A Personal Account on Implementing Reflective Practices

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Introduction

As educators create experiences for their students, they hope that the students will be changed by the knowledge and experiences garnered. Reflective practices are one method for transforming students and helping them become more open to taking challenges and integrating them into new applications. In addition to promoting critical thinking, being reflective helps students understand how the affective factors of their experience influence their perceptions. In turn, this helps improve their abilities to articulate the unspoken parts of their practice.

The Global Engineering Program at Purdue University implemented reflective practices for the first time with their 2013 Global Design Teams. The paper will show the audience how reflective practices were structured for the students and how the reflections were intended to be used. The goal of this paper is to report on lessons learned from pilot work on incorporating a reflective practice intervention in a global engineering program and help offer a look into what can be done to implement reflective practices.

Literature Review

This section of the paper will focus on unpacking the framework behind the reflective practice study that was undertaken. The first part of the literature review will give an overview of the term “reflection” as used in this paper. The second part will show how the conceptual framework was constructed. The third part of the literature review will focus on the outcomes of global engineering experiences (which are specific to the context of the pilot study). The literature review will conclude with how reflective practices can be applied to global engineering experiences.

Reflective practice

Reflective practices are essential to student learning and can give new purpose or meaning to what was learned. In the 1930s, John Dewey explored reflection as a component of learning by trial and error, describing its role in developing relationships and connections between parts of an experience. Dewey refers to this purposeful action as conscious reflective activity; however, the goals of the reflection do not have to be completely understood by the student at that particular time.

Reflective practices have been recommended by other engineering educators. In Gary Downey’s collection of engineering faculty’s experiences in global engineering programs, various faculty mention how important it is for students to reflect on their experiences to reap the transformative benefits of global experiences. Another researcher in adult education, David Boud, states that conscious reflection is important since it allows the development of
the awareness of the decision making process in learning and it enables critical evaluation of choices which in turn influence what will or will not be done (p. 19).³

When learning something new, students have to cope with the arrival of new information by being reflective. Some benefits of reflection may be lost if they are not linked to action and some commitment needs to be made. These actions and commitments can lead to what Jack Mezirow calls perspective transformation.⁴ As a researcher in adult learning, Mezirow determined that a perspective transformation is the process of becoming critically aware of how the assumptions about the world have come to constrain the way we see ourselves and our relationships and why we developed these assumptions and are triggered by a significant personal event.⁴ For Mezirow, a transformation can be a sudden insight into the structure of the assumptions that were made or a series of transitions that occur over time that lead up to the eventual transformation. The transformation can lead to changes in convictions, personal understandings and behaviors (p. 297).⁴

Creating a conceptual framework

In this study, we characterize reflection as a type of response given to an experience that cannot be fully explained by a student’s current knowledge. Since the experience is clashing with what the student already understands, it is uncomfortable. According to Boud, it is that discomfort is what drives a student into reflection to recapture and evaluate the experience in order to make sense of it (p. 18).⁵ As the students reconstruct their experiences and work through their attitudes and emotions, their perception of their experience can change. Figure 1 illustrates this process as articulated by Kolb. Kolb’s model reaches a new understanding by beginning with a concrete experience. The experience leads to observations and reflections, which in turn lead to the formation of abstract concepts and generalizations which allows the learner to test out the implications of their ideas in new experiences. Having skills in all four stages allows the learner to achieve a full range of development and help develop their engineering skills.⁶,⁷
According to Boud, we can sharpen our approach to reflection to gain better insights. In his work, Boud identifies three stages of reflection that a student must undergo. Figure 2 illustrates the various stages of reflection. The first stage of reflection is “recollecting what was taken and replaying the experience in the mind’s eye” where certain overlooked details can be revealed. This could be done as a written exercise or even in a discussion with prompts that unpack details they may not have noticed during their experience. While creating the description of the experience, the student should refrain from judgment that would blind him or her to the issues that need to be reassessed (p. 28). What emerges from this first stage is the observation of judgments and interpretations of what happened at the time of the experience. While students are discouraged from making judgments, the student must take note of the feelings evoked in the experience since they can cloud the student’s perceptions and create barriers to further reflection.
Since taking account of the affective nature of the experience is important, the second stage is “Attending to Feelings”. Boud understands that emotions can be barriers to learning, but they are important enough to be acknowledged and have them removed. Boud also mentions that utilizing positive emotions can drive learners to endure challenging situations and allows learners to be more willing to engage in situations that are stimulating. The danger of being too attached to emotions is that a learner can become rooted in one particular way of interpreting, which prevents further reflection. Boud states that if learner experiences feelings that prevent further reflection, then the learner must find some way to regain flexibility (p. 29).

A common detraction from using reflective practices in engineering is that the students will focus too much on the emotional aspect of the project, such as complaining about the amount of work to be done or the dysfunction of the team. To help avoid this issue, reflective prompts can be worded to address discoveries and anticipations. This would allow the analysis to focus on how the projects and student work would be impacted by new information. The idea would be that the students would start talking about the affective aspect of the project without being overtly asked to do so.

In the third and final stage of reflection, Boud states we must “Reevaluate the Experience”. While it is easy to make judgments from the initial experience, the learner may lose a great deal of valuable information. It is important to relate new data to that which is already known and determine if there are relationships among the data. The student must decide if the new data and its relations are valid and once the validity of the new data has been proven that data will become incorporated into the student’s understanding.

What Boud explains about reflection is related to Kolb’s model of learning, which helps make a positive case for the use of reflective practices in courses. Figure 3 illustrates how Boud’s reflections stages map on to Kolb’s learning model. Having new data linked with existing knowledge and feelings can challenge learners both intellectually and affectively. When the learner is validating the new data, further investigation and reappraisal is needed in order to prevent confounding effects of uncomfortable experiences. The Boud-Kolb Overlay is the framework that was developed to determine how reflection is linked to a student’s learning and how to elicit certain kinds of reflections during various stages in learning.
Understanding Global Engineering Outcomes

This part of the literature review is intended to familiarize the audience to what entails global engineering outcomes. This section will allow the audience to see what skill sets that are desired from students coming in and out of these programs as well as seeing how different programs are set up. This section will also illustrate some of the learning outcomes that are imbedded within global engineering experience being studied for this project and how it relates to reflective practices. This section will also show how reflective practices can be used to help develop these outcomes in students.

For this study, the researcher will focus on the global competencies that are described in Mohtar and Dare’s 2012 paper on the Global Design Teams offered at Purdue University. These global competencies originated from Purdue’s Engineer of 2020 Target Attributes which in turn was inspired by the National Academy of Engineers’ The Engineer of 2020. These global competencies provide technical, professional, and social competence outcomes that students involved with the GDTs should possess and demonstrate after going through the experience. It should be noted that when researching student development in service learning programs, Lima and Oakes also identified that technical, professional and social dimensions were important to student development. Lima and Oakes identified that the technical
dimensions would be at the center of the experience and most accustomed by the students while the social dimensions would be less familiar due to the larger impacts that dimension has on the experience.  

While there are a number of competencies, this research project will focus on a select few of them as seen in the table below. These outcomes have been targeted specifically due to the fact that the GDTs are already sensitized to developing students to achieve these outcomes. It should be noted that achieving outcomes can be supported through Kolb’s model and Lima and Oakes encouraged the use of reflections as a means to develop a better understanding of the social competency that students are least familiar with. Having a student deem his/herself able to demonstrate a global competency, it infers that the student has gone through the cycle and has gained a new understanding of what it means to be an engineer in a global context. This allows the framework discussed in the first part of the Literature Review to be used in a way to scaffold reflective practices to obtain information that a student has indeed achieved a learning outcome.

<table>
<thead>
<tr>
<th>Global Technical</th>
<th>Global Professional</th>
<th>Global Social</th>
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<tbody>
<tr>
<td>The ability to apply familiar concepts to unfamiliar, real-world problems.</td>
<td>The ability to analyze problems from a different cultural frame of reference.</td>
<td>The ability to be cross-culturally adaptable/flexible.</td>
</tr>
<tr>
<td>The ability to use design tools to solve engineering problems.</td>
<td>The ability to communicate professionally in a culturally appropriate manner.</td>
<td>The ability to contribute on a culturally diverse team.</td>
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Table 1. Global Engineering Program Learning Outcomes.

Application of Reflective Practices in Global Engineering

With this particular study, the focus will be on the use of reflective practices in global engineering. The use of reflective practices cover the way in which reflective practices help students develop in global engineering. Recall that in Downey’s work faculty desire a student that is aware of cultural issues, country issues, study abroad issues, and global issues and that challenged students had greater development. If researchers already acknowledge the importance of Kolb’s learning model for students, then using the Boud-Kolb overlay model can also show important aspects of student development. Lima and Oakes regard reflection as essential to learning and go on to state that reflection can help a student process the wide variety of experiences he or she may be having. Therefore being involved in global project experiences allow an opportunity for students to sort out their own development through self-reflection as well as allow faculty to use those reflections as evidence of development. Recall that nurturing students is essential to a successful global engineering program. Having a scaffolded reflective practice experience integrated with a global engineering program can give global engineering faculty an opportunity to see what can be done to improve their students’
development. Downey recognizes that in global engineering, faculty have an over-focus on the areas of global competency and that they overlook the values of other types of knowledge that global experiences render especially knowledge linked to the affective side of the global experience.\(^3\) Most faculties overlook the potential of global engineering in favor to teach the more core courses of engineering. Faculty tend to value the fact that global engineering education helps develop competitiveness with foreign engineering markets and helps expand the student’s comprehension of what it means to be a global engineer. While there is a lot of time and energy needed to make these programs work, it is noted that these programs are on the periphery of engineering education and are fragile. One of the key things that Downey explores is the importance that these experiences have in shaping the identities of engineering students.\(^3\) While global engineering challenges the disciplinary boundaries of engineering, Downey recognizes that those boundaries are becoming more porous and that perhaps the best way to implement global engineering is by redefining and reassessing what is the core of engineering knowledge.\(^3\) Again using the Kolb and Boud overlay model can help students explore the nuances of engineering and allow faculty an intimate knowledge of how the experience is impacting their engineering students.

Methodology

For this section of the paper, the methods for the pilot study will be explained. The first section will explain the context of the study. This should briefly familiarize the audience to the nature of how students are experiencing global engineering. The second part will focus on the construction of the reflective prompts and how they fit with the Kolb-Boud overlay model. The third part of the methodology will focus on how the researcher will measure the reflections from each student. Finally, the researcher will explain the pilot study and the experiences gained by attempting to implement the study.

The Context: The Global Engineering Program

The Global Engineering Program (GEP) organizes several Global Design Teams (GDTs) that work on various engineering service projects across the globe.\(^9\) These projects usually occur in developing countries and have a goal of helping the citizens of those countries overcome some obstacle that affects their livelihood or health. The GDTs are usually composed of a number of undergraduates and graduates from a variety of disciplines. An engineering faculty member generally leads these teams throughout the project life. The GDTs are also usually paired with another institute of learning abroad or a non-governmental organization (NGO). The learning outcomes for the GDTs are tied to certain global competencies, some of which were already addressed in Table 1. According to Mohtar and Dare, GDTs utilize local logistical assistance and engineering support along with a technical faculty advisor to create an experience where students can receive academic for a project that is uniquely provided outside of the normal engineering curriculum.\(^9\) This allows the GDTs an opportunity to address the technical, professional, and social aspects of global competency. To control the quality of the work done by the GDTs, the faculty advisor that heads a project creates a curriculum based on
problem-solving and design. Therefore the students receive credit for their work and are bound by the usual work ethic that is expected of a student in a normal engineering course.

Faculty advisors are recruited based on their disciplinary interest and whether they have interest or support in the developing country that the project is localized in. The GEP defines a successful project as one where students undergo significant development of engineering skills and knowledge and the project has a positive impact on the people that need engineered solutions to their problems. The GEP also has a list of learning outcomes that they wish to develop in students; a few of those learning outcomes are listed in Table 1 and will be sensitizing the data analysis of this study. The timeline for these projects usually involve students and faculty being selected in the Fall semester for a variety of global projects. The GDTs begin meeting in the late Fall semester and utilize the entire Spring semester to gather data regarding their specific issue, design a solution, and test their designs. During the summer, the GDTs will perform a site visit abroad to gather more data regarding their situation, present their current work to their supporters abroad, or implement their design abroad. The activities abroad are often influence by the stage in which the project is in. If the project in a certain community is new, then the focus of the project will be mainly on gathering information and designing several solutions to be tested in a following cycle.

The GDTs are given multiple assessments, mainly to gain data about how the students are developing their global competencies. The assessments are scheduled in a way that allows the GEP staff to track students from when they start the program to when they end the program. The assessments can take the form of surveys, but one form of assessment that the GEP performs is keeping journals. The journals were to include information regarding the development of their designs and addressing any technical issues or any issues regarding their interactions with their partners abroad. While aboard the students were encouraged to note any significant experiences with their interactions with their hosts and the culture in general. The journals were not required for a grade; therefore some students did not partake in the reflective practice of journaling. Since the GDTs do have a culture of at least acknowledging the value of journaling, there exists an opportunity to examine what can be done to increase the effectiveness of this reflective practice as a tool for student development and assessment.

Construction of Reflective Prompts

Using Boud’s stages of experiential learning, the researcher intended to construct the reflective prompts to target those three stages. Journals can be given a structure to reflect how they are progressing. A collection of reflective prompts for a GDT student would at first get at ideas that are concerned about what expectations they have about their involvement, then the bulk of the journal would be concerned about the progress and obstacles being faced as the students delve into their design and finally the journal would resolve with questions at what the students got out of the experience. The first set of prompts is presented below:
1. Describe something you are anticipating (positive or negative) in your GDT work. How do you think it will affect your role and work on the GDT?
2. Describe something you discovered or found interesting in your GDT work. How do you believe this discovery or interesting fact will affect you?
3. Based on your perception describe something you feel could be modified in your GDT work and explain why. How will a modification affect your project?

Recall that Image 2 illustrates the various stages of reflection. The first stage of reflection is “returning to the experience”. Using the Kolb-Boud Overlay model (Image 3), it’s possible to see how useful it is to get students to “return to the experience” when trying to probe the first and second phase of experiential learning. Notice that the first prompts are aimed at having the students revisit what they have experienced. To address this final stage of the reflection process, “reevaluate the experience” and the development of new concepts, the researcher used questions in the second reflective prompt to address how the student’s actions had an effect on the project. The second prompts that were used built up on the initial questions for instance the students were asked, “Last week you were asked to describe something you are anticipating in your GDT work and how it could affect your GDT work. Did what you anticipate happen, if so, how was it addressed? If what you anticipated didn't happen, what would you do to address in the future?” As the students’ experiences continued, the prompts were modified to reflect the time passed in the semester since students would have more experiences that would prompt them to think and reflect on their project. The prompts would attempt to elicit various facets of the students’ experiences. For instance there were questions that asked the students to reflect on the cultural appropriateness of their design as well asking about their communication with their global partner and how the students were using their resources to achieve their designs. As the semester came to a close, prompts asked students to reflect on how the project was wrapping up and what they anticipated for the end of their project and as a result focused more on the processing stage of learning.

Measuring Reflective Practices

Since reflective analysis is content-free and open-ended, students are allowed to make sense of their experiences. When a student makes a choice, it demonstrates that the student recognized the choice and chose it because it made sense as the best choice. To assess whether or not a student has undergone deep reflection, an instructor can observe the responses given to the prompts. According to Samuels and Betts, if the student merely gives a description of his or her experience, then no reflection has happened. However, if students relate the new experience to their old knowledge, deeper reflection is occurring. The highest level of reflection is reached when the student develops new knowledge that can be used to predict outcomes of similar experiences. Chabon and Wilkerson describe these levels of reflection as Descriptive, Empathic, Analytic and Metacognitive, in increasing order of depth.
The reflections taken from the GDTs will undergo the same level of analysis that Chabon and Wilkerson used in their study. If there is evidence of student growth and development from the reflections, then it would prove that reflections do have a significant role to play in global engineering experiences and that educators in those experiences should integrate reflective practice into normal student activities and expectations. This will provide the bulk of the results of this study. If students are coming to understand the competencies in Table 1 in different levels, there are certain conclusions that could be drawn. If the reflections reveal that the students are focusing more on a single global competency, then that shows that students are placing more value on that and may use it more often in their experience than any other competency. So there is a possibility that the data will reveal that certain competencies are more prized than others. If the results show that students are reflecting on a variety of competencies, then the researcher can observe which competencies are generating more reflective responses. That would allow the researcher to decide how to best help structure experiences and reflections that help develop other competencies. If the students are reflecting at different levels of depth, the researcher can investigate which areas of global competency the students need more assistance in. If a student is not going to a deeper level of reflection, then it can be inferred that means that students are not growing enough. When looking at Chabon and Wilkerson’s framework, the data might also reveal that the students are not developing in the more affective means but can reflect heavily on the technical aspect of their experiences. Since the study will ask for multiple reflections, there is an opportunity that the researcher will see some level of increasing depth as the students become more ingrained in their experiences and they reflect more on the themes of global competency.

The Pilot Study

During the 2013 spring semester, the Global Engineering Program sent biweekly reflective prompts to all participating students via an online survey. Students were given one week to respond to the prompts and could write as much or as little as they wanted. No reflective prompts addressed emotional aspects of the experience; rather, they addressed how new discoveries or elements have affected the student’s project. The first time reflective prompts were sent out, only 18 out of 80 students submitted responses. This caused concern over the validity of the eventual dataset, and emails were sent to the faculty advisors and student leaders for each team asking them to remind their students about the reflective prompts.

The second set of reflective prompts was sent out after a major symposium that a majority of the students attended. Once again the student participation was below expectations, with just under 20 responses. After reading student responses, nearly all the students that had responded to the prompts did not answer the second question, which had referred to the first time reflective prompts had been sent out. There was even one student that threatened to not answer any more questions that would refer to previous prompts, whereas others simply responded that they did not recall their previous answers.
Even more concerned about my study, I decided to be more proactive and reach to each team personally to see what I could do to gather the information I needed. I set up times with each team and visited them to talk with the students. I expected that the teams had some form of record through technical reports that addressed the issues my prompts were probing.

Upon visiting each team, the students were asked about what they thought of the reflective prompts and what could be done to improve their response rate. From talking with the teams, certain behaviors were observed. The first major observation that was made was that the student leaders were largely responsible for setting up the agenda of each team meeting while the faculty advisors provided technical resources to the students. The second important observation made was that the students were basically overwhelmed with balancing their project with their normal course work. For one particular student, the prompts were not included on any syllabus or course contract and therefore not important enough to be bothered with. In fact, from these team visits, it was observed that the one team which had included the reflective prompts in their course contract had regular responses. The final observation made was that the teams were recording how their designs were changing through technical reports and even online blogs. Access to all these records to use for data collection was given. The quality of these reports varied from student to student, but they mainly dealt with technical and professional aspects of the project, outlining travel agenda, constraints, and specifications. Some students included evidence of communication with NGOs and clients as a means of showing how the designs were being influenced.

While visiting with the teams illuminated plenty of issues with using reflective practices, using a variety of reflection sources may adversely affect my results and my interpretations. The idea of having the students answer the prompts would give each reflection a common starting question and allow the students to write what they would see as the proper answer. The rigor of the pilot study could be called into question, if multiple sources of reflections were taken. Would reflections from the prompts address the same issues as reflections done on an online blog? There was no uniform way to distinguish the relevant data when students were writing prompt responses, blogs, or technical reports. Disheartened at the prospect that the data collection would have to start again, other ways to help ensure uniform responses were investigated. The current data was given an analysis to see what other kinds of information could be gained from the pilot study.

Results

This part of the paper will focus on analyzing the responses from one particular Global Design Team. The Computer Transportation GDT was a small team of students with six members, of which only one was a senior. This particular team had the best response rate to the reflective prompts, allowing the researcher to see how they developed over time. The team had to face certain challenges including having their sponsor change the objective from pharmaceutical transportation to computer transportation. As such the team had to adapt their designs to allow their NGO partners to carry computers to remote locations of the Ecuadorian Amazon. In this section a sample of student reflections will be shown to see how the students are reacting to their experience and what lessons they are being taught. At the beginning,
students felt the curious and eager about their experience:

At the moment, my group has very limited information on our project. The one part I learned that interested me was the fact that the containers will be transported by canoe. This can be a big design challenge on how to fit multiple containers in a canoe. I am hoping we can get more detail on this in order to really understand how our containers will travel through the Amazon.
-Student B

I find the fact that the containers need to be carried in a canoe through the Amazon to be a very interesting part of our project, because this adds a level of difficulty and challenge to our task rather than just creating a container for medical supplies. It will affect me in the sense that I will research more in terms of prior art that can handle a level of robust/toughness to our project, and the testing that needs to be carried out for that would be different.
-Student F

Upon conclusion of the second week of the semester, I have a stronger understanding of the global design project that I am apart of and the role I should play to make sure the semester is successful. When I first met with my team in December 2012, I found interesting that the project emphasizes decision-making to be made primarily by the students. The advisor and teaching assistants are acting as facilitators and people to confide in when the students need support.
-Student D

The students kept their reflections mainly in the descriptive sense. As the objective of the project changed, the students gave reactions to these new settings. The students keep up with describing the experience and giving little critical analysis of the effects of the change or how they would like to approach the change:

Since the beginning, the most interesting part of the project is the constant changing of the objective. We have been writing a grant proposal from the Office of Engagement and has already had to change the project object twice: from pharmaceutical transport to computer servers, now to 12 laptops. It's interesting because it keeps us on our toes with everything and is delaying the design process.
-Student C

I feel like there was a change in the pace of our work, which helped us get back on track. We are all actively
The students also maintained a technical understanding of the project and gave little observation
to cultural aspects of the project, which was to be expected after reading about Dyment and
O'Connell's work as well as Chabon and Wilkerson's work where students considered giving
descriptions as a form of low level reflections:¹,²

Our project doesn’t really have a cultural requirement.
Our project deals more with the awareness of global
environments. In this sense, we have requirements to
make our containers waterproof, shock proof, and durable
in order to account for the level of humidity and
conditions through which the containers will be traveled.
We also accounted for muddy conditions by eliminating the
thought of a case with wheels so that they will not become
jammed when being pulled through mud.-Student A

The students also mentioned that one of the major issues was the ability to communicate with
their sponsors and the use of materials. Unfortunately the students did not go into detail
regarding how the issues could be overcome but gave cursory remarks about their situation:

Although communication is ongoing, sometimes email
can take longer time to receive an answer and may not fully
answer a question. This can be improved by also using
other communication forms such as Skype or phone call.
Although these are ideal, since he is in Ecuador, the wireless
is not very stable.-Student D

We recently just were notified of our budget, so
materials were just ordered a short time ago. Yet, our
desired purchases have been speculated and asked to be
reevaluated several times. The cooler that was ordered and
obtained failed to meet direct user's needs to hold 7 laptops.-
Student A

Despite, their issues, the students kept working through to the end of the semester and were
making preparations to complete the project:

We are preparing for the final stages of our project by
staying in touch with [our sponsor], and ensuring how we
will get the product being made to him safely and soon
before may. We are also asking him if there are any other
changes he wants done to the case for the laptops, and we
are finishing writing up an abstract to be posted in the journal.-Student F

We are ordering more materials for testing in order to ensure that our product adheres to the direct user's needs and will not fall apart when it arrives in Ecuador. Currently, we are not as organized as desired as we are still in the ordering process due to budget constraints.-Student A

At the end of the semester, the students were able to share what they believe they got out of the experience. What the students described was mainly influenced by the technical and professional realms of the project and not the social. Their reflections were not very critical and focused on their own experiences and not considering the effect or implications the project had on their international clients or partners:

I think my biggest accomplishment would be the different ideas I came up with, with the help of my team and the short-listing of these ideas through narrow pros and cons. Analyzing the good and bad aspects of these ideas. It helped me learn more about the engineering design process through brainstorming and other unique idea generation techniques, and also helped me understand the process more efficiently therefore affecting my work in a positive manner... I think the biggest take away would be the way the design process worked. I had an opportunity to actually speak to a customer who requested and had a need for something we were building, speaking to him on a regular basis to find what exactly he needed and then brainstorming solutions to create something suitable for his needs in the most efficient, cost effective and durable manner required real skill and patience. It taught me that the engineering design process is one that is truly employed in decision making once we begin our actual work which made me very satisfied with the knowledge I had obtained. It will influence me in the future by having provided me with some experience about the do's and don't's when dealing with people who have a bad internet connection, to be more prepared to meetings, to have an agenda or topic list, and how to deal with team disputes.
-Student F

Over the semester, my biggest accomplishment was helping write the Office of Engagement Grand as well as the proposal for the Journal of Undergraduate Research. Our team was selected to do a research snapshot for the journal and we also obtained more than $1,000 from the grant to conduct our research. These affected my work because it motivated me to continue pushing forward with our design project and made our project seem more real and significant... The experience opened me to the fact that a lot of problems in the world have very vague specifications and criteria in which not everything can be answered by asking the direct user. Instead, there are a lot of things that must be researched and assumptions that
Remember that to be considered an empathetic reflection (the second level of reflection after descriptive) a student must show the use of new knowledge to develop a different perspective and in essence challenging old frameworks. The students are all displaying descriptive reflections which show evidence that they have attained new knowledge and are making links between new and old knowledge. An interpretation as to why the students focused heavily on the professional and technical aspects of the project would probably have to do with the fact that perhaps the students are not comfortable in tackling the social aspect of their project. It could also be interpreted that the reflections did not focus on the social aspect because it received little reinforcement or discussion during the course of the project. Understanding that the social aspect was given so little attention and the level of reflection was mainly low-level, there exists an opportunity to build on the pilot study to see what can be done to encourage thinking beyond the technical and professional realm of the project as well as how to make students more critical of their reflections.

Lessons Learned and Future Implications

What was learned from the pilot study ultimately altered what could be done to improve the use of reflective practices in the GDTs. Since the students felt that they were too overwhelmed to answer the reflections, it would be an easy fix to amend the GDT syllabus with an expectation that the reflections would occur. Observing how frequently the students have to be assessed, it might prove beneficial to change the approach to the reflections. One method for changing would be to give a reflective assignment that can be given to the GDT students at the early, middle, and closing stages of the GDT experience. The assignment would only be at a minimum a single page in length and is aligned to what was previously stated by Lima and Oakes as an acceptable method to get students to reflect. Following this method of eliciting reflection, the new reflective prompts will be less in number but will require students to write more. With some directed changes to the questions, the format can be used to target student development during their experiences. Another way to help further student development will be to synthesize responses in the form a one-page mini-report to the team. The students can see that the responses are being read and used by the office as well as seeing their team is developing from an outside perspective. Following that example, the GEP will include reflective practices in their syllabus as three assignments given to students at the start, middle, and end of their GDT experience. Each response can be compiled into a synthesis report that would allow each team to see possible themes of interest or concern. Seeing how reflections help their own project development might encourage students to delve deeper in their reflections and become more involved in the process. Also students may be given access to their own reflections as a way to help them draw connections to what they previously learned and expressed. It is possible with these actions, the student may be able to branch out and use reflections to their advantage.

Acknowledgements
The author would like to thank Mary Schweitzer, Anne Dare, and the staff of the Global Engineering Program for allowing him to take part in improving student learning. The author would also like to thank Dr. Robin Adams, Dr. Brent Jesiek, Dr. Junaid Siddiqui, and Mel Chua for helping him with editing this paper.

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