

# ***Service Learning through Global Engineering in Jabal Al-Natheef, Jordan: A Case Study***

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## **Abstract**

The Global Design Team (GDT) Jordan project coordinated by Purdue University's Global Engineering Program (GEP) brought together an interdisciplinary team of undergraduate and graduate students with the goal of enhancing the waste management practices of a community in Amman, Jordan. Through frequent communications with members of the host community and Ruwwad, The Arab Foundation for Sustainable Development, a not-for-profit organization working with this community, the team identified local needs and researched the feasibility of potential solutions. Students took a three-part approach which utilized the principles of engineering, education, and entrepreneurship to provide an integrated solution to the challenges of waste management in a developing area. Students developed a team structure that facilitated interdisciplinary collaboration and maximized the intellectual diversity of the team. The final on-site project consisted of workshops for the women in the host community to assist them in acquiring skills in paper recycling and journal making. A manual with information on composting relevant to the community was prepared and delivered. This paper presents the lessons learned from the project experience, including understanding cultural barriers, interpreting requirements from project partner organizations, and using effective communications skills for both inter-team collaboration and effective dialogue with external partners.

## **Background**

Aramex International, a global transportation and logistics company based in Amman, Jordan, sponsors community development efforts in partnership with Ruwwad, The Arab Foundation for Sustainable Development, a community empowerment organization serving the East Amman community of Jabal Al-Natheef, Jordan.

The Jabal Al-Natheef community has struggled for recognition by the Amman municipality and, consequently, is a highly marginalized community having received few services provided by the municipality. The community is affected by its highly-dense population of over 54,000 (United Nations Development Programme), many of whom are refugees. Though the refugee population has given the community the status of an 'unofficial' refugee camp, Jabal Al-Natheef receives no recognition from the United Nations for the refugee population and, thus, does not qualify for United Nations sponsored aid. The majority of the community lives in poverty. According to a United Nations Development Programme report, "The area is relatively poor and households are dependent on a wide range of livelihood strategies in order to survive." The refugee population has also further complicated relationships with the Amman municipalities, which provide services to neighboring communities. Ruwwad has made several efforts to increase the municipal recognition of Jabal Al-Natheef, including successful petitioning for the first post office, police station, employment help center, and legal aid service center in the community ([www.ruwwad.jo](http://www.ruwwad.jo)).

Aramex approached Purdue University's Global Engineering Program (GPE) after learning of GEP's Global Design Team (GDT) initiative (Mothar and Dare 2012) which had previously sent students to Ghana, Cameroon, and the Palestinian West Bank to work with local organizations on engineering-related service learning projects (Stillman et al. 2010). In response to needs expressed by Ruwwad and Aramex, Purdue created a course for the spring academic semester of 2011 with a focus on development of sustainable waste management and recycling practices in Jabal Al-Natheef. The project team was composed of twelve undergraduate and graduate students from diverse disciplines including engineering, education, sciences, and the humanities most of whom had not previously participated in service learning projects. Students met one hour per week in a credit-bearing course with the following learning objectives:

1. Develop, test, and implement an interdisciplinary, global approach to challenges in waste management using a 4E approach (engagement, engineering, entrepreneurship and education).
2. Develop cultural understanding and knowledge on waste management issues at the international level.
3. Expose graduate and senior undergraduate students to waste management technologies practiced in the Middle East.
  - Identification of stakeholders and their beliefs, knowledge and potential contribution.
  - Collection and analysis of socio-economic and environmental data in the Jabal Al-Natheef community in Amman, Jordan.
  - Identify objectives, constraints, and trade-offs for sustainable waste management.

### **Early Project Framework**

Students began the project by familiarizing themselves with the geographic, economic, and sociocultural environment of Jabal Al-Natheef as well as the wide range of informal waste management and recycling techniques employed by people in developing areas with similar conditions. A student review of information included articles on waste management and internal reports from previous Purdue teams familiar with the community (Medina 2008; Wilson 2006; Wilson 2009). At the conclusion of the review of initial reports, students planned to address waste collection and/or recycling practices currently in place in the community. When discussing possible challenges for the team, students expressed that cultural differences would prove a major barrier regarding project implementation and communication with Ruwwad.

In order to facilitate communication with members of the host community, Skype calls were held once a week between the GDT project team and partners from Ruwwad. Early on, the calls focused on determining the feasibility of prospective solutions to the challenges faced by the Jabal Al-Natheef community. Students used class time to brainstorm possible solutions. Ideas proposed included drafting an efficient garbage collection route for use by the Amman municipality, organizing a community-based waste collection system, and a recycling system operated by the community. This communication was an effective way to gain insights about the partner's needs and the needs of the community that could be addressed by this service learning project. These insights formed the requirements of the project.

Students learned that the Greater Amman Municipality (GAM), in charge of waste collection, did not provide recycling services to this area. Also, the community lacked the resources (such as recycling bins, garbage trucks, etc.) to carry out any large-scale recycling operation of its own. Ruwwad expressed a desire to educate the community about recycling so

they could implement interim recycling programs. Their eventual goal is convincing the GAM to provide full-scale recycling services to the community.

Ruwwad communicated that such a project, in order to be effective, must include an entrepreneurial component that would provide income-generating opportunities for community members to incentivize participation. Ruwwad had previously found that wide interest existed for such opportunities. Specifically, a study found that 92.4% of respondents believed there were not adequate business opportunities in the area, and 49.6% said they had considered starting a business (Chatagnon 2010). Ruwwad also expressed a concern that the project design should be sustainable, without requiring long-term assistance from external partners. Finally, Ruwwad emphasized the need to involve women and youth, who they believed were best-suited to transfer skills and knowledge to others in the community.

### **Division of Engineering, Education, and Entrepreneurship Functions into Independent Sub-Teams**

In order to accomplish the multi-dimensional nature of the project, the students agreed to create three sub-teams to focus on the areas of engineering, entrepreneurship, and education. Students chose their respective sub-teams based on their individual interests and academic background with four students on each sub-team.

The objective of the engineering sub-team was to identify and propose a feasible, affordable, context-sensitive recycling program/alternative that could both generate income (as an incentive to recycle) and be implementable in Jabal Al-Natheef. The sub-team paid particular attention to literature provided during the initial review on waste management. Examples from India, Mexico, and Brazil, focusing on the organization of labor and resources and how the operations were managed (Medina 2008; Wilson 2006; Wilson 2009), were considered. The sub-team anticipated that understanding the ways informal recycling networks can be organized and the physical and economic conditions of the Jabal Al-Natheef area would enable them to determine the ideal recycling system to implement in Jabal Al-Natheef.

The objective of the entrepreneurship sub-team was to develop viable strategies to recognize entrepreneurial opportunities related to waste management, which can be translated to potential revenue sources for the women and children of Jabal Al-Natheef. They focused on exploring various ways to make recycling profitable and developing a quantitative mechanism to measure how much income could be generated given certain conditions. The questions investigated included the type of materials available to be recycled, possible demand for recycled products among local consumers, and access to markets to sell products.

The objectives of the education sub-team were to serve as educators for both the Jabal Al-Natheef community, to increase awareness of waste management practices, and for GDT-Jordan team by providing contextually-appropriate methodologies for successful and sustainable cross-cultural engagement. With this dual role, their goals for helping the other sub-teams included: providing appropriate background information on the community, researching educational materials relevant to recycling, and documenting the team findings for future work with the community. Secondary research was conducted on best practices for cross-cultural education of youth and on the educational background of the community, including factors such as levels of literacy and years of schooling.

An understanding developed among the members of the project that the engineering and entrepreneurship sub-teams would work together most closely during the early stages of the project to ensure that the proposed system was both technically and economically feasible and

the education team, while being involved in all aspects of the project, would take on a more active role in the later stages to create ways to teach the community about the proposed recycling program.

When project work began on January 13, 2011, sub-teams met independently and reported back to the class as a whole on a weekly basis. Approximately six weeks into the project, students realized that time spent on team communication, both inter-team and between various team stakeholders, was becoming overwhelming. This effort both decreased efficiency and slowed project progress. Students began to find that the division of engineering, entrepreneurship, and education into separate teams made it increasingly difficult to develop effective alternatives that satisfied all three necessary components of the project.

### Team Restructuring and Refining Project Objectives

During week eight of the project, approximately the half-way point, students privately reached a consensus that they were not making adequate progress. With problems including a lack of interdisciplinary collaboration and cohesiveness, the students determined that team reorganization with clarification of team objectives was necessary. At the conclusion of the reorganization, a new team leadership system was implemented: the three sub-teams were replaced by interdisciplinary project-based working groups each of which focused on one particular sub-project (Figure 1). These working groups were distinct from the previous sub-teams because all group activities were vertically integrated, allowing each group access to all aspects relevant to that group.

**Figure 1: Reorganized Team Structure<sup>1</sup>**

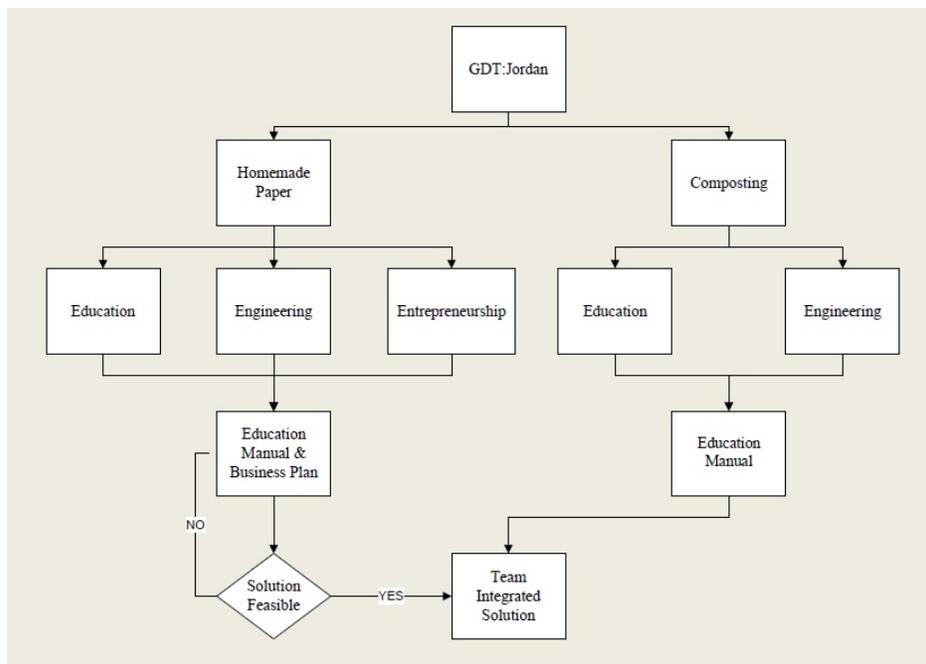


Figure 1: Reorganized Team Structure

<sup>1</sup> Figure reprinted with the permission of GEP (Purdue Global Engineering Program).

The reevaluation of team objectives streamlined the project scope to the completion of two joint sub-projects that together would satisfy the environmental, educational, and entrepreneurial requirements of the partner organizations in the time frame available. The first sub-project was a community-wide composting effort with a focus on educating youth about the composting process and the concept of recycling more broadly, satisfying both environmental and educational requirements. The second sub-project was geared towards training community members to make recycled paper and then use that paper to create journals that could be sold in local markets.

To address communication issues, a third working group was established to manage the flow of information between GDT Jordan students and Ruwwad. This group documented the work in progress and developed monthly progress reports submitted to Aramex and Ruwwad. This allowed the team to streamline their correspondence with Ruwwad and effectively create shared knowledge.

### **Newly-formed Working Groups for Composting and Paper-Making**

With a new project strategy, each respective group began preparing their final deliverables in the limited time frame. The composting working group began work on composting educational materials, focusing on grade school children. Acknowledging the simultaneous desire to also provide an educational material relevant for the entire community, the group decided on a written manual. With this broad audience in mind, the manual included step-by-step composting instructions, information on the science behind composting, and instructions for adults to conduct a composting demonstration specially designed for children.

The writing and reviewing process of the composting manual required six weeks to produce a final product. During the final review phase, particular attention was given to identifying parts of the manual that might not be contextually appropriate. Several instances were noticed and subsequently changed, including replacing images of people more identified with American culture and pictures of animals not native to the Middle East. With the cultural sensitivities addressed, the manual was finalized and prepared for delivery in both paper and electronic formats.

The paper-making project was an important component of the service learning course because it encompassed the three entrepreneurial, educational, and environmental foci of the project. Though the team generated a few unique ideas, the direction of the paper project was heavily influenced by research into social entrepreneurship. One article, a joint collaboration between the Brookings Institute and the Dubai School of Government, highlighted the success of the Zaytoona organization in Caro offering trade skills to poor residents (Abdou et al. 2010). A second article, from INC economic news organization, provided an editorial view of the positive benefits of social entrepreneurship for women in the Middle East (Sosa 2011). Some members of Ruwwad also mentioned the existence of other social entrepreneurship groups in the city that had experienced success. Based on this background, it was determined that the best way for community members to commercialize the results of project would be to assemble recycled paper into hand-made journals to be sold in the greater Amman area.

Using basic paper-making techniques, recycled paper is ground into pulp, placed in a large tub of water, and collected on thin wire-mesh screens, forming a thin layer of new paper. It was agreed that an interactive workshop was the most effective way to instruct members of the community on this process. Accompanying the workshops would be a written instructional manual with photos illustrating the steps involved. The manual would allow members of the

community to recreate the workshop for others after the GDT team left the community, allowing for project sustainability.

In preparation, students held a mock workshop with team members to identify any difficulties and ensure the instructions were provided with an appropriate level of detail. This exercise also gave the workshop leader an opportunity to practice. Overseeing the workshops was the communications group lead member, of Lebanese heritage, who provided insight about communication patterns appropriate for a Middle Eastern audience. Another member of the paper group documented the mock workshop, taking pictures to be included in the manual. With both the composting and paper-making projects complete, the team was ready to implement their program on location in Jabal Al-Natheef. Three students were selected to travel to Amman to implement and evaluate the components of the project

### **On-Site Project Implementation**

With the semester's end, preparations were made for project implementation in Jabal Al-Natheef. Students selected to travel attended meetings to prepare for Jordanian culture, Arabic language, and the logistics of conducting the workshops in Jabal Al-Natheef. The traveling team departed for Jordan on May 12, 2011, one week after the end of the academic semester.

The first full day upon arriving in Jordan coincided with Ruwwad Day, an open community event which allowed guests to tour Jabal Al-Natheef and learn about local community development efforts. The events of Ruwwad Day included narrated walks through the community, a school tour, and expositions of community projects. Many of the community projects involved artistic endeavors, including pottery, cloth goods, and functional artwork made from recycled materials. What was most clear from the presentations during that event was the creativity and passion of the community.

Following the events of Ruwwad Day, the project implementation began in earnest. The first accomplishment was delivering the composting manuals, both in hard-copy and digital formats, to Ruwwad. With the manuals written in English, full use by the community would have to wait for a translation into Arabic, which could not happen within the week. Another concern posed by Ruwwad was a lack of space and materials to conduct a composting workshop. Thus, it was decided that Ruwwad would take the initiative on composting implementation sometime after the team departed.

Preparation for the journal making workshops soon began. The workshops, conducted over three days, included 18 women of different ages from the community. Supplies brought by the team included paper making kits, while Ruwwad supplied tubs for water, paper, and other necessary appliances. Laminated paper-making or journal-making manuals were distributed beforehand. The lead instructor gave directions from the head of the table in English, demonstrating the steps with her own kit, and then the student-interpreter translated. After the instructions, the students walked around observing the workshop process, answering questions and helping when necessary.

The first day of workshops involved making sheets of paper, first white and then in color. Participants in the workshop picked up on the idea easily. Each student was involved in tasks of either instructing or preparing paper materials. After the first workshop ended, there was interest in taking kits home for more paper making, and kits were supplied to those who requested. Those who took kits home came back on the second day with creative paper made with common home-based objects. The second day of workshops involved making more sheets of paper, but this time aesthetic features were added to the paper. Since most instruction was completed during the first

workshop, most time during the second workshop was spent answering questions and engaging with the community. The third and final workshops involved participants creating journals using the completed sheets of paper.

At the closure of the third workshop, each participant had at least one journal and all participants expressed verbal appreciation with the workshops and satisfaction with the products that they had created. The workshop atmosphere was very relaxed with the women talking and joking, both with one another and with the students. A few brought notebooks to record instructions and new English words that they had learned over the course of the workshop. Over time, most participants and GDT students communicated freely, using both Arabic and English words and addressing each other by first names. The workshop days also allowed students to learn more about the community through these first-hand experiences.

Ruwwad members invited the GDT team to tour several local schools, including an all-girls high school. GDT members found the students to be energetic and optimistic, despite a lack of educational resources. Many students expressed an interest in seeking higher education. They lacked knowledge about advanced professions because role models were scarce in their community.

### **Lessons Learned**

From informal assessments taken at the beginning of the course, the majority of GDT students had no previous experience in service learning projects, or were unfamiliar with the best practices in service learning. Instead, the team developed its own organization, communication, and design practices over the course of the project, using essentially a trial-and-error approach. Over the course of the project, design practices that advanced the goals of the project were continued while detrimental practices were changed or eliminated. This process allowed successful completion of the project and revealed several distinct yet related lessons for future improvement.

Service and learning are commonly thought to be related such that the more participants learn about the community they are serving, about themselves, and about their craft (whether that is engineering, communication, etc), the more effective their service is because of greater personal engagement. Similarly, while the lessons presented here can be understood independently, they are also intimately connected and work synergistically to support more effective projects.

Initially, the GDT students lacked a strong understanding of the community and its needs. This lack of information was the first obstacle to be overcome in properly defining the problem the project would address. Talking with members of Ruwwad through Skype was critical in forming relationships to better understand community conditions and needs. Even with consistent communication between the team and Ruwwad, the entire scope of the community could not be gleaned to provide complete context necessary for the project. This problem was identified by students during the reorganization of the project to create more streamlined communication and information dissemination.

With communication issues addressed, the students began applying the information learned into the project deliverables, addressing context-sensitivity and understandability. This project proved that understanding the culture of a community and understanding the challenges that a community faces are closely interconnected, and both are necessary for a successful project.

In order to construct an effective problem definition for a service learning project, especially when it is international in scope, participants must put themselves mentally into the context of the community they are serving. Just mastering a discipline or set of skills (waste management, for example) is not enough to fully comprehend the broader implications unless the context of the work is also fully understood. One part of understanding context is learning the right questions to ask, which can come from prior experience and familiarity with the challenges of the specific project at hand.

Another part is approaching the project with open-mindedness, flexibility, and cultural humility. Service learning projects are a process of continual, iterative learning. As the project progresses, students gain new insights which inform further work and allow flexibility in the project direction.

In order to accommodate the dynamic nature of such projects, teams need a flexible organizational structure that allows for rapid adaptation when necessary. The initial structure of the GDT Jordan team lacked this ability, a fact that hindered the team's progress. The team's reorganization was a major improvement that allowed the team to adapt quickly to changing needs.

Separating service learning teams into discrete groups based on specialty area (engineering, education, and entrepreneurship as earlier done by the team) was problematic. It constricted the problem overview of each sub-team and undervalued information not seen as directly relevant to each sub-team's view of the problem. By reorganizing the structure of GDT with a team-based approach, team members realized that all aspects of the project were interconnected and could not be solved discretely. The new structure also allowed the project team to address challenges in a comprehensive way and in a vertically-integrated manner. This brought together all project research, documentation, communication, and deliverable-related work.

Reorganization of the team also allowed for better utilization of the team's vast diversity. While the team was interdisciplinary from the beginning, with students from engineering, the sciences, and the humanities, collaboration was limited by the sub-team structure. In contrast, the new structure re-envisioned the team as not uniquely an 'engineering team' but rather an interdisciplinary team working on an engineering-related project. This allowed for the consideration of a greater range of perspectives and fostered greater creativity and innovation.

The reorganization also helped the team utilize the individual diversity of the students, which included multiple ethnicities, different countries of origin, and varying academic experience (from undergraduate freshmen to doctoral students). By eliminating the limited structure of the sub-teams, students were more comfortable expressing their individual personalities and different backgrounds when working on the projects. The reorganization of the team and the redefinition of the problem, together with the use of a single liaison to more effectively manage communications between the GDT team and Ruwwad, created a truly context-sensitive approach that more closely addressed the needs of the community.

With these changes, the team goals shifted from the very broad idea of addressing waste management to a focus on specific areas of importance relevant for the recipient community. Because the workshops involved interaction with the community members, more information was needed about their learning styles, academic backgrounds, and the 'outside knowledge' that they 'brought to the table.' At the same time, the students were forced to confront and challenge their own preconceived notions about the community and to reconcile these with the acquired knowledge that they learned about the community during the class.

Thus, while the GDT Jordan project was deemed a success, many lessons were learned about enhancing team flexibility and cross-cultural understanding. The team's understanding of the community was improved through enhanced communication and a shared knowledge base. With the initial failures of the sub-team structure, team members realized that diversity takes many forms and is often underutilized. The right mindset and team structure is necessary for maximizing the effectiveness of the diversity represented. Understanding these concepts will benefit future teams with a focus on service learning.

### **Conclusions**

The GDT Jordan team was tasked with developing context-sensitive solutions for waste management challenges in the Jabal Al-Natheef community of Amman, Jordan. Through published material, research, and correspondence with members of the community and Ruwwad, students gained knowledge about the needs of the community and developed solutions to enhance waste management practices while enriching the community and providing new entrepreneurial opportunities.

Students overcame preconceived expectations, which negatively affected the initial problem definition, and learned about the physical conditions in the community as well as its culture and values to effectively serve the community's needs. With greater understanding of the community, the team was able to provide a focused project that addressed an important and relevant community need.

The initial team structure of function-based organization inhibited the team's success; it was soon replaced with a vertically-integrated, project-based approach that proved more effective. The revised approach allowed the team to engage in context-sensitive problem solving, apply solutions that met specific local needs, and encompass all goals of the project to make maximum use of the team's diverse composition. In the end, for each of the two sub-projects pursued, the team approached the challenges collectively, considering all aspects relevant to the project as well as the context. This approach increased sensitivity, reduced preconceptions, and allowed solutions that were effective to the community.

Over the course of the project, the students' approach to the challenges of waste management in Jabal Al-Natheef evolved significantly as they adapted to new information and insights. This evolution affected all aspects of the project, including defining the problem scope, determining how to best structure the team, and understanding the culture of the community. In the end, the GDT Jordan team was able to implement effective solutions because of their willingness to adapt to changing needs. Students learned that this willingness and ability to adapt, sometimes in unexpected ways, was necessary for the development of solutions that are both relevant and beneficial to the community being served.

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