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Research Article

Involvement of civil engineering students in water resources projects: a field-based laboratory

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Abstract

Water resources projects are implemented in a wide variety of physical environments that may provide appropriate field laboratories for water related courses such as geology, hydrology, fluid mechanics, hydraulics, water supply and sewerage, water quality, irrigation and water management. This paper discusses a water related courses field-based laboratory and its impact on the student learning process for a civil engineering program through the involvement of students in water resources projects. The field-based laboratory has three objectives, namely: to strengthen laboratory as well as field experiences of civil engineering students in the area of water resources; to build and integrate scientific skills throughout their engineering education utilizing water resources projects as case studies; and to provide technical assistance to the implementer (local government units) of water resources projects. The students enrolled in water related courses were chosen for involvement in water resources projects in the areas of design, engineering surveys, watershed case studies, water quality analysis and monitoring, hydrologic analysis and computer based simulation-modelling. The students were subjected to written and hands-on skills pre-test and post-test to determine their capabilities before and after their involvement in activities. The working attitudes and values of the students were also assessed and these were included in the hands-on pre-test and post-test. Statistical tools such as means, standard deviations and t-test were used to analyze the impact of the involvement of the students. Based on the analysis, the students involved in the water resources field-based laboratory acquired more knowledge and

enhanced their skills in the different water related courses, including the use of computer based tools/software for map generation and water related simulation models. Furthermore, the working attitudes and values of the students were improved after their involvement. Thus, it is strongly recommended that engineering schools should look for opportunities to establish field-based laboratories for student involvement in community projects.

Keywords: education, water resources, field-based laboratory, civil engineering, Philippines.

Introduction

The increasing degradation of the quality of the water resources, currently reaching alarming rates, has prompted concerned agencies and local government units to respond by adopting policies and programs geared along the lines of resource protection and management. Water resources management is ultimately the most appropriate program to meet the demands for desired quantity and quality of water at any particular location and time.

The current strategy in water resources management is an integrated and collaborative approach involving different sectors of the society [1]. It necessitates an interdisciplinary approach to problem solving, with law, policy, community development and resource economics issues contributing as much to solutions as engineering, biology, hydrology and chemistry, wherein the collaboration from different sectors is significant. It provides an opportunity for academic institutions to involve students and faculty in what may be considered as a teaching-service-learning strategy.

Department of Environment and Natural Resources of the Philippines issued an Administrative Order No. 99-01 for the adoption and implementation of a collaborative approach to watershed management programs to local government units [2]. In response, the local government of Catbalogan, Samar, issued an Executive Order No. 2005-04 for the creation of the Municipal Watershed Vegetation Committee as an initial component of the water resources management program [3].

Samar State University has a unique involvement in the planning and implementation of the water resources management program in Samar. The water resources authorities in the local government of Catbalogan requested the university to assist the water supply district services with their preliminary research needs and data requirements to establish a technical information database of the watershed areas. In this context, the Office of the Vice-President for Planning, Research and Extension organized the different colleges of the university to become part of the program. The College of Engineering accepted the responsibility, since it was viewed as being a learning opportunity for the faculty and students. A Memorandum of Agreement was entered into by Samar State University, Catbalogan Water District, Catbalogan Local Government Unit.

A water resources project, by its nature, addresses all components of water resources engineering concepts that will allow for a broad array of projects to fit the learning needs of civil engineering students [4].

Civil engineering students enrolled in water resources related subjects were identified to become involved in the water resources projects and management programs. The involvement of the students has to be completed on a term basis or a complete subject course like hydrology, water supply, hydraulics, fluid mechanics, environmental engineering, water quality control and management. The water resources projects and programs served as a field-based laboratory for the students enrolled in water resources subjects. This teaching-learning strategy is a new methodology employed in the College of Engineering of Samar State University. Therefore, there is a need to assess and analyze the impact of the involvement of the students in both their academic and personality development.

Objectives

Generally, this paper aims to discuss the water related courses field-based laboratory and its impact on the civil engineering student learning process. The field-based laboratory has the following objectives:

- to strengthen laboratory as well as field experiences of civil engineering students in the area of water resources,
- to build and integrate scientific skills throughout their engineering education utilizing water resources projects case study, and
- to provide technical assistance to the implementer (local government units) of water resources projects.

Methodology

The research for this paper utilized a descriptive-evaluative method, wherein the impact of the involvement of students in the water resources projects as a field-based laboratory was evaluated using pre-test and post-test questionnaires. The study included the development of a field-based laboratory manual to facilitate and guide civil engineering student's participation/involvement in the water resources projects and programs. The following laboratory manuals were developed: water quality monitoring; rainfall and runoff measurements; hydrologic survey and water discharge measurements; development of maps using autocad software; and water chemistry and bacteriological analysis.

Student preparation

The civil engineering students enrolled in water resources related subjects were chosen to be involved in the water resources projects and management programs. A two-day workshop was conducted to orient the students to their role in the projects and to align the project requirements to the water resources related subjects. The students were given a field-based laboratory manual for a particular assigned activity and supervised by the respective professor of the water related subjects. The logistics and financial requirements including food and other expenses during the involvement in the projects were provided by the Catbalogan Water District.

Activities

Rainfall and runoff data collection

The students enrolled in applied hydrology and hydrology subjects were involved in the rainfall and runoff data gathering activities. The students were given a field-based laboratory manual on rainfall and runoff data gathering.

Engineering/hydrologic survey of the watershed areas

Twenty civil engineering students enrolled in engineering/hydrologic surveying subjects and water supply were divided into two groups. Each group was assigned to a certain area of the watershed for their engineering survey activity and this was closely supervised by an assigned instructor from the College of Engineering of Samar State University and a field engineer from Catbalogan Water District. The surveying instruments of the Samar State University were used throughout the activities. Each group was provided with appropriate instruments and instructions/orientation on the area to be surveyed. During the actual survey, the students were provided with security personnel to clear the area from high shrubs, tree branches and other dangers. The survey activity was the establishment of profile along the Nasarang River and its tributaries and topography of the watershed. The stream/river discharges along identified points and volumes were also gathered during this survey.

Development of maps using Autocad software

Following the engineering surveys, the students developed maps based on the obtained survey data using AutoCAD software (Automap). The students used the computer facilities of the Catbalogan Water District and the Samar State University Civil Engineering Computer Laboratory.

Water quality monitoring, water chemistry and bacteriological analysis

The students enrolled in environmental engineering subjects were involved in the water quality monitoring, water chemistry and bacteriological analysis. The water quality instruments of Catbalogan Water District were used in these activities. The students were provided with a field-based laboratory manual [5], and with close supervision from faculty of the College of Engineering of Samar State University.

Hands-On Skills Pre-Test and Post-Test

The impact of the involvement on water resources on student skill development and attitude was evaluated through pre-test and post-test questionnaires. This was composed of procedure item test where hydrologic survey skills were considered. The project researchers developed a 20-item hands-on skills test which covered the subjects in the hydrologic/engineering survey. It was checked and validated by a group of civil engineering instructors from the College of Engineering of two universities in Region 8 who are proficient on the content. This instrument was subjected to analysis for facility values, which determined whether an item shall be retained or rejected, and discrimination indices, which determined the discriminating power of an item.

Attitude Test

The students were subjected to an attitude test using a standard questionnaire [6]. The attitude test determined the students' attitudes in terms of work habits, work attitudes and analytical skills before and after their involvement. The evaluation is qualitative in nature.

Statistical Treatment

The study used the t-test for independent samples (two-tailed) to test if there is no change in their skills. The formula used was: [7].

$$t = \frac{\mu_1 - \mu_2}{\sqrt{\frac{(n_1 - 1)\,\sigma_1 + (n_2 - 1)\sigma_2}{n_1 + n_2 - 2}\,(1/n_1 + 1/n_2)}}$$

Where t is the computed t-value of the independent samples; μ_1 and μ_2 are means o f the pretest and posttest respectively; n_1 and n_2 are number of cases of the first and second groups respectively; σ_1 and σ_2 are standard deviations of the first and second groups respectively.

The weighted mean was used to determine the attitude of the students' interns of work habits, work attitudes and analytical skills. The following was the guide that was used in the treatment of the data:

Scale	Interval	Interpretation
5	4.51 – 5.00	Completely agree
4	3.51 – 4.50	Agree
3	2.51 – 3.50	Neutral
2	1.51 – 2.50	Disagree
1	1.00 – 1.50	Completely disagree

Results and Discussion

Water resources projects and involvement of the students

Students of the following water related subjects were involved in the implementation of the water resources projects (2005-2008): engineering/hydrologic surveying; water supply; hydraulics; hydrology; and environmental engineering. However, only the extent of involvement of students that took place second semester school year 2005-2006 was evaluated and presented in this paper. The students conducted the survey within the watershed areas of Catbalogan water sources. The survey includes profile leveling, boundary definition and stream discharge surveys. The students were also involved in the tree planting and vegetation enhancement activity in the watershed. After the survey, the students developed the map based on the data obtained from engineering survey.

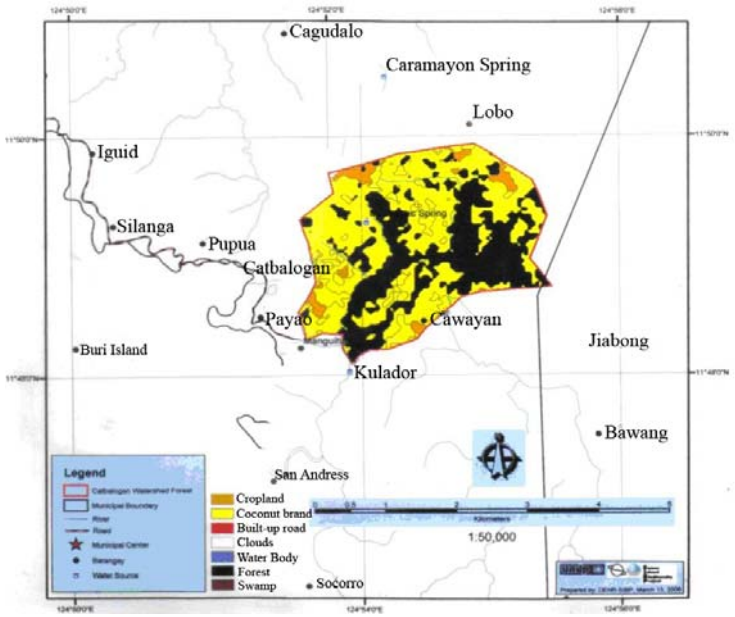

Figure 1: The Catbalogan Water Source Watershed Area

The Mayor of Catbalogan, the Hon. Codofredo Uy signed the Memorandum of Agreement (MOA), while the environmental engineering instructor and the manager of water supply district, *Sanguniang Bayan* witnessed the signing during the launching of the program as shown in Figure 2. The MOA was the basis for defining the extent of student involvement such as tree planting, engineering survey, water quality monitoring, water chemistry analysis, bacteriological analysis, rainfall and runoff measurements, autocad and utilization of water related computer software.

Figure 2: The MOA Signing. Mayor of Catbalogan Samar as he signs the MOA.

The students conducted profile leveling along the watershed area in Masacpasac, Caramayon, Catbalogan, Samar. Caramayon is one of the sources of the water supply as shown in Figure 3.

Figure 3: Survey along the Watershed Area.

The students conducted a stream survey in Masapasac and Caramayon water sources and in other water bodies within the Catbalogan watershed, as shown in Figure 4.

Figure 4: Stream Survey along the Watershed Area.

The students were also involved in the watershed vegetation rehabilitation program within the watershed of Catbalogan. This activity was a completion requirement for the environmental engineering subject and the students planted over 1,000 tree seedlings, as shown in Figure 5.

Figure 5: Tree Planting Activities of the Students.

Impact of involvement in water resource projects

Civil engineering student's skill development

A pre-test and post-test were conducted during the beginning and at the conclusion of the activities to determine the competency level of the students in terms of technical skill in surveying. The first group had numbers 1 to 10, while the second group had numbers 11 to 20.

Table 1: The Pre-test and Post-test of the Students Involved.

Student Number	Post-test	Pre-test	Difference
1	20	12	8
2	25	15	10
3	23	8	15
4	27	10	17
5	21	10	11
6	24	12	12
7	19	11	8
8	16	7	9
9	13	8	5
10	14	6	8
11	15	10	5
12	16	7	9
13	24	8	16
14	15	8	7
15	14	13	3
16	21	10	11
17	17	10	7
18	13	8	5
19	10	7	3
20	19	12	7
Total	368	192	176
Mean, μ	18.40	9.60	8.80
Standard deviation, σ	5.84	3.03	5.39
Computed t-value	4.45	df = 38	
Critical t-value	2.021	$\alpha = 0.05$	
Evaluation	Reject Ho. There is a change in their skills		

It can be gleaned from Table 1 that 100% of the students involved in the program showed better performance in the post-test than in the pre-test. Thus, the hypothesis which stated that "There is no change in the student skills" was rejected. This meant that the involvement of the student in the program has contributed to the improvement of their surveying skills.

Student attitude

The attitude of the students was evaluated using a qualitative standardized questionnaire and the responses are shown in Table 2.

Table 2: Attitudes of the Students Involved in the Program.

Attitude Statement	Weighted Mean	Interpretation
1. I considered minor details in the assigned task.	4.50	A
2. I derive satisfaction from working out in the watershed project.	4.52	C
3. People tell me that I miss some details in my work.	3.80	A
4. I notice other people's errors in articles, documents or other projects.	2.50	D
5. My teacher tells me I should pay better attention.	2.45	D
6. I daydream when I know I should be paying attention.	3.45	N
7. When I pay attention I got board.	2.04	D
8. I often find myself trying to remember what I was about to do next during the assigned task.	2.34	D
9. I arrange my schedule so that I can work on tasks that require the most concentration during the time of day when I am most alert.	4.56	C
10. When I get into the groove of doing something, almost nothing can get me out of it.	4.32	A
11. When I am working on the project, I tune out my environment	3.56	A
12. It irritates me when others in my group did not perform better than I do.	4.34	A
13. I find that I am always rushing at the last minute to get things done.	2.43	D
14. I break projects down into smaller steps.	4.56	C
15. I feel that I am behind in things that need to be done.	4.52	C
16. I find it difficult to decide which things are most important when I have a lot of tasks to do.	2.87	N
17. I set chunks of time aside each week to accomplish certain tasks and generally stick to that schedule.	2.56	N
18. Delays before starting a group project irritate me; I feel I would get going faster on my own	4.45	A
19. I praise my group's mates every time they perform well.	4.34	A
20. I stick to solutions that have proven effective in the past.	4.21	A
21. When solving a problem, it's better to have a lot of possible solutions from group mates rather than one really good idea.	4.53	C
22. I get distracted when a lot of my group mates going on around me.	3.56	A
23. I take on too many projects at once.	4.11	A
24. When I begin a task, I set specific objectives for what I want to achieve during that involvement session.	4.27	A
25. I find irrelevant information or thoughts popping into my head when I'm trying to focus on a task.	3.87	A
26. In group work, I encounter power struggles that cause tension	2.78	N

Legend: 4.51 – 5.00 completely agree (C) 3.51–4.50Agree(A) 2.51– 3.50 Neutral (N) 1.51 – 2.50 Disagree (D) 1.00– 1.50 Completely disagree (CD)

From Table 2, it can be noted that the students have positive attitude towards the assigned task in the program. The highest weighted mean of most attitude statements is "agree".

Conclusions

The following were the conclusions made based on the salient findings of the study:

(1) The water resources related subjects were appropriate venue for the involvement of the civil engineering students in water resources engineering projects and management program and can be a teaching strategy as a field-based laboratory;

(2) The involvement of the civil engineering students in the water resources projects was guided by the field-based laboratory manuals developed by the instructors;

(3) The post-test scores of the students were significantly higher than the pre-test which showed that the students gained more knowledge and skills from their assigned tasks, hence, the civil engineering students learning and experiences pertaining to water resources projects were enhanced and improved;

(4) The students have improved their attitude towards working as a group; and

(5) The involvement of the civil engineering students in water resources engineering projects has developed partnership opportunities for the College of Engineering of Samar State University and the Catbalogan Local Government Unit.

Recommendations

The following recommendations were established based on the findings:

(1) The involvement of the students to any community-based projects should be aligned to the mission of the university and within the subject matter of the course;

(2) Financial support should be provided to the students who will be involved in the projects/programs;

(3) The involvement of the College of Engineering to Water Resources Management Program should cover other components in the program such as design of water engineering structures; and

(4) For future research related to this study it is highly recommended that involvement of students include flood and disaster mitigation taking into consideration the social science component, which would lead to closer involvement with local communities.

References

1. Meiman, James, R. (2005). Legacy of collaborative watershed research between the rocky mountain forest and range experiment station and Colorado State University. A paper presented at AGU hydrology days, March 8, 2005. **Watershed Science Journal**, Colorado State University, 273-278.

2. Department of Environment and Natural Resources Administrative Order No. 99-01, (1999), Manila, Philippines.

3. Catbalogan Executive Order No.2005 – 04. Office of the Mayor Catbalogan , Samar, Philippines.

4. Smith, M., Cohen, A., Raybuck, J., 1997. Building sustainable service-learning: the case of community-based watershed management, http://www.ucowr.siu.edu. 05/08/2006.

5. _____.(1985)**,** Standard Methods for Examination of Water and Wastewater. 16th Edition. APHA. AWWA.WPCF. Baltimore, Maryland, USA: Port City Press.

6. Super, D. E. (1968). *Work Values Inventory*. Boston: Houghton Mifflin.

7. Walpole, R. E. (1997). *Introduction to Statistics*, 3rd Edition. Philippines: Simon and Schuster(Asia) Pte, Ltd.

8. Loucks, D. Stedinger, J,R., Haith, D. A. (1982). *Water Resources System Planning and Analysis.* New Jersey: Prentice-Hall, Inc.

9. Botkin, D. B., Keller, E.A. (1997). Environmental Science, 2nd Edition. Philippines: C & E.