AC 2010-68: COMMUNITY BASED LEARNING IN ENGR 101 TERM PROJECT: TOY DESIGN FOR SCHOOL CHILDREN IN DISADVANTAGED OLD CAIRO COMMUNITY

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Community based learning in ENGR 101 term project: toy design for school children in disadvantaged Old Cairo community

Abstract

Introduction to Engineering (ENGR 101) is the first engineering course students take upon admission to the engineering program. It is required of students in all disciplines of engineering. It is a one credit hour course that meets once a week and covers topics including History of Engineering, Engineering fields of specializations, the engineering profession, engineering communications, engineering ethics and societal obligations. It also focuses on teaching students the engineering approach to problem solving and includes a course project. Community Based Learning was introduced into the ENGR 101 course via the term project which is a required component of the course. The project was to design toys for children ages 7 to 14 years at a school in a disadvantaged squatter community in Old Cairo, Egypt, where infrastructure is poor and education and social mobility can be very limited. The project was carried out in partnership with a non-government organization (NGO) named "Sohbit Khayr" based in the Stable Antar neighborhood in Old Cairo. This paper shows how the introductory engineering course was redesigned to integrate community based learning while meeting the stated ABET course outcomes. Included are detailed step-by-step instructions on the tools and structure of the project so that it may serve as an example for others wishing to adapt some of these tools to other courses. The paper will present the outcome assessments and survey results to evaluate the project's success in meeting the stated outcomes and includes a discussion on the benefits to the students and the community partner.

Introduction

Community based learning is a pedagogical approach in which the student is engaged with the community in order to learn. The aim of the engagement is to promote learning at a deeper level on the part of the student and to have the community benefit from the learning. Community based learning is different from community service. In community service, the aim is to serve the community and the measure of success is on the benefit gained by the community. Community based learning on the other hand places the focus on the learning and gives students a more authentic and detailed model for the profession in the short term while offering the potential for more substantive community engagement than mere acts of charity in the long term.

One can evaluate projects based on the 4-block diagram shown in Figure 1. Projects can be of high service or low service to the community and they can be of high learning or low learning for the student. A project that is high service and high learning (quadrant IV) is beneficial to both the student and the community partner and would be a good candidate. But a project that is of high service to the community but of low learning (quadrant II), for example cleaning parks and painting playgrounds would NOT be considered community based learning but would qualify for a community service project. The key to community based learning is that the project and engagement must serve the outcomes of the course and ensure that the learning that is required of that course is achieved and not compromised.

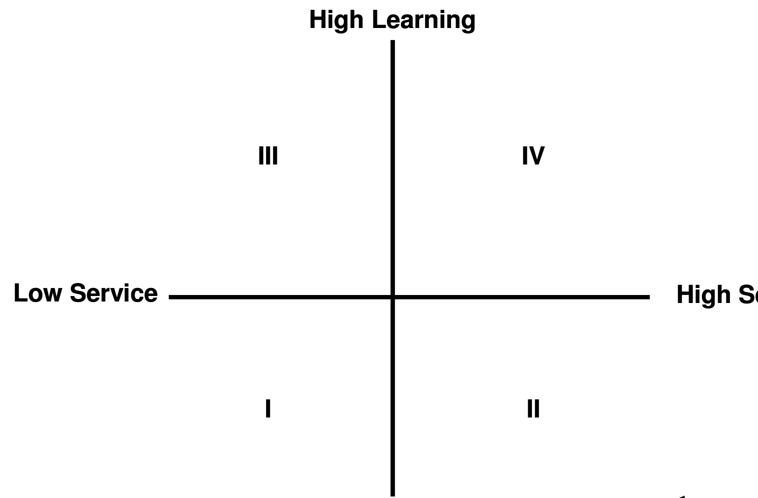

Figure 1 – Community-Based Learning Four-Blocker[1]

This experimental introductory course asks first-year engineering students to design toys for schoolchildren in a poor Cairo neighborhood. The paper will show how the project is structured to ensure that course outcomes are met while also taking the learning to a deeper level by engaging with a community partner. In the end, the students learn what they need to learn from the course but they also gain skills beyond that and have a profound impact on their character and an impact on their communities. The substantive engagement with the community is not merely an act of charity but an enabler to sustained social development. Giving children toys is charity; engaging children in the design of a toy that appeals to them is community engagement and community based learning.

Pedagogies of Engagement and collaborative learning

Community based learning is one of several methods or strategies for student engagement. Smith et al.[2] present a survey of various strategies for engaging undergraduate students, including active learning, service learning, problem-based learning, and team projects. It includes a history of these methods and research results on the outcomes of such methods. Their research found that cooperative learning yields several advantages over individual learning, including higher academic success, improvements in the quality of relationships with other students and faculty, and better psychological adjustment to college life. Thus, cooperative learning is particularly appropriate for an introductory course.

There are several examples in the open literature of cooperative learning. Reid[3] presents practical techniques for implementing active and collaborative learning in lectures and labs. Lengeiza et al[4] present a student design project, part of Lehigh University's Integrated Learning Experience, in which a multidisciplinary team of students design a golf course. Selecting capstone design projects was a topic of a Harvey Mudd Design Workshop[5]. Gorman[6] also provide examples of capstone projects from the University of Virginia in a paper that focuses on Criterion 3 of the ABET criteria on Program Outcomes[7]. The projects Gorman highlights in the paper demonstrate how to incorporate the four types of knowledge the engineering student needs: information, skills, judgment, and wisdom. The third Harvey Mudd workshop also investigated the social dimension of engineering students' collaborative projects, and highlighted the value of social-scientific and pedagogical scholarship for instructors creating such projects[8].

Simply assigning a project to be a team project doesn't necessarily constitute or guarantee cooperative learning. Johnson et al[9] identify five key elements to successful cooperative learning: positive interdependence, individual accountability, promotive interaction, social skills, and group processing.

The community-based learning project presented in this paper is a team project that attempts to promote cooperative learning as a strategy for engagement and also as a lesson for how engineering teams functions. Some aspects of the project grade include a group grade to promote interdependence, and student evaluations of one another's team work and contribution promoting individual accountability and group processing. The research for this paper is for the most part qualitative, with some quantitative survey results. Qualitative research serves the purpose of providing detailed description and its merits and appropriateness in engineering assessment are described by Leydens et al.[10]. The current paper starts with a description of the learning outcomes of the course and how the term project relates to the outcomes. This is followed by detailed descriptions of the project, the community partner, the project schedule and deliverables, and a brief review of each team's design. The Record Book was an assessment tool developed and used by the students; its contents are described in sufficient detail so as to enable other instructors to make use of it. Finally, quantitative and qualitative feedback is obtained from the student and community partner and the benefit for each is discussed.

Learning objectives & course outcomes

Introduction to Engineering (ENGR 101) is a one credit-hour course required of freshmen entering any of the American University in Cairo's engineering programs. The objective of the course is to introduce students to various aspects of engineering, including the different fields of specializations and the engineering majors available within the School. It also introduces students to the engineering approach to problem solving and to the various tools and methods used by engineers (such as estimation, sketching, brainstorming, etc.). Multiple sections of the course are taught independently by faculty from the engineering departments within the school. This course has six outcomes, assessed as part of the ABET process, that all sections must meet. The course outcomes are:
"After completing the course, students will be able to:

1. Identify and describe the engineering field of specialization.
2. Explain the different career paths for engineers.
3. Practice the engineering approach to problem solving.
4. Identify the engineer's ethical and societal responsibilities.
5. Practice technical writing and presentation using computer tools.
6. Work in a team."

Term project & how it relates to course outcomes

The course grade is based on assignments, an exam, and a term project. The term project is the vehicle for integrating community based learning into the course. In general, the project is intended to serve as an opportunity for students to demonstrate they have achieved the various outcomes that are addressed in the course. Students design a simple product, and in doing so show that they are able to define the problem, come up with an engineering solution, implement a design, work in teams, and document their work in the form of a technical report, engineering presentation, and engineering sketches.

For the term project, students were asked to form teams of four and design a toy for children ages 7 to 14 years in a squatter community in Old Cairo. A squatter community is a settlement on land or property to which there is no legal title. It consists of make-shift houses and due to its illegal or semi-legal status, it lacks infrastructure such as proper roads, utilities, etc. These are very poor areas. The neighborhood specifically that was targeted in this project is named Stable Antar. It lies in the hillsides of the Old city of Cairo. The partnership of a non-government organization based in Stable Antar was essential for access to the community. The NGO runs a school in the area and the school children would be the end customers and would test the final products and vote for their favorite toy. The engineering student team that gets the most votes receives a prize. Students learn to how to anticipate the child-clients' needs and desires and the engagement with the community is much more substantive than merely giving the children toys.

The term project addresses course outcomes 3 through 6, while the other two outcomes are covered by other aspects of course including lectures, assignments and guest speakers. In coming up with the toy design, students will practice the engineering approach (outcome 3) starting with identifying the needs of the children from this age group and demographics, brainstorming ideas for toys that appeal to this customer base, selecting the best idea to proceed with, implementing the design, etc. They will also identify the ethical and societal responsibilities of the engineer (outcome 4) and are asked to reflect on ethics in the final stage of the project. In addition to the product, each team will prepare and submit an engineering report and make a technical presentation on their product design (outcome 5). And most certainly, they will learn to work in a team (outcome 6) as they embark on the various stages of this project.

Background on the NGO and its school

The Non-Government Organization that runs the school is called "Sohbit Khayr," which is an Arabic term that translates roughly to "A friendship of goodwill." The school is located in a squatter community in Old Cairo where harsh economic conditions and lack of access to transportation and other social factors lead to children dropping out of school and trying to find a trade. The school is non-traditional; it is part-vocational where children learn a trade like carpet weaving (thereby appealing to their need to learn something that will earn them a living in the short-term) and part "educational" in the classic sense of a grade school, where children learn reading and writing, and develop social skills to succeed academically. The school's vision is to give children self-confidence, engage them intellectually, and provide them with opportunities to develop problem solving skills.

Project Timeline

AUC's spring semester starts in February and ends in May. At the start of the semester, I went to visit the school and met with the teachers and the director to brainstorm ideas and scope out a project that would be both suitable and relevant. I attended a class with the school children (theatre) and was assured that the interaction and involvement with the school would be beneficial for the course project and the students. I also wanted to ensure that the area and the school would be welcoming and safe for the engineering students. The NGO is heavily involved in this community which meant that we were well received.

Orientation (mid-March): Norhan Momen, the NGO's Education coordinator visited the engineering class about 3 to 4 weeks into the semester to provide an orientation. Some students were resistant to and weary of going to a poor community, and wanted to design toys for siblings, neighbors, or other children they knew. However, Norhan was able to answer questions about the school children, the community, and the school and reassure students regarding their concerns. The orientation also included an orientation to toys, game, and play. A variety of toys/games were made available in class and students worked in groups playing with each toy, sketching it, and analyzing features in the design that they could leverage. In this orientation, the project teams were formed and the project details, deliverables, and time line were discussed. Students were also given a draft of the Record Book and asked to review the deliverables as a team and give feedback to the instructor. Once the dates and deliverables in the Record Book were agreed on, no changes were permitted.

Site Visit (late-March): Mid-semester the engineering students visited the School at Stable Antar. Although AUC instruction is in English, many students are bilingual in Arabic. There is a profound socio-economic gap between the school children at Stable Antar and the engineering students at AUC and essentially no social or other interaction between them. The physical location of Stable Antar is inaccessible and the typical Cairo resident would have no reason to ever venture into this neighborhood which lies deep in the hillside and requires a 30-minute hike through 1-meter wide winding haphazard system of alleys and unpaved roads. This was the first time for most of the engineering students to see and communicate with children from a squatter community. To break the ice, the day's activities started with an engineering challenge that served as an intellectual stimulator and icebreaker. The challenge was to work in pairs to assemble a ReadyMech toy (readymech.com) without knowing what the final shape looks like a priori. Following the ice-breaker was a short social break. After the break, the engineering students were asked to work with the children to identify their likes/dislikes and brainstorm ideas for their term projects. And at the end of the day, the children and engineering students played a short game of soccer at the children's request (boys against girls).

Informal design review (early-May): After the visit, students were given assignments to brainstorm ideas for the term project, establish selection criteria for choosing the project to pursue, and develop a design. The instructor held a preliminary design reviews with each group in advance of the due date to ensure that progress was being made and the prototype was in a nearly finished stage. Issues with implementation were also addressed. Such a prototype / preliminary design review is good practice, typical of what practicing engineers would be required to do, and it also deters student groups from procrastinating and leaving the project execution to the end of the semester. The Record Book was collected periodically (three times during the semester), ensuring continual progress, and offering guidance and tools for following the engineering approach.

Product Demos (mid-May): At the end of the term, the children from the Stable Antar school were invited to the University campus to judge the toys. The children were divided into groups and escorted to each station to play with the toy/game for about 10 minutes. After the children had rotated to each station, they were asked to vote for their favorite toy or game; the team that designed the toy/game with the most votes won a prize. There was a tie between a soccer goal shooting practice toy and a twist on the game twister. The soccer appeals to the children, both girls and boys and the game twister was colorful and engaging and different enough that it too appealed to many children. T-shirts and lunch were provided for the children and the AUC students. In addition, hands-on-science demos were borrowed from a physics lab, including the bed of nails that demonstrates the concept of pressure and other science-made-fun demos. For dessert, the students made ice cream using liquid nitrogen to instantly freeze the mixture. Science you can see, taste, and feel: this is an effective way to get both children and University students excited about science and engineering.

Final presentation and Technical Report (final week of classes): The engineering students submitted an engineering report at the end of the term and made a technical presentation which was evaluated by their peers. The peer evaluation of the presentations was an opportunity to discuss with students the role of peer review in engineering, ethics in the review process, and the role of engineering societies like ASME and others in reviewing work objectively to ensure the integrity of the process. Students also submitted for the final time their completed Record Book that includes sketches, brainstorming of ideas, notes, to-do-lists, selection criteria, proposal, a team evaluation, and a reflection on ethics.

The projects

There were five teams that semester, each with a different project. This section describes each of the five projects that the student teams completed.

Group #1: Bend & Twist [Figure 2] – This toy is a variation on the game Twister. The team added another dimension to the game by introducing shapes (in addition to the colors) so the game has added strategy. They made the game from a washable canvas-like material for added durability; they observed that children in this age group play aggressively and the play areas are outdoors (which means they are dusty) and decided to make the game washable to accommodate their clienteles' surroundings. They made the game board larger than the standard size and came up with a creative package: the game board folds onto itself transforming it into a self-made carrying case [Figure 3]. They also provided game instructions in Arabic to serve the client.

Figure 2 – Children playing with Bend & Twist

Figure 3 – Team leader demonstrating how to pack the game into its self carrying case

Group #2: Magnetic Baby Foot [Figure 4] – This team designed a game that is based on foosball, or as it is called in Egypt "baby foot". The team chose this idea to appeal to the children (both boys and girls) who all loved to play soccer. However, this game is played a bit differently. In foosball, two players each control rows of game pieces that rotate around a fixed pole. The game the students designed is different in principle: it uses an avatar for each player, and it's a team sport. Each player controls his avatar and the motion is unrestricted in the plane (unlike the original game where the rows can move only along a single axis).

Figure 4 – Magnetic baby foot

Group #3: Push Scooter [Figure 5] – This team designed a push scooter with a focus on cost and recycling. They made their scooter from empty soda bottles, pipes and other materials that the school children can find in their environments. The team had observed that the school children like to play games rather than play with toys, and so the objective of the game was to push the scooter while blindfolded, with the aid (verbal instructions only) of a partner. The pair that maneuvers through the path in the least time blindfolded wins. The wheels of the scooter were made of soda bottles with colorful pins for sound and visual appeal. The frame was made of plastic tubes/pipes with adjustable height and decorated with an adhesive colored green. This team focused on simplicity and low cost, so that the school children can make and assemble similar units from common materials.

Figure 5 – Push Scooter toy

Group #4: Air Rocket [Figure 6] – This group designed and constructed a home-made air rocket. The body of the rocket is made of PVC piping and the launch pad is a block of wood. The air tank is a flexible plastic bottle and it is connected via tubing to the launch pad. The child launches the rocket by stomping on the air tank. This group sought to make a toy that demonstrates a scientific principle, to encourage children to develop interests in physics and science in general. They also had a second objective of making the toy from household items so that the children could build similar models themselves.

Figure 6 – Air Rocket Toy

Group #5: Goal! [Figure 7] – This team made a goal post with three targets for shooting practice. The post is made of a wooden frame covered by a fabric with three openings, each with a different point value.

Figure 7 – Goal!

The Record Book [Figure 8] – A Record Book or log was maintained by each student and it essentially paced the project and ensured that the engineering approach was followed deliberately. The Record Book contained:

1. Calendar with project milestones and due dates
2. Team members page with the names and contact info for each member of the group
3. Project assignment (part I, II, and III) which includes the objective of the assignment, the deliverables for each phase, the sections of the textbook relevant to each phase, and a grading checklist with the maximum point value for each deliverable.
    a. Phase I deliverables were: Background research on toys, history of toys, toy design concepts including references and three annotated sketches of toys of interest. Following the assignment description were three pages of engineering paper for sketches and two pages of lined paper for background notes including references.
    b. Phase II was the field visit and pre-trip requirements as well as post-trip reflection. The deliverables were: two pages of notes from a pre-trip team meeting (in which students discuss what questions they will ask the children and prepare for the visit), field trip attendance including notes, comments, questions, and ideas from the visit, brainstorming of ideas for the term project, developing criteria for selecting the idea they will develop into their term project, and a project proposal that includes a sketch of the proposed design and a page describing features of the design. All these deliverables have designated pages in the Record Book.
    c. Phase III is essentially the execution of the proposed design, team work assessment and reflections. Deliverables include preliminary design review with their working prototype, detailed calculations, task lists, notes, etc in the Record Book, a final design tested by the children on exhibition day, a technical report, and a technical presentation. Check-lists were provided in the Record Book for each deliverable. In addition, the end of the Record Book includes a team evaluation rubric page for each team member and a page for ethical reflections in which students comment on any ethical dilemmas encountered in the project execution and relate ethical cannons studied in the lecture to the project.

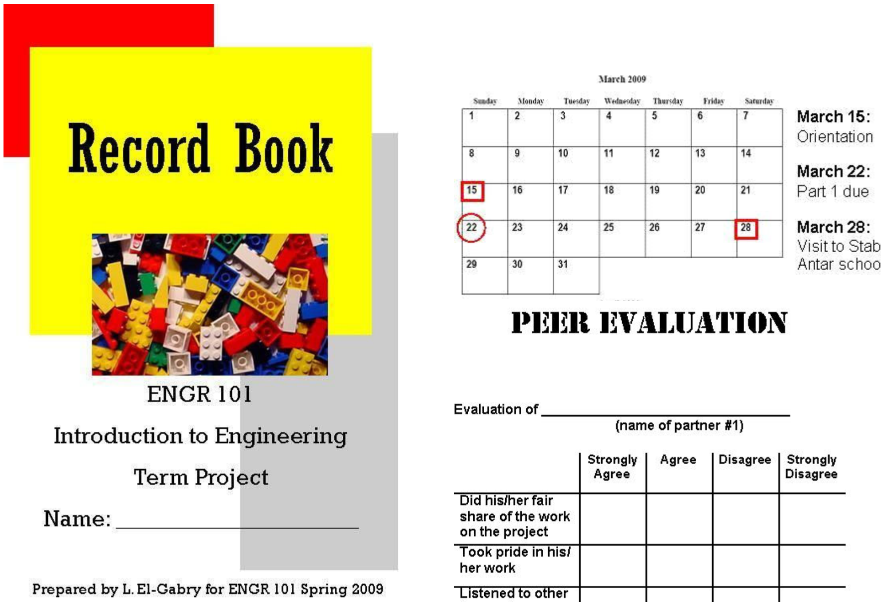

Figure 8 – Cover page and select pages from the Record Book

Student Feedback

Feedback from engineering students was solicited in the form of a survey developed to evaluate the effectiveness of community based learning courses. They were also asked to complete a course outcome assessments as part of the ABET evaluation process, and specifically to assess the degree to which each of the six course outcomes were attained.

The responses to the ABET assessment for spring 2009 semester in which community based learning was integrated into the course are shown in Figure 9. The community based learning project was designed to address outcomes 3 through 6. With regards to outcome 3, over 2/3rd either agree or strongly agree that that they have been able to achieve this outcome and can practice the engineering approach to problem solving and only 1 person disagreed that the outcome was achieved. In terms of outcome 4, 58% agree or strongly agree that they have achieved the outcome and are able to identify the engineer's ethical and societal responsibilities; again, only 1 person disagreed that this outcome was achieved. The same holds true for outcome 5 where again 58% strongly agree or agree that the course achieved this outcome and they were able to practice technical writing and presentation with only 1 person disagreeing that the outcome was achieved. Finally, 92% agreed that the sixth outcome on team work had been achieved, and this certainly can be attributed to the project.

	OUTCOMES	SA	A	N	D	SD	AVERAGE
1	Identify and describe the engineering fields of specialization.	3 25%	9 75%	0 0%	0 0%	0 0%	4.25
2	Explain the different career paths for engineers.	3 25%	5 42%	4 33%	0 0%	0 0%	3.92
3	Practice the engineering approach to problem solving.	6 50%	2 17%	3 25%	1 8%	0 0%	4.08
4	Identify the engineer's ethical and societal responsibilities.	3 25%	4 33%	4 33%	1 8%	0 0%	3.75
5	Practice technical writing and presentation using computer tools.	4 33%	3 25%	4 33%	1 8%	0 0%	3.83
6	Work in teams.	8 67%	3 25%	0 0%	1 8%	0 0%	4.50

Figure 9 – ABET Outcome Assessment Survey: SA- Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

In addition to assessing course outcomes, a survey was developed and administered by the Gerhart Center for Philanthropy and Civic Engagement and the Center for Learning & Teaching to evaluate courses that included community-based learning (CBL). The survey included questions on demographics followed by statements that students respond to before/after the community based learning course to assess the effectiveness of the CBL experience. There were a total of 13 responses: 13% of the students were juniors, 62% sophomores, and 23% freshmen. This course is normally taken by freshmen declared in one of the engineering majors. Figure 10 shows a summary of student demographic data collected in the survey.

Standing	
Freshman	23%
Sophomore	62%
Junior	15%
High school education	
American diploma	23%
British (I/GCSE)	39%
Egyptian (Thanaweya Amma – this is the National Egyptian diploma, equivalent to the U.S. high school diploma)	38%
Student involvement in activities	
Conferences	5 students
University social development clubs	4 students
Other university activities	4 students
NGOs	2 students
Activities with family and friends	2 students
No activities	2 students

Figure 10 – Summary of Student Demographic

The majority of the survey is a presentation of statements and students select their level of agreement with the statement before and after the course. For example, one statement is "I know how to communicate my ideas with individuals from different socio-economic groups" Before the course, 8% strongly agreed, 61% agreed, and 31% disagreed. After the course, 62% strongly agreed and 38% agreed showing a significant improvement in the students' confidence in their ability to communicate their ideas. Other statements presented in the survey that students had to rate their level of agreement with include:

- I know that I can make a positive difference in the lives of others
- I know how to communicate my ideas in a situation that is new to me
- I have a responsibility to help those individuals who are less fortunate than me
- I know how to become involved in helping others who are less fortunate than me
- I am confident that I can help individuals in need
- I will act to work for long term social change in society
- I have a good understanding of the social justice issues in the community where I am going to provide services
- It is my civic duty to give back to society

In general, the reply after the course shifted to a more favorable position than before the course in the same proportions as the afore-mentioned example on the ability to communicate ideas with individuals from different socio-economic groups.

Students were asked about their attitudes before the course; 69% said they were anxious, 15% were indifferent, 8% were excited, and 8% were disappointed. After the course, the attitudes changed with 54% saying they were excited, 38% were satisfied, and 8% were indifferent.

Students also had an opportunity to provide comments. Below are three such comments:
"I was scared. Then I found it easy and interesting."
"It was too much for one credit although i enjoyed it so much"
*"I don't kno*w if the project is too big for this course but I'm enjoying it anyways and I think I *have learned a lot by doing it as an engineer."*

Student Reflections

One of the important elements of community based learning is student reflection. Immediately following the visit (i.e. on the bus ride back to campus), students were asked to reflect on the experience collectively. Each student was given the microphone for a few minutes to reflect; these reflections were recorded and transcribed. Below are some of those reflections

"The kids are in fact very creative and we sat with them and got out of them things. At first we *asked them they didn't know but once we asked them what do you play with and what do you use* and play with daily then they said a lot of very *"gemda" [colloquial Arabic for awesome or* deep] things that we wrote down. And we learned from them also a lot of things."

"The kids there really want to learn. When I take the scissors from one then he says no give it to me to do it myself."

"They *are good and they want to learn. But they don't know anything new. All they know is* what they play there. You come to tell them something new and they tell you all the games they *play there. We want to teach them something new other than what they're* learning."

"They're very smart and very creative but their problem is they're barely exposed to anything. They don't know the difference between game and toy. We try to ask them what do you want us to make for you to play with and they say "we want to play oola [hopscotch]." They don't understand that we can make them an object to play with. But they're very creative and there is a lot of potential.*"*

This last comment is a most interesting and important observation and points to a serious engineering problem (that extends beyond toy design) and that is: how do you make something for people who don't even imagine what you can do for them? This is particularly important for engineering projects in the developing world where engineers must resist the temptation to simply make a change or install a system in a community without input from the community. A solar/wind powered irrigation system for instance may be an excellent engineering solution but if that farm community doesn't understand or want the system, then is not a sustainable solution and essentially not a solution at all and runs the risk of becoming an artifact on the land rather than a useful system.

Benefits to Students

The community based learning project benefited students in several respects, perhaps the most obvious being the ability and opportunity to interact with a social group that they may not normally be exposed to. Even the "toughest" or seemingly coldest of students were touched by the experience in a human way. They learned first-hand social responsibility and ethics and their opinions and misconceptions of the poor and their responsibility towards them as engineers and as human beings living in a society changed. A common remark from those who worked hard on the project was the fact that they worked as hard as they did because they liked it. There was also a lot of gratification in seeing their designs played with. There was a true end customer to evaluate the product and not just an instructor grading the work. The presence of a real customer with ill-defined requirements added a dimension of reality and challenge to the project. For example, the students struggled initially with collecting information from the children that they can use in designing a toy based on the needs and interests of the children. Students asked the children initially: What toy do you want us to make you? What do you like to play with? And found that the kids didn't know. One student made a very striking reflection that the children were so ill-exposed that they didn't really know what toys were possible and would recite the games that they know how to play like hopscotch and soccer. The children don't grow up getting "toys' but use their ingenuity to play games with minimal or no props at all, so they couldn't fathom that these students could make an object for them to play with. Some children said they wanted dolls or teddy bears when pressed to name an object but eventually the students learned that they need to pose their questions to the children differently to get responses that would be useful in defining their project. The groups dealt with this creatively by adjusting their questions and the group that designed "bend and twist", for example, said that they designed this to appeal to the children who liked hopscotch because it had some of the same elements. A valuable lesson learned is that in engineering, you may be presented with vague customer requirements and perhaps ill-defined specifications that you must turn into real products that appeal to the customer nonetheless.

On the bus ride from the site visit, there was a noticeable transformation in the relations and bonds among the students and also between the students and instructor. The shyness was gone; students spoke openly and frankly during the video reflections. The group "clicked," and this social element and friendship makes the work enjoyable. The class as a whole was more collaborative and cooperative. For example, during the product demos, there was a program of events that included lunch and ice-cream making with liquid nitrogen and clean-up and bringing back equipment to campus, etc. The students rose to the occasion and asked to help with nametags, or T-shirts, or passing out food, or going to get more milk and cups for the ice-cream from a near-by shop. This is going well above and beyond the course requirements, and quite different from the students at the start of the term who were there to get this one credit course over and done with. It is not uncommon for the participants in a collaborative learning exercise to develop personal relationships[2].

Benefits to Community Partner

The educational coordinator and the staff from the NGO who participated in the activity were asked for their feedback. There were a number of key benefits they cited. First, the children enjoyed the interaction with college students, as well as the intellectual challenge that was posed with the ice-breaker activity. They liked the fact that the children and the students were engaged in a challenging task together that required persistence. The NGO also were pleased with the children voting for their favorite toy and casting their votes anonymously. To the children, this was a chance for them to learn that their opinion matters and that their vote is uninfluenced by the votes of others or by what anyone else says. This is empowering for the children and a boost to their self-esteem and also an introduction to the democratic process. The scientific activities that accompanied the demo were also well-received as they gave children a chance to see the exciting hands-on science, and perhaps help them aspire to stay in school and look towards technical jobs or careers. The fact that the engineering students made these toys for them based on what they told them was perhaps one of the most significant aspects of the project. There are others who work with this NGO in community-service groups but generally these groups come in to do a particular activity; never was there a two-part follow-up where in one part, the children are asked for their input and a second part in which they are able to see how their input inspired a particular design and get to play with and vote on designs that they themselves inspired.

Conclusion

Integrating community based learning into the introductory engineering course has been successfully carried out via the term project. The project was to design a toy for children in a disadvantaged community in Old Cairo. The students worked in teams to apply the engineering approach to problem solving. The community based learning approach has had several advantages both to the students, the community partner, and the course as a whole. Students were able to exercise the engineering approach to fulfill the needs of a real customer who ultimately evaluates their product. They also tackled issues of social class and poverty indirectly by visiting and interacting with the children in their community in addition to bringing the children to the University. The students worked extremely hard on their projects and the social networking and rapport that was developed as a consequence of the collaboration and interaction including the field trip and throughout was instrumental to keeping the students motivated and excited about the work. The community also benefited from the sustained interaction; there was a field trip at the school and a second field trip at the end of the term to the University where the children were able to reconnect with the college students and test the products they inspired. Overall, this experience was a true learning experience for everyone involved—and it was "fun," which goes a long way to making the work doable.

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