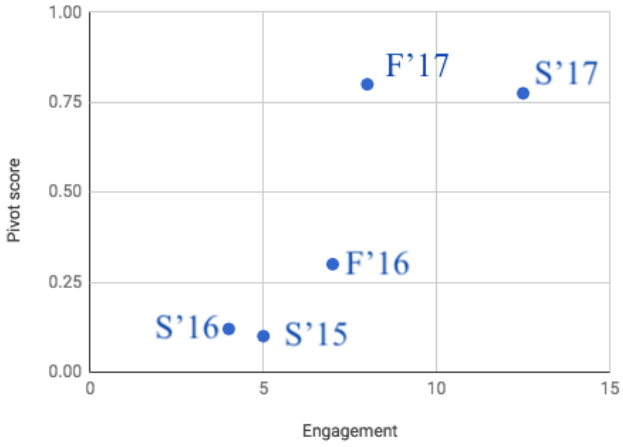

Figure 3: Pivot score versus Engagement level by semester

Conclusions and Future Directions

The ITD program has experimented with multiple ways of driving students into deeper levels of stakeholder engagement over the last few years (details of the which can be read in the Appendix) in order to explore the most effective ways of achieving student empathy, and what success as a result of this empathy might look like. Looking at how students have absorbed and then incorporated the feedback they received, early results seem to indicate that better stakeholder experiences are leading to more pivoting and iterating in student projects. Anecdotally we are seeing that this pivoting and iterating is contributing to an increased quality of student work, leading to the presentation of more compelling and realistic solutions in the final competitions. Additionally, it is likely that improved professor understanding may contribute to increased pivoting and project quality.

After the three years of experimentation, the ITD program settled into the following set of exercises as the most effective way to teach students how to develop empathy:

- A non-threatening interview conducted by phone or in-person to break down resistance to verbally asking questions to less familiar people.
- Subject matter expert (SME) speakers or overview videos brought in once a challenge is announced to help the students get their bearings on a problem definition.
- A "Design Your Own Stakeholder Engagement Plan" that is created by the team once they have defined their problem, which is actively managed by the professor to ensure that each team member is planning to delve into at least Engagement Level 3, if not Level 4.
- A stakeholder engagement reflection assignment in which students compare what they *thought* would be problems, what they learned were *actual* problems after their stakeholder engagement exercise, and what this means for their problem-solving career in the future.

- Continued requirements assessed in deliverable rubrics to check in with stakeholders throughout the semester as they define their solution subsystems and build their proof-of-concept models.

The program is also exploring the feasibility of inviting outside guests during the critical pitch proposal mid-semester.

Future areas of research might include influencing higher student participation rates and deeper engagements within this newest model of "design your own" stakeholder experience; analyzing the effects of pivoting on overall student performance across a larger sample size; identifying tools to measure user empathy and finding its effect on project quality; determining what influences student ability to empathize; training professors to identify and encourage pivoting opportunities; and designing curriculum to reach those students who are inherently less inclined to adopt these types of engineering education techniques.

Additionally, concerning the user empathy exercises, while some can be time-consuming, especially at the scale of a freshman introductory program reaching 1,200 students per year, others are much more manageable. An additional consideration is that some activities are better able to reach all students, while some are left more to the student's own desire to do a good job. The early user empathy experiences, designed to simulate the design challenge on campus for easy access and relatively deep engagement, were successful in reaching nearly all students but took an inordinate amount of staff time to create and maintain. In reviewing the pivoting observations, these simulations had less of an effect of students talking with people, but did bring greater enthusiasm to the project. Further investigation into which level is truly "deeper" when considering both level of empathy developed as well as quality of solutions as a result of pivoting is needed.

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Appendix

Below are descriptions of the Stakeholder Engagement experience ITD designed for each semester from Fall 2014 through Fall 2017, the student engagement each hit, their relative merits and limitations, and the author's judgment on the overall value of each.

1. Fall 2014: Visit the proposed lot (walking distance) of the proposed Foreign Language dormitory. Students were encouraged to walk to the lot to see firsthand the typography of the land and the surrounding context, and to incorporate what they found in their solution.

Pros	Cons	Student Uptake	Prep time	Value
Since it was a project they could relate to (living in a dorm), the site visit triggered impulses of recognition, such as: it is an easy walk to Safeway; the dorm should have storage for food / cooking facilities.	Not a deep Engagement since potential users were not engaged.	Estimated < 10% given the site visit was a polite suggestion rather than an assignment.	None	Low

2. Spring 2015: Accomplish everyday tasks in wheelchair. ITD procured used wheelchairs for the duration of the semester. Students were instructed to consider and write down the difficulties of performing everyday tasks in a wheelchair, and also to consider and write down difficulties of using a wheelchair without the benefit of modern infrastructure. During one class period, a wheelchair decathlon was held, where students tackled 5-6 tasks, including: transferring from the class chair to the wheelchair without using their legs, washing hands in a small bathroom, putting a shirt and pants on over their clothes without using their legs, and navigating a muddy lot. Finally, they were to shift a pile of books up a small set of stairs without using their legs (by crawling). They were instructed to watch their classmates doing the same and note difficulties they observed. Each student turned in a User Empathy reflection on the difference between their "anticipated" difficulties compared with their "actual" and "observed" difficulties, and what they could extrapolate from this.

Pros	Cons	Student Uptake	Prep time	Value
Accomplished level 4 very effectively. Also, students were encouraged to borrow wheelchairs to further their experiential knowledge. Students were energized by their experiences.	Not effective at levels 2 and 3: talking with and observing real users: wheelchair users in Africa. Finding space for 25 wheelchairs through the semester was difficult.	Nearly 100% since the exercise was done during class.	Several hours procuring the wheelchairs.	Medium

3. Fall 2015: Simulated minefield for teams to navigate, for personnel landmine detection project. The ITD team turned the building basement into a dark, hot, loud Cambodian forest with landmines, using easily visible mouse traps and invisible "Snap Pops." Student teams were instructed to map the minefield, and not to get "injured." Students were instructed to consider and write down the difficulties of detecting landmines, and afterwards consider the difference between what they anticipated and what they experienced, and what that meant for problem-solving in their future.

Pros	**Cons**	**Student Uptake**	**Prep time**	**Value**
Accomplished level 4 somewhat effectively. Also, was an enjoyable team bonding experience.	Not effective at levels 2 and 3: talking with or observing real users: Cambodians in affected regions. Also, accuracy of our minefield was limited by faculty member's experience.	Nearly 100% since the exercise was done during class.	Several days setting up the minefield and manning it, and a day to dismantle.	Medium

4. Spring 2016: Simulated polluted beach and ocean for plastic debris removal project. The ITD team turned a room into a polluted beach front with tangled fishing line, knee-deep plastic bound in tangles, and plastic fish hidden for "fishing." Student teams were instructed to find the healthy fish for points; no points awarded for "dead" or "sick" fish. In a separate task, student teams were tasked to mimic turtles feeding and to pick from a water bucket the actual jellyfish from what turned out to be plastic bags, in something like a gambling exercise. Some turtles "survived" the feeding experience, while others perished. Students were instructed to consider and write down the difficulties of dealing with ocean debris, and afterwards consider the difference between what they anticipated and what they experienced, and what that meant for problem-solving in their future (Stakeholder Engagement reflection).

Pros	**Cons**	**Student Uptake**	**Time to Prepare**	**Value**
Nothing of note.	Far too remote from reality to help the students much, on any stakeholder engagement level.	Nearly 100% since the exercise was done during class.	Several days setting up the beach front and manning it, and a day to dismantle.	Low

5. Fall 2016: Off-campus excursion to local food deserts to purchase and prepare dinner on a food stamp budget. Students were assigned one of 5 neighborhoods to travel to (via public transportation), find and purchase a meal within a family food stamp budget, and prepare and eat it together. Stakeholder Engagement reflection was required afterwards.

Pros	Cons	Student Uptake	Time to prepare	Value
Somewhat effective at level 4, and some interviewed stakeholders on their trip, achieving level 2. Also, a team-building experience.	Too many students did not interact with stakeholders, and some teams took shortcuts since unsupervised.	Roughly 50-60% of students had an authentic food desert experience.	A few hours to identify suitable neighborhoods.	Medium

5. Spring 2017: Off-campus walking, biking, and driving excursions to understand risks to cyclists and pedestrians. Students were asked to pick two of the three activities to do for an hour: walk, bike, drive. Stakeholder Engagement reflection was required afterwards.

Pros	Cons	Student Uptake	Prep time	Value
Somewhat effective at level 4, and some teams also interviewed stakeholders, effectively achieving level 2 as well. Also, a team-building experience.	Too many students did not interact with stakeholders, or took shortcuts. Also, despite instructions, some students engaged in unsafe driving, walking, or cycling.	Roughly 40-60% of students had meaningful experiences.	Negligible.	Medium

6. Fall 2017: ITD's first "design your own stakeholder engagement adventure." Student teams built a Stakeholder Engagement Plan based upon their unique problem statement around diverting waste streams from the landfill, which would enable each student the opportunity to get to engagement levels 2 and 3 at a minimum, and 4 if possible. Professors provided feedback on before the teams implemented. Stakeholder Engagement reflection was required afterwards.

Pros	Cons	Student Uptake	Prep time	Value
Effective at level 2, and many teams accomplished level 3. Each engagement plan was unique, and gave students the experience of how to conduct this exercise for themselves.	Level 4 was elusive, and varying degree of success in level 2 and 3. Also, some local stakeholders (eg, the landfill) were inundated by student calls.	Roughly ¾ of students (eventually) had meaningful experiences.	Negligible	Medium