# Enhancing Students' Motivation in the Undergraduate Teaching of Hydraulic Engineering: Role of Field Works

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**Abstract:** The paper describes the pedagogical impact of fieldwork in undergraduate hydraulic engineering subjects in an Australian university. Field studies have been regularly organized to complement traditional lectures in hydraulics for the last 10 years. Anonymous student feedback indicated a strong motivation for taking hydraulic courses that include a fieldwork component. Such courses are also associated with lower failure rates. Employers' response has highlighted strong industry support for such fieldwork experience. Another outcome is the students' personal development gained during such activities. The study also shows that the selection of field trips is critical to maximize students' learning.

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## Introduction

Engineering is related to the application of sciences to real-world applications, and engineering graduates must be familiar with professional problems, practical applications, and relevant solutions for the benefit of society. During the last three decades, universities in developed countries have rationalized their engineering curricula, as well as making cost cuts that have led to a general trend toward reduction of formal contact hours [e.g., Russell et al. (2000), Liggett and Ettema (2001)]. This tendency has been associated with the development of computer-based courses and "virtual teaching," project-based subjects, and management courses, often at the expense of practical studies and fieldwork. The situation is illustrated by trends in engineering education journals and expert publications, although ASCE's *Journal of Professional Issues in Engineering and Practice* appears to be an exception (Table 1, column 3). This alarming direction is also true in the teaching of hydraulic engineering, as illustrated by a recent issue of the *Journal of Hydraulic Engineering* (Vol. 127, No. 12) on "Teaching Hydraulic Design" and papers presented at the Theme E of the 30th Biennial Congress of the International Association for Hydraulic Engineering and Research (Table 1, 4th, 5th columns). These sources include only two articles, representing less than 5% of publication numbers, that discuss the role of practical work and field studies to support the teaching of hydraulic engineering [e.g., Chanson (2001)].

In the present paper, the writer revisits the role of field studies as part of the undergraduate teaching of hydraulic engineering in an engineering curriculum. The paper is based upon experience at the University of Queensland (Australia) and is documented with anonymous surveys of undergraduate students, questionnaires to young graduates, and surveys of employers.

## Field Studies in Undergraduate Teaching of Hydraulic Engineering

Water supply in Australia is limited because of the dry climate. The spatial and temporal variability of the rainfall is high, varying from zero rainfall for several years to extreme hydrological events. High evaporation coupled with surface runoff variability make the development of water resources more expensive and possibly less effective than in many other countries. Water engineering expertise is therefore critical to the continent's future development, and most undergraduate civil and environmental engineering curricula in Australian universities include a significant hydraulics component.

At the University of Queensland, hydraulics and water resource engineering lectures are included in the civil and environmental engineering curricula, which deliver respectively about 80 to 140 and 5 to 20 new graduates each year. Following a first year common to all engineering degrees, the students are taught hydraulic engineering in a series of compulsory and elective subjects that are common mostly to civil and environmental engineering students. Since late 2001, the compulsory subjects include hydrology in the 2nd year, fluid mechanics and open channel flows in the 3rd year, and a component of civil design in the 4th year (Table 2). Elective subjects are typically taught in the 4th year, although some might be undertaken in the late 3rd year. In Table 2, each subject corresponds to 2 units in the engineering curriculum of 64 units over 4 years, and subjects associated with laboratory work are marked (a), while those including fieldwork activities are marked (b). For the last 10 years, typical class sizes have been about 70 to 150 students in compulsory subjects and 25 to 80 students in elective subjects. Class sizes for 2002–2003 are listed for four subjects in the 2nd column of Table 3.

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**Table 1.** Survey of Technical Papers Published in Engineering Education Journals and Specialized Conference

| Subject | *International Journal of Engineering Education* | *Journal of Professional Issues in Engineering Education and Practice* | *Journal of Hydraulic Engineering* special issue on "Teaching Hydraulic Design" | 30th IAHR Congress Theme E Education, Research and Professional Development in Water Engineering |
|---|---|---|---|---|
| Period | January 2000 to December 2001 | January 2001 to April 2003 | December 2001 | August 2003 |
| Total number of papers | 139 | 104 | 11 | 34 |
| Papers on computer-based engineering courses, | 57 | 6 | 1 | 12 |
| including papers on virtual teaching | 12 | 3 | — | 8 |
| Papers on quality assurance | 11 | 2 | — | — |
| Papers on project-based courses | 32 | 5 | 2 | — |
| Papers on management issues | — | 6 | — | 1 |
| Papers on field work and studies | 0 | 2 | 1 | 1 |

With over 33,000 students, the University of Queensland is the largest and oldest university in the State of Queensland and is regarded as one of the four leading universities in Australia, with the universities of Melbourne and of New South Wales (Sydney). Although the University of Queensland might not be strictly characterized as an average university, its undergraduate civil engineering curriculum is representative of Australian civil engineering curricula, with broad-based courses and a strong focus on water resources.

### Pedagogy of Hydraulic Engineering Courses

The course material is structured to guide the students from the basic principles of fluid mechanics to their application to engineering design. The focus is on the basic understanding of fundamental principles and their sound applications to real-world applications. Fundamental lectures are complemented by simple physical modeling (Table 2) and numerical modeling. Advanced elective subjects cover more applied topics, such as movable boundary hydraulics (CIVL4110 and 4120), numerical modeling of unsteady open channel flows (CIVL4120), design of dam spillways (CIVL4120), and mixing and dispersion in rivers and estuaries (CIVL4110 and 4140). Each subject typically contains 35 hours of lectures and 12 hours of tutorials plus some practical work. The subject assessment is a combination of end-of-semester examination and semester work, including practical work reports and oral presentations.

In the context of undergraduate subjects, design applications in the classroom are restricted to simple flow situations and boundary conditions for which the basic equations can be solved analytically or with simple models. Fieldwork activities (Fig. 1) are essential to illustrate real professional situations and the complex interactions among all engineering and nonengineering constraints [e.g., Chanson and James (1998), Chanson (1999)]. For example, a culvert design requires a hydrological study of a stream to estimate the design flow rate and to predict the risks of emergency conditions. The dimensions of the culvert are based on hydraulic, geotechnical, and structural considerations, and the impact of the culvert on the environment must be taken into account, for example, in flooding of the upstream plain and tailwater conditions (Chanson 2000).

Although first introduced to motivate students' interest, field studies in undergraduate hydraulics courses have been an integral part of the teaching pedagogy for more than 10 years at the University of Queensland. The fieldwork assessment component typically ranges from 5 to 25% of the overall assessment (Table 3, 3rd column). Importantly, it adds some personal experience to teaching. How many professionals have walked on a fully silted reservoir, counted endangered wildlife species (e.g., koalas, swamp wallabies), and recorded water quality parameters and fish habitat characteristics? Many will never feel such real-life context, but this experience can be enlightening under expert guidance as part of undergraduate studies.

**Table 2.** Undergraduate Teaching of Hydraulic Engineering in Civil Engineering Curriculum at University of Queensland

| Type of subject | 2nd year | 3rd year | 4th year |
|---|---|---|---|
| Compulsory subjects | CIVL2140 hydrology | CIVL3130 fluid mechanics[a]<br>CIVL3140 Open channel flows[a–c] | CIVL4510 civil design (30%)[b,c] |
| Elective subjects | | | CIVL4110 coastal hydraulics[b]<br>CIVL4120 hydraulic design and structures[b,c]<br>CIVL4140 mixing in rivers[c]<br>CIVL4160 advanced fluid mechanics[a,c] |

[a]Subject associated with laboratory work activities.

[b]Subject associated with field work activities.

[c]Subject lectured upon by writer in 2002 and 2003.

**Table 3.** Field Work in Undergraduate Hydraulics Subjects Conducted in 2002 and 2003 at University of Queensland

| Subject | Number of students | Field work sites | Assessment component of subject (%) | Type of assessment | Remarks |
|---|---|---|---|---|---|
| CIVL3140 open channel flow | 84 | Minimum energy loss culverts and Gold Creek dam spillway | 5 | Individual report | 3rd year compulsory subject |
| CIVL4120 hydraulic design | 24 | Fully silted Korrumbyn Creek dam reservoir, Hinze dam spillway, and Molendinar water purification plant | 10 | Group report (4 to 5 students per group) | 4th year elective subject |
| CIVL4140 mixing in rivers | 39 | Environmental and ecological assessment of Eprapah Creek estuary | 25 | Group report and oral presentation (9 to 10 students per group) | 4th year elective (CE) or compulsory (EE) subject |
| CIVL4510 civil design | 73 | Minimum energy loss culverts and Flood plains in Norman Creek catchment | 20 | Group report and oral presentation (8 to 9 students per group) | 4th year compulsory subject |

Note: CE=civil engineering and EE=environmental engineering.

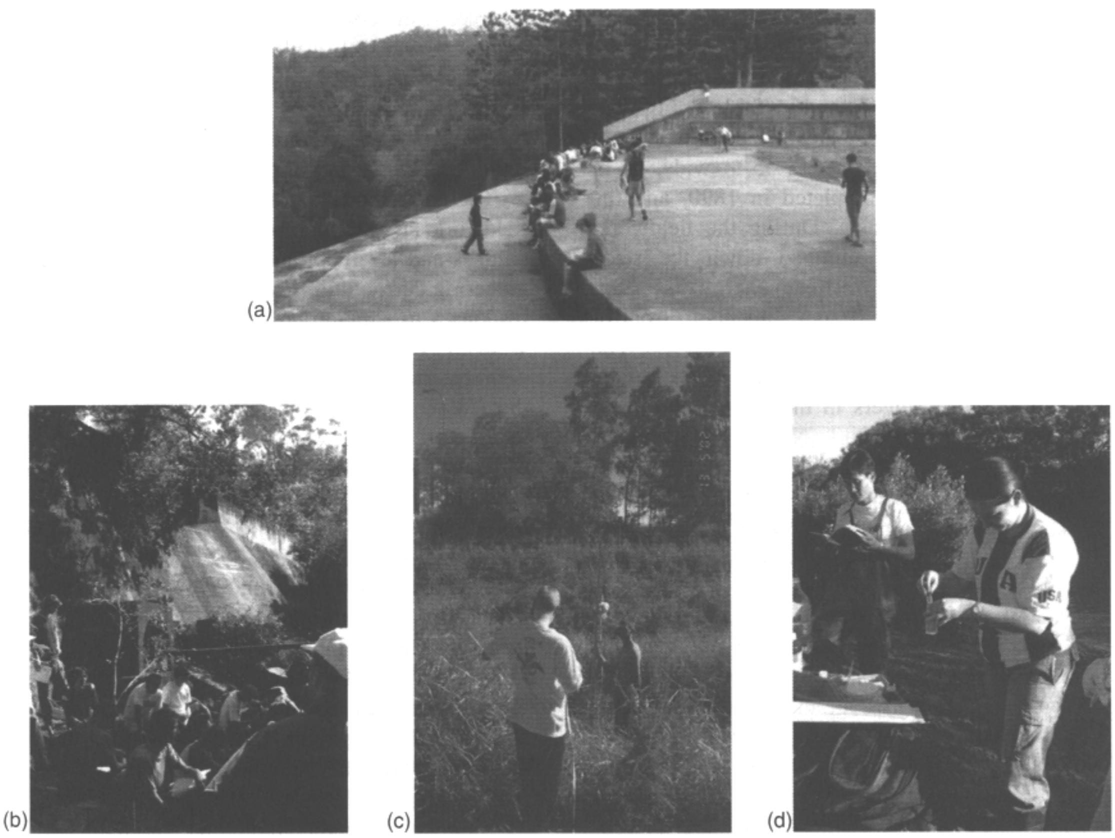

**Fig. 1.** Undergraduate student field trips: (a) CIVL3140 open channel flow class (84 students) in Gold Creek dam stepped spillway; (b) field study on September 4, 2002, with CIVL4120 hydraulic design class (24 students)—students in front of fully silted Korrumbyn Creek dam in dense subtropical rainforest; (c) CIVL4510 civil design students (73 students) surveying flood plain (courtesy of L. Cheung); and (d) CIVL4140 mixing in estuary fieldwork (39 students) at Eprapah Creek on April 4, 2003—students conducting sampling tests in mangrove (courtesy of Joyce H.)

**Table 4.** Web sites and Internet Resources Related to Student Field Work Activities

| Description | URL |
|---|---|
| CIVL3140 open channel flows Web site | ⟨http://www.uq.edu.au/~e2hchans/civ3140.html⟩ |
| CIV4120 hydraulic design and structures Web site | ⟨http://www.uq.edu.au/~e2hchans//civ4120.html⟩ |
| CIVL4140 Mixing in rivers Web site | ⟨http://www.uq.edu.au/~e2hchans/civ4140.html⟩ |
| CIVL4510 Civil design Web site | ⟨http://www.uq.edu.au/~e2hchans/civ4510.html⟩ |
| Extreme reservoir siltation in Australia | ⟨http://www.uq.edu.au/~e2hchans/res_silt.html⟩ |
| Hydraulics of minimum energy loss culverts | ⟨http://www.uq.edu.au/~e2hchans/mel_culv.html⟩ |
| Environmental and ecological assessment of Eprapah Creek, Victoria Point QLD | ⟨http://www.uq.edu.au/~e2hchans/eprapa.html⟩ |

### *Selection of Field Studies*

At undergraduate levels, a careful selection of fieldwork sites is essential to maximize learning. First, basic safety and security standards must be met, and a proper balance between successful and other sites is also important. The former may include a healthy waterway or a successful spillway design, while the latter includes polluted streams, spillway failures, and poor culvert designs. The writer's experience suggests that successful design sites are as important as failures. Everyone can learn from a failed design, although it takes some research to comprehend all aspects of the causes of failures, such as the sources of pollution of a stream, but it takes a well-trained professional to emphasize the key details of a successful design. Why is this design successful? What could have been wrong? How?

The writer has organized undergraduate fieldwork in hydraulic engineering for more than 10 years, involving more than 1,000 undergraduate students. Fig. 1 illustrates recent examples, and details of these field studies are summarized in Table 3. Fig. 1(a) shows CIVL3140 open channel flow students inspecting the Gold Creek dam spillway. Key features include a 55-m wide, 60-m long broad crest, a stepped chute completed in 1890, and the absence of a downstream stilling basin. During the fieldwork, students surveyed the broad crest, climbed down the steep stepped chute, and investigated the downstream energy dissipator. Fig. 1(b) shows CIVL4120 hydraulic design students in front of the fully silted Korrumbyn Creek dam, disused since 1926. The dam and reservoir were accessed after a 45-min bushwalk guided by National Park and Wildlife rangers in the dense subtropical rainforest of Mount Warning National Park (NSW). The fieldwork was focused on sediment processes in the catchment. Students surveyed both the upper and lower catchments and the fully silted reservoir and discussed the site's possible use as a tourist attraction and potential source of aggregate for the local construction industry.

Fig. 1(c) shows CIVL4510 civil design students surveying a flood plain in the heart of Brisbane. Students working in groups surveyed eight sections of the creek, including culverts and wide flood plains. Each group conducted hydraulic computations for design and less-than-design flow rates and prepared newer designs for a larger flood. The results were presented in a series of reports and oral presentations assessed by student peers and lecturers. Fig. 1(d) shows CIVL4140 students conducting an ecological assessment of the estuarine zone of a small subtropical creek. For 12 h, students surveyed hydrodynamics, water quality parameters, fish populations, bird behavior, and wildlife sightings at four sites (Chanson 2003). They concluded their work with a group report and an oral presentation in front of student peers, lecturers, professionals, and local community groups.

## Survey Results

Feedback was sought on the role of fieldwork in the undergraduate teaching of hydraulic engineering. Advice was received from students, recent graduates, senior professionals, and employers in civil/environmental engineering.

### *Undergraduate Student Feedback*

Anonymous student feedback was collected at the end of four field studies in 2002 and 2003 of two compulsory subjects (CIVL3140 and CIVL4510) and two elective subjects (CIVL4120 and CIVL4140) (Table 3). The assessment component and type of fieldwork are summarized in Table 3, while Table 4 lists relevant Internet resources. Fig. 2 presents results of anonymous student feedback, and full results are detailed in the Appendix. The student feedback forms were prepared with advice from the Tertiary Education Institute of the University of Queensland. Although feedback was anonymous and not compulsory, more than 70% of the classes answered (Appendix).

The anonymous results demonstrated that students considered fieldwork an essential component of the hydraulic engineering courses and an important aspect of their civil/environmental engineering curriculum [Figs. 2(a and d)]. Fig. 2 presents students' responses to simple questions/statements. The scale ranges from 1 to 5 where 1=disagree, 2=unsure, 3=agree moderately, 4=agree strongly, and 5=agree very strongly. Fig. 2(a) indicates that 78% of the students believed strongly or very strongly that "field work was an important component of the subject" (average for answers 4 and 5). The survey results showed that students perceived a clear difference between a construction site visit, the investigation of a hydraulic structure in operation (or disused), and a hands-on field study. Fieldwork encouraged strong group bonding and was well suited for group work, allowing students to gain better in-depth understanding of professional teamwork and design. Although the students believed that field studies did not replace traditional lectures, a large majority felt that field experience helped them to think more critically in hydraulic engineering. Fig. 2(b) highlights that 96% of the students believed that fieldwork plays "a vital role to comprehend real-word engineering" (average for answers 3 to 5).

Anonymous results highlighted that field studies were not self-learning or self-paced. For example, nearly half of the students did not agree strongly or very strongly that field studies were self-paced (Appendix). Students needed expert guidance and knowledge to comprehend all aspects of a prototype design. For example, 80% of students strongly and very strongly welcomed on-site guidance (average for answers 4 and 5, Appendix). In a

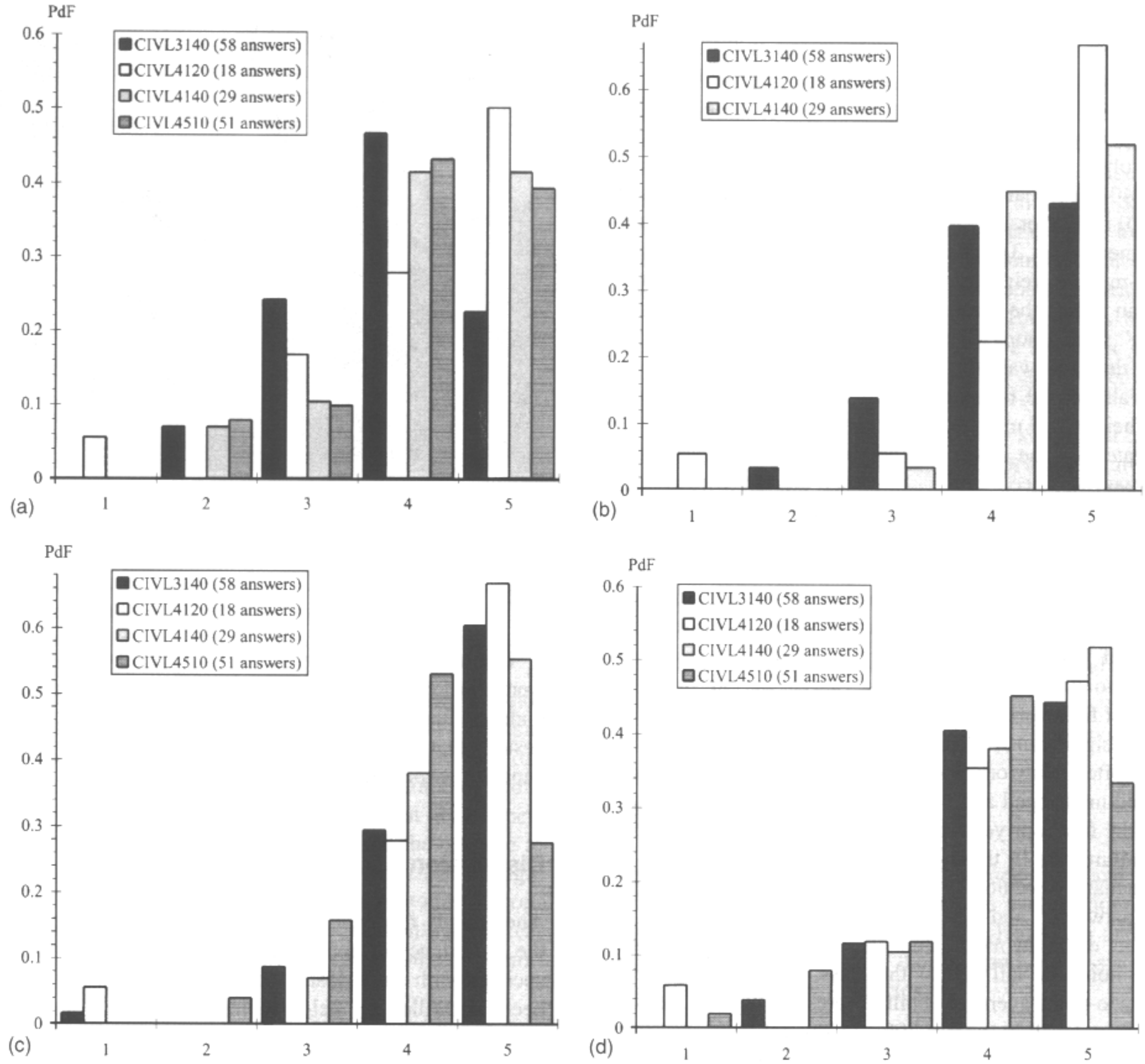


**Fig. 2.** Anonymous student feedback from undergraduate field studies conducted in 2002–2003 in CIVL3140 open channel flow (84 students), CIVL4510 civil design (73 students), CIVL4120 hydraulic design (24 students), and CIVL4140 mixing in rivers and estuaries (39 students)—horizontal scale: 1=disagree, 5=agree very strongly: (a) "The fieldwork was an important component of the subject"; (b) "The fieldwork plays a vital role to comprehend real-world engineering"; (c) "The lecturer communicated enthusiasm for the material"; and (d) "All things considered, do you think that fieldwork and site visits are an important component of the (civil/environmental engineering) curriculum?"

few instances, some students conducted fieldwork on their own, but the outcome was disappointing, their reports indicating that they learned little and missed vital issues. The writer interviewed students who conducted either supervised or unsupervised fieldwork for the same course. A general observation was that students involved in unsupervised studies did not learn to think more critically. Most students regarded expert supervision a necessity to gain firsthand knowledge that may be emphasized by an enthusiastic lecturer [e.g., Fig. 2(c)]. This aspect was particularly important during multidisciplinary field studies. For example, during the environmental and ecological assessment of a creek [Fig. 1(d)], academics from the Department of Zoology (UQ), professionals from the Queensland Government Environmental Protection Agency (EPA), and local wildlife experts were involved and interacted with the students during the field study. The same experts were also involved in the assessment process.

Handwritten and verbal student comments added some personal feedback highlighting a strong student motivation for taking hydraulics courses associated with fieldwork. Field trips helped

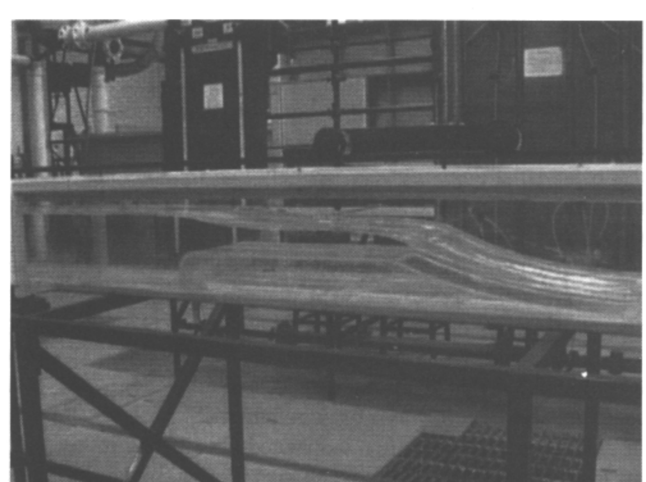

**Fig. 3.** Photographs of broad-crested weir experiment in CIVL3140 open channel flows—flow from left to right, channel width: 0.25 m, channel length: 3.2 m

the students to visualize professional situations and motivated them much more than conventional lectures and audiovisual aids (e.g., slides, video), even laboratory work (Fig. 3). While laboratory work allows hydraulic studies under carefully controlled flow conditions, fieldwork offers the students some professional exposure and involves prototype dimensions. For example, students in the CIVL3140 open channel flow course conduct both field studies [Fig. 1(a)] and laboratory work (Fig. 3). But the broad-crested weir experiment (Fig. 3) does not have the fascination of a 60-m long, 55-m wide weir crest [Fig. 1(a)]: "This is the real stuff," "nothing can beat the real-world [experience]," "awesome, breathtaking" were among CIVL3140 students' comments on the Gold Creek dam spillway. At the Gold Creek dam spillway, students can walk on the broad crest and climb down the stepped chute (step height: 1.5 m, step length: 4 m) [Fig. 1(a)]. They see the quiet waters in the reservoir and can imagine the "rushing waters" down the steep chute. Students clearly expressed a greater motivation for having hands-on experience in the real world under academic supervision.

This increased interest in the course always translated into higher marks in homework and examination papers and, more importantly, a smaller failure rate in these subjects. Prior to the introduction of fieldwork, the failure rate in hydraulics subjects was about 15 to 30% on average over a 10-year period. Since the introduction of fieldwork, the failure rate in the same subjects has been reduced significantly. (This trend was best noted during the first 2 years after fieldwork was introduced because the curriculum remained unchanged and examinations were similar.) On average, over the first four years following the introduction of fieldwork, the failure rate in these hydraulics courses was 10.6% on average (standard deviation: 7.2%). Since then, the failure rate has ranged between 5 and 22%.

The impact of fieldwork on students' performance was mostly noticeable among the tail end of the class, that is, the students with low grade-point averages. Failure rates among the weakest students were reduced by nearly 70%. In several instances, individuals were noted to "switch on" during fieldwork, and some students commented "I gained interest for the civil engineering course thanks to the real stuff (field studies)"; "field works are great stuff"; and "why don't all lecturers bring us in the field?" (anonymous student feedback).

### Professional Feedback

In addition, the writer interviewed a number of former students, that is, civil and environmental engineering graduates with fewer than 5 years of experience. Of a sample of over 40 young graduates, 95% had a vivid memory of the field trips in hydraulics, and 90% believed strongly or very strongly that field studies were an important part of the curriculum. Most believed that fieldwork experience helped them in their career development.

The writer further interviewed a number of civil engineering employers, including government departments, private consultants, and mining and construction companies. Of a sample of more than 25 senior engineers, managing directors, and CEOs, all (100%) stressed that field experience, including fieldwork under academic supervision, was a basic requirement for civil engineering graduates. This was often associated with strong in-kind support to assist and facilitate field studies. For example, during the field study shown in Fig. 1(d), the EPA contributed more than 25 man-hours and launched a boat on the study day; local communities contributed more than 80 man-hours; and equipment was lent by several academic, government, and local institutions.

**Fig. 4.** Group photograph at end of field study of large culvert (design flow rate: 220 $m^3/s$) in August 2001 (courtesy of Ahmad Abdullah Sani)

During discussions with leading engineers, some employers were shocked to learn that fieldwork was no longer compulsory in undergraduate civil engineering curricula. Their response suggested that senior professionals placed more emphasis on hands-on experience than on virtual education.

## Discussion

Anonymous feedback and discussions with students highlighted the importance of appropriate on-site guidance and expertise associated with enthusiastic lecturers [e.g., Fig. 2(c)]. Students can become thrilled by field studies directly relevant to the course material. For example, a culvert is often perceived as a "dull" structure in the classroom, but it may become a fascinating hydraulic structure in the context of hydraulic fieldwork, particularly with large structures. Fig. 4 shows the writer with a group of students in a culvert outlet located in the city of Brisbane.

From experience, the selection of field-study sites must be changed from year to year. The weak students who failed the subject in the previous year must be given the opportunity to learn more and be involved in a new field activity.

### Personal Experiences

A key outcome of fieldwork is the personal experience gained by students. While this aspect is hardly quantifiable and often ignored by university management, there is no doubt that field studies can enhance students' individual experience and personal development. The writer has experienced this first-hand and has received much individual feedback. For example, an international student was very surprised to see a koala walking right in front of her during an ecological survey; a former army member involved in fish sampling said "I did not believe that I would ever use survival skills in an engineering course"; and a female first-class honors student who discovered the intricacies of practical work in harsh subtropical conditions with no freshwater or toilets on site added, "it was more a matter to mix with the environment than to study river mixing."

Group work contributes to new friendships and openings, for example, between civil and environmental students, Australian

**Fig. 5.** Group bonding at end of 12 h of estuarine field study (CIVL4140, April 4, 2003) (courtesy of Joyce H.)

and international students, and students and professionals involved in the study (e.g., Fig. 5). Such personal experiences are at least as important as the academic experience.

While introductory field studies are simple, advanced fieldwork sometimes may be feared by students. The writer can mention cases of students who were apprehensive about the field experience prior to the activities. For example, fish sampling, work in snake-infested areas, and wildlife surveys are not always perceived as a "fun" activity. Yet all the students had the courage to take on the challenges, and the writer has not experienced a single failure. Discussions with students after the field activities demonstrated that some learned to control their fears and all had a great experience. (Group fieldwork is particularly well suited to anxious students.)

## Summary and Conclusions

Student fieldwork was introduced systematically in a series of hydraulic engineering courses in undergraduate civil and environmental engineering curricula. Field studies complement traditional lectures and laboratory work. Anonymous student feedback demonstrated a strong student interest in fieldwork associated with greater motivation for the course, leading in turn to lower failure rates. Feedback from former students indicated that fieldwork experience was an important component of their studies and helped their professional development. Employers testified that fieldwork is an essential component of a hydraulic engineering course and should be a requirement in all civil/environmental engineering curricula.

The present study highlighted the very significant role of fieldwork in the teaching of hydraulic engineering. Lecturers and professionals should not be complaisant about attempts by university hierarchy and administration clerks to cut costs by eliminating field studies. Although the preparation and organization of fieldwork with large class sizes are a major effort, the outcome is very rewarding for the students and the lecturer. From his own experience, the writer has had great pleasure in bringing his students to hydraulics fieldwork during the last decade and to experience their personal development first hand.

## Acknowledgments

The writer acknowledges useful feedback from and discussions with past and present students and the useful comments of the reviewers. He also thanks his wife Ya-Hui Chou and their children Bernard and Nicole for their support and assistance during numerous preliminary field trips.

## Appendix. Detailed Anonymous Student Feedback Surveys

Anonymous student feedback from undergraduate field studies conducted in 2002–2003 at the University of Queensland. Scale: 1=disagree, 2=unsure, 3=agree moderately, 4=agree strongly, and 5=agree very strongly.

| | |
|---|---|
| Subject: | CIVL3140 open channel flow |
| Course: | 3rd year civil and environmental engineering (compulsory) |
| Date: | September 11, 2002 |
| Assessment: | Individual report |
| Number of students: | 84 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| Comments specific to the fieldwork | | | | | | | |
| The course was structured to ensure maximum learning | 0.00 | 0.05 | 0.10 | 0.52 | 0.33 | 58 | 4.12 |
| The fieldwork was an important component of the subject | 0.00 | 0.07 | 0.24 | 0.47 | 0.22 | 58 | 3.84 |
| The lecturer provided appropriate on-site guidance during the fieldwork | 0.02 | 0.00 | 0.07 | 0.46 | 0.46 | 57 | 4.33 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| Fieldwork improved my ability to work in a group | 0.00 | 0.18 | 0.42 | 0.28 | 0.12 | 57 | 3.35 |
| Fieldwork contributed to group bonding | 0.02 | 0.02 | 0.29 | 0.26 | 0.41 | 58 | 4.03 |
| The lecturer communicated enthusiasm for the material | 0.02 | 0.00 | 0.09 | 0.29 | 0.60 | 58 | 4.47 |
| I have learned to think more critically | 0.00 | 0.07 | 0.33 | 0.40 | 0.19 | 57 | 3.72 |
| I like the self-paced approach | 0.02 | 0.02 | 0.31 | 0.28 | 0.38 | 58 | 3.98 |
| The fieldwork plays a vital role in compre hending real-world engineering | 0.00 | 0.03 | 0.14 | 0.40 | 0.43 | 58 | 4.22 |
| General comments about fieldwork in civil and environmental engineering courses | | | | | | | |
| The field experience has helped me to develop the ability to work in a profes sional environment | 0.00 | 0.09 | 0.26 | 0.40 | 0.25 | 57 | 3.81 |
| The course(s) was (were) structured to help me to improve my learning skills | 0.02 | 0.05 | 0.29 | 0.39 | 0.25 | 56 | 3.80 |
| I like the self-paced approach | 0.02 | 0.02 | 0.28 | 0.37 | 0.32 | 57 | 3.95 |
| All things considered, do you think that fieldwork and site visits are an important component of the curriculum? | 0.00 | 0.04 | 0.12 | 0.40 | 0.44 | 52 | 4.25 |

| | |
|---|---|
| Subject: | CIVL4120 advanced open channel flow and hydraulic design |
| Course: | 4th year civil engineering (elective) |
| Date: | September 4, 2002 |
| Assessment: | Group report |
| Number of students: | 24 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| Comments specific to the fieldwork | | | | | | | |
| The course was structured to ensure maximum learning | 0.00 | 0.06 | 0.06 | 0.56 | 0.33 | 18 | 4.17 |
| The fieldwork was an important component of the subject | 0.06 | 0.00 | 0.17 | 0.28 | 0.50 | 18 | 4.17 |
| The lecturer provided appropriate on-site guidance during the fieldwork | 0.00 | 0.00 | 0.06 | 0.33 | 0.61 | 18 | 4.56 |
| Fieldwork improved my ability to work in a group | 0.00 | 0.11 | 0.28 | 0.28 | 0.33 | 18 | 3.83 |
| Fieldwork contributed to group bonding | 0.00 | 0.06 | 0.22 | 0.28 | 0.44 | 18 | 4.11 |
| The lecturer communicated enthusiasm for the material | 0.06 | 0.00 | 0.00 | 0.28 | 0.67 | 18 | 4.50 |
| I have learned to think more critically | 0.00 | 0.11 | 0.33 | 0.28 | 0.28 | 18 | 3.72 |
| I like the self-paced approach | 0.00 | 0.11 | 0.17 | 0.17 | 0.56 | 18 | 4.17 |
| The fieldwork plays a vital role to comprehend real-world engineering | 0.06 | 0.00 | 0.06 | 0.22 | 0.67 | 18 | 4.44 |
| General comments about fieldwork in civil and environmental engineering courses | | | | | | | |
| The field experience has helped me to develop the ability to work in a professional environment | 0.00 | 0.06 | 0.24 | 0.47 | 0.24 | 17 | 3.88 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| The course(s) was (were) structured to help me to improve my learning skills | 0.00 | 0.00 | 0.29 | 0.47 | 0.24 | 17 | 3.94 |
| I like the self-paced approach | 0.00 | 0.06 | 0.29 | 0.24 | 0.41 | 17 | 4.00 |
| All things considered, do you think that fieldwork and site visits are an important component of the curriculum? | 0.06 | 0.00 | 0.12 | 0.35 | 0.47 | 17 | 4.18 |

| | |
|---|---|
| Subject: | CIVL4140 mixing in rivers and estuaries |
| Course: | 4th year civil environmental engineering (elective/compulsory) |
| Date: | April 4, 2003 |
| Assessment: | Group report and oral presentation |
| Number of students: | 39 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| Comments specific to the fieldwork | | | | | | | |
| The course was structured to ensure maxi mum learning | 0.00 | 0.10 | 0.28 | 0.45 | 0.17 | 29 | 3.69 |
| The fieldwork was an important component of the subject | 0.00 | 0.07 | 0.10 | 0.41 | 0.41 | 29 | 4.17 |
| The lecturer provided appropriate on-site guidance during the fieldwork | 0.00 | 0.00 | 0.14 | 0.46 | 0.39 | 28 | 4.25 |
| Fieldwork improved my ability to work in a group | 0.00 | 0.07 | 0.14 | 0.57 | 0.21 | 28 | 3.93 |
| Fieldwork contributed to group bonding | 0.00 | 0.00 | 0.11 | 0.52 | 0.37 | 27 | 4.26 |
| The lecturer communicated enthusiasm for the material | 0.00 | 0.00 | 0.07 | 0.38 | 0.55 | 29 | 4.48 |
| I have learned to think more critically | 0.00 | 0.07 | 0.29 | 0.50 | 0.14 | 28 | 3.71 |
| I like the self-paced approach | 0.00 | 0.03 | 0.28 | 0.52 | 0.17 | 29 | 3.83 |
| The fieldwork plays a vital role to compre hend real-world engineering | 0.00 | 0.00 | 0.03 | 0.45 | 0.52 | 29 | 4.48 |
| General comments about fieldwork in civil and environmental engineering courses | | | | | | | |
| The field experience has helped me to de velop the ability to work in a professional environment | 0.00 | 0.00 | 0.24 | 0.34 | 0.41 | 29 | 4.17 |
| The course(s) was (were) structured to help me to improve my learning skills | 0.00 | 0.00 | 0.21 | 0.54 | 0.25 | 28 | 4.04 |
| I like the self-paced approach | 0.00 | 0.00 | 0.24 | 0.66 | 0.10 | 29 | 3.86 |
| All things considered, do you think that fieldwork and site visits are an important component of the curriculum? | 0.00 | 0.00 | 0.10 | 0.38 | 0.52 | 29 | 4.41 |

| | |
|---|---|
| Subject: | CIVL4510 civil design |
| Course: | 4th year civil engineering (compulsory) |
| Date: | May 2002 |
| Assessment: | Group report and oral presentation |
| Number of students: | 73 |

| Survey question | Percent of answers 1 | 2 | 3 | 4 | 5 | Number of answers | Mean out of 5 |
|---|---|---|---|---|---|---|---|
| Comments specific to the fieldwork | | | | | | | |
| The course was structured to ensure maximum learning | 0.02 | 0.10 | 0.41 | 0.35 | 0.12 | 51 | 3.45 |
| The fieldwork was an important component of the subject | 0.00 | 0.08 | 0.10 | 0.43 | 0.39 | 51 | 4.14 |
| The lecturer provided appropriate on-site guidance during the fieldwork | 0.04 | 0.16 | 0.33 | 0.37 | 0.10 | 51 | 3.33 |
| Fieldwork improved my ability to work in a group | 0.00 | 0.10 | 0.33 | 0.47 | 0.10 | 51 | 3.57 |
| Fieldwork contributed to group bonding | 0.02 | 0.02 | 0.16 | 0.57 | 0.24 | 51 | 3.98 |
| The lecturer communicated enthusiasm for the material | 0.00 | 0.04 | 0.16 | 0.53 | 0.27 | 51 | 0.04 |
| I have learned to think more critically | 0.02 | 0.08 | 0.41 | 0.41 | 0.08 | 51 | 3.45 |
| I like the self-paced approach | 0.02 | 0.14 | 0.39 | 0.35 | 0.10 | 51 | 3.37 |
| General comments about fieldwork in civil and environmental engineering courses | | | | | | | |
| The field experience has helped me to develop the ability to work in a professional environment | 0.02 | 0.10 | 0.27 | 0.45 | 0.16 | 51 | 3.63 |
| The course(s) was (were) structured to help me to improve my learning skills | 0.02 | 0.12 | 0.33 | 0.43 | 0.10 | 51 | 3.47 |
| I like the self-paced approach | 0.04 | 0.12 | 0.37 | 0.37 | 0.10 | 51 | 3.37 |
| All things considered, do you think that fieldwork and site visits are an important component of the curriculum? | 0.02 | 0.08 | 0.12 | 0.45 | 0.33 | 51 | 4.00 |

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