

MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

A case study of curriculum review in hydrology and water resources engineering

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Stakeholders and industry expressed concern at the lack of interest by many students in taking up careers in hydrology and water resources engineering. This was partly attributed to the limited extent of coverage in the courses offered in Department of Civil Engineering at Makerere University. This paper discusses how with the assistance from an industry based engineer, a new curriculum was designed that would reflect the requirements of industry and would compare favourably with any other course nationally and internationally. It also demonstrates new methods in teaching learning and assessment that supported the new curriculum. Reports from both the external examiner and stakeholders were very encouraging about the standard achieved. It suggests that curriculum revision should be a regular and should involve stakeholders.

Introduction

Water Resources Engineering is a third year engineering course offered in the Department of Civil Engineering at Makerere University, to B.Sc Civil Engineering students. It was taken after a prerequisite combined course, of Hydraulics and Hydrology in second year. At that time it was the only course offered in this specialized area of engineering at this level. Other areas like public health engineering had two courses.

This was a source of concern for stake holders and members of the industrial fraternity and yet proper water resource development and management is very essential for our livelihood². Many young graduate engineers were not interested in taking a career in Hydrology and Water Resources Engineering. On the other hand careers in Public Health Engineering were more promising. One of the reasons advanced was lack of sufficient background at the University in the subject area.

It was therefore necessary to address this problem, by reviewing the course content, with the purpose of broadening the coverage and increasing the relevance; develop innovative ways of teaching the subject and improve the linkages with industry so as to support teaching, learning and research.

The Department of Civil Engineering looked towards industry to provide the necessary support and initiative. A senior engineer from industry and employed in Government, was requested to support the Department of Civil Engineering and assist in addressing the above problems.

The lecturer subsequently set out his own pedagogical objectives while at the same time making them appreciate the role of the engineer in society. In the process he formulated useful teaching methodologies. The following

paper summarizes what transpired over the three-year period from 1998 - 2001.

Objectives

The objectives of the study were:

- To review the course content in water resources engineering with the purpose of broadening the coverage and relevance.
- To apply new techniques of teaching and learning towards achieving the objectives of the water resources engineering course.
- To demonstrate the effectiveness of the new teaching and learning techniques on improving the performance of students in the subject.
- To make recommendations based on the results, on how to improve the teaching, learning and assessment, which approaches could be replicated elsewhere.
- To improve the linkages with industry so as to support teaching and learning.

Methodology Course Content

The course content was reviewed and expanded by comparing to other courses within the East African region, United Kingdom and Republic of Ireland. It was noted that the Department of Civil Engineering had one course entitled Hydraulics and Hydrology in second year, followed by Water Resources Engineering in third year. In other universities, however, all three subjects had separate courses. This meant that the coverage in Hydrology at Makerere was much less.

Since the process of introducing new courses at the university was very lengthy (three to four years), the challenge was therefore, was to incorporate within the existing course,

sufficient and relevant material and make it comparable to courses being offered in other countries.

Furthermore, a course schedule was developed which included the objectives, course outline, lecture schedule, assignment and test schedule and method of assessment. A field trip was also scheduled.

Teaching methods

The teaching and learning methods adopted were based on the lecturer's own experience in several African and European countries.

Results

Course content

The objectives of the Water Resources Engineering course developed were:

- To introduce the steps involved in the planning of a water resources project, its extent and environmental aspects.
- To introduce the various processes in the hydrological cycle and appreciate the importance of meteorology to man
- To introduce the factors affecting the storage capacity of reservoir and appreciate the effect of sedimentation on the life of a reservoir.
- To introduce measures of mitigating floods and routing
- To introduce the concepts of hydrological modelling and to estimate stream flow using deterministic and stochastic methods.
- To introduce the occurrence of groundwater in nature and to simulate different situations.
- To introduce the detailed processes in the planning and implementation of irrigation project.
- To introduce issues affecting water resources in Uganda

The course content was reviewed and the following is the new content.

These were: Introduction to Water Resources Engineering and Case Studies, Hydrological Cycle, Evaporation, Soil Moisture, Infiltration and Percolation, Hydrometry Drought Analysis, Rainfall Analysis, Reservoir Yield, Mass Curve Analysis, Flood Routing, Flood Mitigation, Frequency Analysis in Hydrology, Rainfall Runoff Relationships, Groundwater, Irrigation and Water Resources of Uganda.

The assignments were eight and they counted 25% towards the final mark. The tests counted 15% and the final exam counted 60%.

During the Introduction, case studies of important water resources engineering projects were presented. These were; the Aswan High Dam in order to introduce the concepts of storage with respect to surface water and environmental impacts and the Great Libyan Man Made River Project to introduce the concepts of groundwater development.

In the subsequent departmental curriculum revision of 2003, this course was divided into the two components of

hydrology and water resources engineering. The prerequisite was hydraulics and it became a full course.

Lectures

The lecturer was fully engaged elsewhere during the week and therefore lectures were only conducted once a week, in one four-hour session on Saturdays during the term sessions of 1998/1999. In the subsequent Semester sessions, lectures were conducted during the week in two-hour sessions on consecutive days. There were no formal lectures on weekends.

The lecture period on Saturday was divided into two with the first session starting at about 8.30 and ending at 10.00 a.m. There would be a break for 30 minutes and the second session would start at 10.30 a.m. and would last until mid-day. During the break there was opportunity for good interaction between the lecturer and the students. The techniques employed in the delivery of the lectures are explained below.

Lectures would start with the background to the topic and the reasons why it is important to study that particular topic in relation to the overall course. This would be followed by the scientific or engineering theory and any derivations. It would later be followed by an example of the application of the theory, often numerical. The lecture notes provided a summary to the typed notes.

Classes were given typed notes derived from several textbooks to augment the textbook from the book bank system.. They were normally provided at the beginning of the lecture. The typed notes amounted to over 300 pages, which were initially covered in 25 weeks spread over 7 months in the term system and in 13 weeks spread over 4 months for the semester system. In the first year they were given to the students free of charge and in subsequent years they had to make photocopies themselves. Some students opted out of buying the typed notes and used only the class notes. They were still able to do very well (above 75%).

The presentation was usually on a chalkboard and rarely with an overhead projector. It was interactive and the concepts would be developed together with the class. Attendance to the lectures was good with over 90% of the students present, even on Saturday. There were no tutorials except in 2000/2001, one tutorial was given on request to review some topics. At the end of each topic a take home assignment would be given

Assignments

Assignments given after each topic, were designed to give a complete coverage of the subject matter. The type of questions were both analytical, problem solving and descriptive. When students handed them in they were checked, and, if they were incomplete, they were returned to the students who would complete them. Students were given deadlines and were not penalized for handing in the assignments late. This was to encourage students to understand the topics at their own pace and discourage copying, in order to meet a

deadline. A total of eight assignments were given in each year resulting in up to a total of some 60 pages of hand written work. Assignments were assessed regularly and returned to the students. They were also specifically shown where they made mistakes and why they did not attain full marks. A comment would be put on their work ranging from excellent (95-100%), to good (80-90%) (depending on their performance) so as to encourage them or sometimes to prompt them.

Tests

Tests were conducted at the end of Term 1 and end of Term 2 in the year 1998/99 and before the Christmas break for the subsequent years. These covered material up to the end of the first and second term respectively. In the semester system they did only one test. They covered the subject material up until two weeks before the test; about 70% of the course material. A repeat test was given at an agreed time that covered the same range of topics as previously given and the higher mark of the two was carried towards the final mark. On the answer sheets comments of excellent (above 80%), to good (50-60%) were made. Below the pass mark of 50% a comment of "please see me" was made and they would be advised on how to overcome their weaknesses and improve performance and or the need to do another test. Sometimes they would be required to the test as coursework.

Field trips

Two trips were conducted during each course. One was to Jinja to visit construction of the Owen Falls Extension and the other to the Water Resources Management Department and National Meteorological Centre in Entebbe. Students appreciated them and learnt about the workings of these Departments.

Examinations

At the end of the course a three-hour examination was conducted. The exam consisted of ten questions and students were required to answer six of them, with question one being compulsory. The exam covered the whole range of topics taught and included two essay questions. The rest were analytical, problem solving or structured type. The questions were similar to those done in the assignments.

The external examiner was very impressed by the course content, the standard of coursework and the examination and the performance of the students.

At the end of the course, awards sponsored by industry for the best male student and best female student in the course were made.

Industrial placement

Arrangements were also made to place the students and many opted to work in the consulting firms and contractors. Over twenty students were taken every year. Some were able to identify final year projects from their industrial experiences.

Conclusions

A revised course content for Water Resources Engineering was developed and taught to civil engineering students, during the three year period. This course is comparable to any other course in this domain within the region and internationally. External Examiners appreciated this.

It was subsequently developed into two courses of hydrology and water resources engineering while the prerequisite became hydraulics.

New teaching and learning techniques were applied to the teaching of water resources engineering. Informal reports from industry, indicate that they are very pleased by the knowledge of graduates in this field and have subsequently assigned them challenging tasks.

Way forward

Curriculum revision should be a regular activity, of any engineering academic department and requires initiative of staff and support from stakeholders.

It requires staff to keep the links with stakeholders and industry

It should also be supported by improvements to teaching and learning.

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