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GEOGRAPHIC INFORMATION SYSTEMS AS COMMUNITY BASED LEARNING CLASS: CHALLENGES AND LEARNING OPPORTUNITIES

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Abstract
Community based learning (CBL) is a pedagogical approach in which students serve their community while fulfilling their academic requirements. This approach was adopted in a Geographic Information Systems class that was redesigned and taught as a CBL class in collaboration with three local community partners: the Municipality and the Fire Department of Nablus City, and the Urban Planning and Disaster Risk Reduction Center at An-Najah National University. 35 students employed the GIS skills and the knowledge they gained in:(a) collecting data about buildings earthquake vulnerability in Nablus city; (b) establishing and managing geodatabases using the collected data; and (c) developing and testing several earthquake scenarios. These outputs were introduced to the community partners at the end of the class. This paper discusses the learning opportunities and the role of each stakeholder, and it addresses the challenges that were encountered during the planning and the implementation of the class.

Key Words: Community based learning (CBL), teaching GIS, community service

INTRODUCTION

The community-based learning (CBL) is a learning approach in which academic institutions and community (organizations) work together in order to meet their common needs. In the CBL approach, a mutual beneficial partnership between academic institutions and community organizations is created by integrating community service into the academic activities (Bonnette, 2006). According to this relation, students, under the supervision of the instructor, help communities identify, assess, and solve problems related to their concerns and needs, while, in their turn, the communities provide a means for students to apply their knowledge to real-life problems. The CBL, therefore, can positively impact students' learning by providing a rich learning environment in which the community provides authentic learning opportunities. This environment will help students understand the connections between classroom materials and real-world problems (Wolf and Statham, 2008). In other words, students have the opportunity to experience how theoretical knowledge from their discipline is applied in practice on real-time cases and projects.

In addition, the CBL gives students a chance to learn about the community context, where they will be working in the near future. On the other hand, the CBL enriches community with responsible citizens by fostering civic and social responsibility via integrating them into the academic curriculum (Strand et. al., 2003). The CBL pedagogy has informed and significantly enhanced the traditional approaches in higher education by grounding the learning process in explicit learning objectives, preparation, and reflection within a community context (Bringle and Hatcher, 1995).

The main focus of this paper is a CBL initiative that was planned to promote student learning through community engagement as a new pedagogical approach that was designed and implemented in a geographic information systems (GIS) class offered in the Civil Engineering Department at An-Najah National University (ANU), Palestine. The paper addresses the challenges and explores the learning opportunities in teaching the essential concepts and techniques of GIS within a proposed CBL framework. Furthermore, the paper discusses the mechanisms/strategies through which the students incorporated the knowledge they gained into a community project conducted in collaboration with three community partners. Finally, the author evaluated learner achievement and levels of satisfaction through distributing a questionnaire at the end of the course.

The community partners were also interviewed in order to determine the degree of their satisfaction with students' performance and course outcomes.

CBL Initiatives in Engineering and Technology Education

In engineering education, CBL generally matches new approaches of teaching that go beyond the traditional objectives of acquiring and applying knowledge in areas like mathematics, science and system design. CBL emphasizes the importance of the expertise needed in real world problem solving and all related skills such as the ability to function in multidisciplinary teams, to communicate effectively with team members and community representatives, and to synthesize engineering models and applications (Hobson, 2000). Such expertise might include: professional and ethical responsibility, the impact of engineering solutions in a global and societal context, and knowledge of contemporary models and applications (Thompson et. al., 2005).

As part of engineering training, technology classes have high potential to be taught as CBL courses. Kurt (2001) has stated that a variety of technology courses can be redesigned and implemented in such a way that combines the academic learning with community service, which is the main focal point of CBL. In CBL technology classes, students may identify communal needs that can be satisfied using the related technology. For instance, they may be given the opportunity to make advances in technology by developing new interactive and user-friendly models, which can be used by a community organization as documented by Hobson (2000) and Jamieson et al. (2002). To implement such community initiative successfully, two types of student training are required: (1) extensive training on the technology which is fundamental to a technology class; and (2) thorough training and follow up on the implications of the community issue under investigation (Duffy et al., 2000). While the former training is usually carried out by the instructor, the latter type is fulfilled through the collaboration and coordination between the instructor, the learners and the community partners.

Consequently, in a CBL technology class, students will have more grasp on the theory underlying the technology they are learning about and a strong technical skill set. They will, in addition, be able to employ theses skills in implementing a community project that will suite the various learning styles and abilities. As students complete these learning and training sessions, they will gain practical skills that they will need in their future careers.

Geographic Information Systems (GIS) is a commonly used technology in engineering applications. It is a computerized database management system for the capture, storage, retrieval, analysis and display of spatial data (Foresman, 1998). GIS, as a learning subject, contributes to the students learning by giving them access to relevant information, training them on data storing, manipulation, analysis, and enhancing their GIS mapping skills (Unwin, 2012). It also provides active tools for tactical and strategic support, diagnosing and correcting errors, mapping and managing spatial complexity of the real world (Buck et. al., 2012). All these peculiar characteristics make GIS technology a fit topic for a CBL class in which diversity of community issues can be treated.

Students in the present class employ the GIS technology in helping three community organizations in handling a challenging issue that is the lack of well-established micro spatial scale or building-based databases. The students addressed this issue through a four-stage framework that will be discussed in the following section.

The Learning Framework

The instructor presented the GIS community-learning activities as a four-stage framework involving: problem definition, data collection, data analysis and project output presentation. The framework engages GIS students in a cycle of concrete experience that perfectly matches the requirements of student-centered learning model. According to this framework, students (1) define specific problems within the scope of the community project through orientations and interactive training sessions facilitated by the instructor and the community partner teams; (2) generate hypotheses and collect more detailed data under the supervision of the instructor and in collaboration with the community partners; (3) analyze the collected data and test the hypotheses using the specialized GIS tools; and finally (4) reflect on their results and present them to the beneficiaries.

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This framework allowed students who have variety of skills and learning styles to work together in order to develop and integrate these skills. Simultaneously, the framework allowed students to exercise autonomy in creative project development, and to promote GIS modern techniques throughout their community. Furthermore, the proposed framework presented students with opportunities to tie action, learning activities and outcomes together, which in turn helped enhance the following skills:

- *Critical thinking skills:* students were able to consider the issues from multiple perspectives, those of teammates (who might also have different perspectives within the same team), those of the instructor and those of the community partners;
- *Team work skills:* students had the chance to take individual and collective actions involving planning short and long term activities, problem solving, effective communication skills, and skills of coordination between different groups and stakeholders;
- *knowledge management skills:* students were able to select and manipulate relevant data sets, and to utilize GIS in generating alternative solutions for specific community problems; and
- *Conflict management skills:* students were able to practice negotiations, conflict prevention and management, and consensus building.

Finally, the proposed framework was characterized as an iterative one in which students moved back and forth from the field to the classroom and vice versa. This made the students well-informed about the issues under investigation and created the climate for open discussions focused around the problems the students encountered while interacting with the community environment.

The Planning and Implementation

The goals of this framework were achieved through a broader process by which the GIS CBL class was planned and implemented. The following sections discuss the major steps in this process starting with the early stages of exploration, followed by preparation of the action plan and the implementation, and ended with the evaluation of the class by participating students and community partners.

Exploration

Teaching GIS as a community based learning class depends mainly on the quality of the partnership between the academic institution and the community organization. As long as this relationship is durable, carefully planned and formally articulated, and as long as both the instructor and the community representatives share very clearly defined goals, the GIS CBL class activities will run smoothly and the benefits for both sides will be maximized.

The key factor that ensures a successful achievement of these two requirements is the selection of an appropriate GIS community project. The selected project should be, on one hand, relevant and meaningful to the community by improving the quality of life for individuals, groups and/or for the entire community. The project, on the other hand, should be compatible with the course content so that students can enhance their academic learning while working on different components of the project. To successfully achieve this endeavor, the instructor started an exploration process in advance in order to identify a project that achieves the mutual benefit of the community partner and the educational institution.

This exploration process started in March 2012 with four community project ideas including:

Project 1: *Mapping Villages Located in Zone C*
Project 2: *Mapping and Analyzing School Serviceability Areas in Nablus City*
Project 3: *Mapping and Analyzing the Spatial Distribution of Healthcare Centers in Nablus City*
Project 4: *Mapping Nablus City for Earthquake Evacuation*

Four months later, July 2012, the fourth project was selected as the proposed GIS CBL class project.

Although the first project had a high, if not the highest, potential to be adopted in the proposed GIS CBL class due to its importance to the community and its high potential as an application of the class content, the project was excluded due to the difficulty of implementing the project. This is because villages located in Zone C are completely controlled by the Israeli Occupational Army (IOA) which requires a special permit for any Palestinian who wants to visit these villages. The instructor realized that there was no means to obtain permits for the students to reach these villages to conduct the fieldwork during the data collection stage.

The second and the third project were excluded due to the difficulties which faced the instructor in early stages of the exploration process. The candidate community partners were governmental organizations in both cases. It was highly difficult to find a contact person via phone or email, and, when they were contacted, it was obvious that they were unenthusiastic to be involved in such cooperation between their organizations and the university. Consequently, the instructor dropped the two projects because it was not possible to share well defined goals with community representatives.

The process in the fourth project went much more smoothly and the exploration ended with locating three community partners: the Urban Planning and Disaster Risk Reduction Center (UPDRRC) at An-Najah National University (NNU) as a primary partner, and the Municipality of Nablus city and the Fire Department at the city as secondary partners. The three partners showed high interest to collaborate in such an activity.

During the preliminary stage that lasted from July to September 2012, and in collaboration with the three partners, the overall goal of the GIS community project was set to align well with the course educational goal of applying GIS technologies and methodologies to solve community problems, especially those related to spatial dimensions. The detailed objectives were left to be set during the orientation period so the instructor could engage the students in the problem definition process.

At this stage, the role of each stakeholder was briefly described as follows: the instructor will play the role of the a facilitator for all orientation and training activities, and he will, of course, teach the theoretical materials and the GIS technical training. Students will collect the data sets and use them to build the GIS database, and they will work on achieving the different components of the project. UPDRRC team will be the trainer during the orientation period, the municipality of Nablus city will be the data provider and the fire department will give their feedback during the scenario building stage of the project. These roles and the challenges in defining each of them are described in detail while discussing the action plan preparation stage.

Action Plan

It is true that CBL enriches the educational experience of students by giving all stakeholders (teachers, students and community partners) an opportunity to collaborate and facilitate shared community-based project (Bonnette, 2006). However, it is necessary to keep in mind that the community project, in itself, does not guarantee significant enhancement in the students' academic learning without integrating the project with academic curricula. It is essential, therefore, to prepare a well thought of and purposeful action plan focused on the academic learning objectives and the corresponding in-class and field activities.

In order to maximize students' academic learning, the action plan should achieve a careful balance between in-class activities including course-specific contents and GIS laboratory training, from one side, and the real-world experience involving community learning and field work activities, from the other side. An unbalanced action plan will lead to satisfying one side at the expense of another and that will in turn compromise the course learning outcomes. The action plan should also include well-defined mechanisms for continuous evaluation and assessment of the students' performance throughout the semester, as well as tools to solicit student and community feedback.

Activities in the proposed action plan for the GIS CBL class can be classified into three groups according to stakeholders' time commitments and their roles:

(1) Community Partner Teams:

Community representatives, mainly form UPDRRC, will give the participating students orientation sessions in the first three weeks. The orientation will involve: (1) theoretical background about the seismic activity and building collapse mechanisms; (2) field work training about how to assess buildings and how to complete the field survey; and finally (3) the importance of the GIS project to the community and to the UPDRRC in particular.

The success of the orientation stage and the progress in the field work is highly dependent on the commitment of trainers from UPDRRC as the primary community partner, so it was of high importance to adopt a strategy that guarantees the continuity of the activities through motivating UPDRRC team to make the CBL orientation one of the priorities on their agenda. The instructor invested quite reasonable amount of time in preparing a well-detailed plan and introducing it to the UPDRRC before the semester started. The UPDRRC was involved in discussions of the various components of the plan and their feedback was taken into consideration before making the final draft. The plan covered all activities required from UPDRRC team and the objectives for each orientation session and the required resources and equipment.

Since community partners view the relationship with academic institutions from a cost/benefit standpoint, it was, therefore, important to introduce all details about: (1) supervision activities and the needed time for each activity; (2) the use of staff and resources for training during the orientation stage and in the later stages of the class; and (3) a clear vision about the output of the class and how important it is for both students and the community partners.

(2) The Instructor:
In addition to teaching GIS theory and giving laboratory training, the instructor is responsible for preparing the course action plan and coordinating activities with the community partners both before and during the semester. The instructor will also define explicit learning objectives and explore the community objectives, and then he will work with the community partners on defining the common needs and matching the learning objectives with the community expectations. Both the instructor and the community partners will work together on identifying mechanisms to make these common objectives achievable through a community project. The community project will be implemented as a continuous set of activities that are distributed throughout the semester starting from the first week and ending in the last week.

(3) Students:
Students will be the main stakeholders in the class. They will participate in in-class activities involving the GIS theoretical grounding and the GIS training sessions. The students will also participate in the orientation activities led by the UPDRRC team early in the semester. After that, the students will do the fieldwork and data collection as part of the community project implementation. Part of the class time is dedicated to giving the students an opportunity to reflect on what they learned and to critically think about the links between course content and the community experience.

Implementation

The implementation stage started with the orientation process aiming at informing students about the importance of community based learning and the importance of the project they are doing to the community partners involved in the GIS CBL class. As part of the orientation activities, the instructor coordinated with the Center for Excellence in Learning and Teaching (CELT) at ANU to host the students in a workshop about the importance of the collaboration between the university and the local community organizations. During this workshop, participating teachers presented model project that were accomplished with the community as part of their courses. Students became aware of the wider context for the GIS CBL project they are doing and its value to the community.

To better assist the students with their work, the director of the UPDRRC met with the students during the second week of the semester, as scheduled in the action plan. He presented the criteria of building vulnerability assessment and trained the students on how to complete the corresponding field survey prepared by the UPDRRC team. After this meeting, the students made two site visits to collect some data samples as an exercise. The students collected data about the city buildings including: the building use, the number of floors in each building, the construction dates, the structural status of the building, the distance to the nearest street, and the width of streets serving the neighborhood where each building is located.

Afterwards, students had an opportunity to meet with an engineer from UPDRRC who came to class to answer their questions and to help them in resolving the several challenges they encountered during the data collection. Students, at this point, became more skilled in data collection techniques and became ready to

complete the rest of the project components.

At the end of this orientation period, students became more informed about the community based learning practices, concepts and requirements, and the CBL course objectives. They were given opportunities to reflect on different class and project activities, community partnerships, student supervision and assessment, and course assessment criteria.

The 35 students were then divided into 10 teams of 3 or 4 students, and the city was divided into neighborhoods so that each team will select one neighborhood. In order to manage the class activities, especially the worksite activities, each team designated a team leader who was responsible for several tasks including: coordination between his/her group members, filling and submitting the field visit reports, submitting progress reports, collaborating with other groups, and communicating with the instructor and the community representatives.

The data sets collected on weekly basis were used in the GIS laboratory training and the weekly exercises. This made the students more involved in what they were doing and enabled them to think critically about the results of their weekly assignments. It also gave them the chance to go back to the field during the next round of data collection to fill the gaps in their data and to address any shortcomings. In addition, this experience with data collection and GIS training made the students more responsible about the data they collected unlike the projects they do in traditional classes where they use hypothetical data or ready-to-use data sets, in the best case scenarios.

At this point, a good portion of the class time was devoted to discussions focused on application of the GIS techniques which led the students to critically think about complex issues of class project like including community views and feedback on GIS models. Throughout the semester, the students posted discussion threads, especially those related to their field work and project activities, and their reflections on a web-based student learning community. This allowed the students to share their learning experiences and to post questions to the instructor as well as to other students.

Once the students finished the data collection and built the geodatabase, they became ready for the analysis stage in which they applied the GIS theories and techniques they had learned in the class on the community project: Mapping Nablus City for Earthquake Evacuation. The students used the geodatabase to build an interactive GIS model through which they assessed the existing conditions of the city and examined the city readiness to different scenarios of earthquakes measured on Richter scale. The GIS model consisted of several components each of which was accomplished by one student team. The students were given the chance to give and receive feedback on each project component through a mid-point presentation.

In order to keep the community partners informed about the project progress, the director of the UPDRRC was invited to class one more time. This gave the students an opportunity to discuss their ideas with the community partner and to get directions on how to match the collected data with the European Earthquake Standard Code (the code applied in Palestine). The instructor continued this work by training the students on how to convert these data sets into GIS data and to make them ready for the final presentation in the last week of the semester.

In the final stage, the students were able to create the GIS database which contained needed data about all buildings in Nablus city. They produced a CD-ROM that included the GIS database in addition to the maps and data layers generated as outputs of their projects. The students presented three copies of the CD-ROM to the three community partners who can use them to guide the firemen, ambulance drivers and municipality teams during the evacuation process. It can be also used by the UPDRRC to guide city development plans and to impose restrictions on areas of high risk.

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Class Evaluation

Students' Feedback

Students' evaluation of the class is an essential procedure for teaching GIS as CBL class as this learning approach has been introduced at ANU for the first time. After the students finished the class contents including the field work, GIS training sessions and the theoretical materials, it was essential to get their feedback and evaluation of what they have learned in the classroom, how they perceived the CBL teaching methods in comparison to traditional ones, what they have experienced at the worksite and to what extent they thought they have impacted their community. As such the goal in this section is to examine the success of the GIS as a CBL class from the students' standpoint.

A five-item questionnaire was distributed to 31 class participants in order to assess the impact of the experience on the participants. The responses to the five questions are shown in Table 1. The provided data is used to evaluate the current CBL teaching techniques and activities, and to establish guidelines for improving these teaching and learning activities in future CBL courses.

Table (1) Student class evaluation

Question	Number of students answered		
	Yes	No	Neutral
Question 1: Was the CBL an appropriate teaching approach for the GIS course?	28	1	2
Question 2: Was the information and training provided during the orientation period sufficient to guide your performance?	21	2	8
Question 3: Was the experience of working on a real world project (CBL project) and assignments a better experience in comparison with hypothetical project assignments?	20	0	11
Question 4: Will you select a similar type of CBL class if you were given the choice between a traditional class and CBL class?	19	3	9
Question 5: Do you think the GIS CBL project was beneficial for the community?	31	0	0

Question 1: Was the CBL an appropriate teaching approach for the GIS course?
This question was posed in order to evaluate the overall satisfaction of the participating students with the CBL class. The overwhelming majority of the students have shown high level of satisfaction with the newly introduced learning approach. As shown in the table above, 28 out of 31 students thought that CBL was, in general, an appropriate pedagogical approach to learn GIS. Less number of students responded positively when they were asked more specific questions about the details of their experience with the CBL course as shown in answers of the following questions.

Question 2: Was the information and training provided during the orientation period sufficient to guide your performance?
Students overall evaluation indicated that they were satisfied with the instruction and the training materials. 21 students (67%) thought that they received sufficient information and training from the community representatives during the orientation period while 2 students (6.5%) thought differently. The rest of the participants (26%) were neutral and added significant comments. Their comments focused mainly on the fact that the training sessions were informative but the activities were rather intensive and that the orientation period was not enough to cover all necessary training activities. Other responses also indicated that the scope of a few of the orientation sessions was wide which made those sessions less beneficial. Consequently, the sessions were confusing as far as the tools and models were to be applied in practice. Thus, it is important for the future GIS CBL course instructors to expand the orientation period in order to make the activities less intensive, and to prepare clearer orientation agendas with enough explanations of the rationale and purpose for each session.

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Question 3: Was the experience of working on a real world project (CBL project) and assignments a better experience in comparison with hypothetical project assignments?
There were no negative responses to this question. 20 students thought that the CBL project and assignments were better than working on hypothetical projects. This highlights the fact that students prefer to apply what they learned in a real world context and that more learning happens in interactive approach where students do weekly GIS exercises using data sets that they had already collected during the previous week. However, 11 students gave neutral responses which show that they were not completely satisfied with a real world project for the class and mentioned two important issues to consider when implementing a GIS CBL class.

The most frequent difficulty those students encountered was that they were overwhelmed initially when they started raw data collection and the data preparation stages. Another related concern the majority of those students raised was that they worked under much pressure as they failed to meet the submission due dates for their weekly field reports and lab exercises. A suggested countermeasure to this problem should focus on two action plans to be incorporated in the next version of the GIS CBL class. The first one is to select smaller study samples which will reduce students' effort to collect and prepare the data sets. The second one is to include time management training in the orientation sessions. Such training will orient students to implementing effective time management strategies that are essential for such kind of projects.

Question 4: Will you select a similar type of CBL class if you were given the choice between a traditional class and CBL class?
19 students expressed a preference for CBL class over a traditional class, while 3 students preferred a traditional class if they were given the choice. This shows that the CBL pedagogical approach successfully engaged most of the students and that they thought that effective learning had occurred. The 9 neutral students added comments which indicated that the excessive time commitment associated with the GIS CBL made them more hesitant to register in another CBL class, especially when they have 5 other classes in the same semester.

In this case, a potential action suggested to deal with this important issue of crowded student schedules is to review the work load and make it more proportionate with the academic credits awarded. This might call for policy changes where CBL classes are given more credit hours than traditional ones. Additionally, in terms of course sequence, the CBL course should be offered in the senior year when student schedules are less in number and their work load is more convenient for meeting the higher demands of CBL teaching and learning.

Question 5: Do you think the GIS CBL project was beneficial for the community?
Students showed consensus on the importance of the GIS CBL project to the community partners. This might be attributed to the effort the students invested during the data collection and preparation. It might also be attributed to the keen interest of the community partners who came to the class and explained how important the class was to their organizations and to the city. The partners' effort in training the students on the data collection and documentation mechanisms has borne good fruit.

At the end of the questionnaire, the students were given an opportunity to write additional comments. Most of the students indicated that unlike other traditional courses, they had enough opportunity to develop teamwork and communication skills and to experience these skills within a professional context. Other students mentioned that as this was their first experience with the community, they were nervous at the beginning of the course but once the orientation stage was concluded, they became highly motivated to do their tasks in the GIS CBL project. They remarked that their confidence improved gradually as they were progressing in the class materials and the project, and because they were interacting with the specialists from the community organizations on several occasions.

Community Partners' Feedback

The instructor sought feedback mainly from the UPDRRC because it was the primary community partner through informal conversation. The staff at UPDRRC appreciated the constant effort the students invested to make the project succeed. They were also impressed with the commitment the students showed and they

highlighted the importance of this positive experience in strengthening the ties between the classroom and real world problems. The staff showed their center's readiness to continue working on these kinds of projects and to participate in designing advanced classes in which more spatial geo-databases can be implemented using the collected data in this class. They suggested using the data collected in the GIS CBL course in redesigning another course entitled Structural Design against Earthquake to make into a CBL course.

CONCLUSION

The course was carefully planned to gradually immerse the students in community work and accordingly it was divided into stages starting with orientation and slowly moving into the fieldwork data collection, the GIS laboratory training, and the interactive in-class activities and the online discussions. The class was concluded by class evaluation as part of the class assessment. Students emphasized the fact that their experience with the GIS CBL was very rewarding one. This experience has helped consolidate the position of community-based learning as a pedagogical approach at ANU and has demonstrated that teaching GIS as a CBL class was productive. The students have, on the other hand, raised a number of issues that might compromise the sustainability of the newly adopted learning approach. Most of these issues can be dealt with through striking a careful balance between the GIS class contents and the fieldwork activities.

The desired balance is unlikely to be achieved without a well-established CBL experience which calls for continuing the efforts invested in this class. One promising indication towards the accomplishment of this goal was the positive feedback from the community partners that reflects their satisfaction with the quality of the service they received and the importance of the service to their organizations' missions. More work, however, is still needed to improve the learning environment and to make it more appealing for learners. It is important for them to feel that the CBL work load does not add much burden to their already busy schedules.

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