

DEVELOPING SKILLS THROUGH FIELDWORK

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Abstract $\frac{3}{4}$ The Civil Engineering degree programme at Coventry University (in common with all other undergraduate programmes within the University) is committed to developing 'Academic and Professional Skills'. A major contribution to skills development within the Civil Engineering programme is via a module based around a residential field course. The module, 'Field and Enterprise Skills', is mainly devoted to a surveying / setting out project, defined in a detailed written specification given out at the start of the module. The practical work is carried out during a residential period of 5 days. In spite of the subject-specific nature of the fieldwork, the main aims of the module, explicitly and implicitly, are the development of skills. The experience provides opportunities for personal development, through reflection on performance, evaluation of strengths and weaknesses, and analysis of roles and responsibilities within the team. There is an element of peer assessment. The paper gives some detail about the module, and considers its success in achieving its aims.

Index Terms $\frac{3}{4}$ Fieldwork, Group working, Skills, Surveying.

SKILLS

For some years, undergraduate courses at Coventry University have been guided by the University's "Enterprise Code of Practice" [1]. At its core, the Code required that a list of capabilities be developed in all courses: personal, communication, working with others, vocational, numerical, information technology, and innovation and problem solving.

More recent moves in higher education in the UK towards the use of programme specifications and benchmarking statements, together with national initiatives in the area of key skills, have prompted the University to update its Code of Practice. This has led to the creation of the "Code of Practice for Academic and Professional Skills Development" [2]. This states that 'Coventry University offers students opportunity, encouragement and help to develop the capabilities outlined below within their programme of study. This will enable them to enhance their readiness for employment and take maximum advantage of their higher education to develop their academic and professional skills. All programme specifications should articulate how the programme addresses the Code and

indicate where skills are supported by central resources in the University.'

Each of the skills is described in terms of:

- Intended outcomes ("students should be able to")
- Indicative coverage
- Potential methods of development and assessment

The list of skills, together with the intended outcomes for each, is given in Table I.

TABLE I
ACADEMIC AND PROFESSIONAL SKILLS

Skill	Students should be able to:
Learning to learn	<ul style="list-style-type: none"> • Accept responsibility for their own independent and lifelong learning • Reflect on their learning and appraise their capabilities and achievements • Identify their needs for effective learning
Working with others	Work effectively as part of a group with respect for the dignity, rights and needs of others
Problem solving and innovation	<ul style="list-style-type: none"> • Use problem solving skills in a variety of practical situations • Demonstrate creativity, flexibility, perception, decisiveness, confidence and an awareness of values
Numeracy	Manipulate, interpret, analyse and present numerical data
IT and online learning	Use computer based systems for learning, communicating, collaborating with peers and tutors, and working with data
Communication and literacy	Communicate effectively in appropriate forms in a wide variety of situations
Career management	<ul style="list-style-type: none"> • Appreciate the values, culture, structure and processes of work organisations relevant to their area of study • Appropriately match their experience and academic achievements to employer expectations
Information management	Carry out research relevant to their field of study by retrieving and using information effectively drawn from a variety of sources
Personal development planning	Demonstrate self awareness, set personal goals and record achievement

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INCLUSION OF SKILLS IN ENGINEERING COURSES

The “Dearing report” [3] suggests that ‘there are two ways in which institutions might include key skills in their programmes: by embedding them in existing programmes as the vehicle for development; or by creating parallel modules of “skills development”’.

There have been several initiatives in skills development at universities, including some aimed specifically at engineering courses. An example is the TRANSEND project based at the University of Surrey in partnership with other universities [4]. This has found that skills are included in engineering courses using three approaches: embedded, where skills development is implicit in the general content; integrated, where skills development is explicit in the aims yet is integrated in the technical and academic content; and bolt-on, where skills development is treated in separate modules.

EXAMPLE OF INTEGRATED SKILLS DEVELOPMENT

This paper describes an element in the civil engineering programme at Coventry University in which skills development is **integrated** with engineering studies. Of the Academic and Professional Skills listed above, the exercise makes a significant contribution to the development of:

- Working with others
- Problem solving and innovation
- Numeracy
- Communication
- Personal development planning

In addition, it makes some contribution to the development of:

- Learning to learn
- IT and online learning

THE MODULE

The module, “Field and Enterprise Skills”, is a first year compulsory module on a number of accredited Civil Engineering degrees. It is designed to allow students to develop the range of skills specified above using a traditional surveying field course as a vehicle. Typically between 20 and 30 students study the module each year. They are taught by 2 members of staff, for 2 hours per week over a period of 9 weeks prior to a week-long residential field course that takes place at the Preston Montford Field Studies Centre, Shrewsbury, UK.

The primary objectives of the module, taken from the module descriptor, are:

- ‘You will develop leadership and transferable enterprise skills to be able to properly plan, prepare, organise and report on engineering field activities.’

- You will be able to present your results and your interpretation of observations in formal spoken and written form.
- You will acquire planning, organisational and communication skills needed for the successful interpretation of a specification and the management and execution of engineering surveying work.’

The following description of the module and residential week is taken from the briefing sheet issued to students:

- ‘You will work in groups and undertake a variety of measurement and setting out tasks to test theoretical and practical knowledge of Engineering Surveying. It will also be an opportunity to work in a group environment where organisation, planning, co-operation and individual effort will be tested to the full. It is a demanding course, both physically and mentally, but one which should provide a stimulating and worthwhile experience if full participation is given.
- The group will be on site at approximately 10.30 am on Monday enabling a familiarisation and reconnaissance session. There follows 3 full days in the field with evening evaluation and preparation sessions. All fieldwork should be complete by the end of Thursday with final reports and drawings submitted by the end of Friday at which point the course will finish and the group will return to Coventry.’

The general scheme of the surveying work is outlined in a specification document:

- ‘The task for each group is to set out and survey a section of a proposed road. The horizontal alignment of the road consists of 2 straights with an intervening horizontal circular curve.
- Horizontal control should be provided by establishing a traverse through the group area using existing control stations as a reference. Vertical control should be provided by levelling into each section from a reference bench mark which is based on the Ordnance Survey.
- A tacheometric survey of part of the group area will be undertaken to produce a 1:500 contoured plan.
- Setting out exercises that are typical of a construction site will have to be undertaken. These will include the setting out of the road centre line, a base for a small structure, profile boards for a drainage line and slope stakes for highway construction control.
- The group has complete control over the order and progress of work. This must be carefully considered to optimise the available personnel and instrumentation.
- Each survey task requires the group to demonstrate that work is satisfactory and complies with the Specification. This involves applying and recording appropriate checks. The group should also consider the application of gross checks to their work to prevent unnecessary future problems.’

PREPARATION

Although Coventry University operates a non-semesterised system, the start of the module is delayed until the end of January, with the week-long residential field course taking place in May. An activity timetable is shown in Table II.

The students are placed in groups of 4 to 6 that have been selected by staff with the aim of distributing the perceived stronger and weaker students throughout the groups so that they all have an equal opportunity to successfully complete the field course.

The role of staff on the module is seen as guiding and supporting rather than leading the students. The staff assume a dual role of clients (assessors) and consultants (advisors). They guide the students through the exercise, helping them to identify and formulate their own solutions to problems, and only suggesting prescriptive solutions as a last alternative.

The documentation given to students in week 1 consists of:

- A 3 page briefing that gives the marking scheme, the main stages of the module and the requirements for all coursework submissions.
- A detailed 6 page specification listing key surveying tasks and accuracy requirements.

A formal introduction to the module occurs in week 2. The students perform an individual SWOT analysis and are asked to comment on the role that they perceive they will have within the group. They are also required to produce a list of field activities based on the specification document, a 1:1000 plan with all known data on it, and encouraged to visit a web site [5] and notice board that has photos of the field centre and the group areas from previous years. All of these tasks are set in order that the students can become familiar with the work as quickly as possible.

During the next few weeks the groups collate their individual list of activities and formulate a timetable of fieldwork activities by taking into account the available surveying equipment and personnel. They also identify preparation work that is required, and allocate group members to be responsible for its production. The group is also required to keep minutes of meetings and produce action plans. Typical preparation work consists of calculation of setting out data, spreadsheets and drawing templates that will speed up the tasks in the field or simplify the production of the final Group Field Course Report. The fieldwork and preparation timetables are together termed the Group Action Plan.

In week 5 each group submits an initial Group Action Plan to staff for review and comment. As part of this submission, they produce a set of criteria that they consider will lead to successful operation of their group and a set of ground rules that members of the group will operate by. Staff review this submission informally and give feedback to the group with particular emphasis on guiding the students

towards performing a critical path analysis in order to identify critical activities and estimated completion times for the fieldwork and preparation. This aspect of the Group Action Plan is usually found to be lacking for the following reasons:

- Lack of knowledge of certain surveying tasks
- Limited resources (time, personnel and equipment)
- Unknown variables (speed and accuracy of their work, weather)

The students are asked to revise their Group Action Plan in light of the feedback and further knowledge they have gained since its first submission. The staff emphasise that their plan *will* change and develop over the course of the module. The final Group Action Plan that is to be assessed is submitted in week 8.

By week 10 all preparation work is to be completed and each group submits a folder containing all of their work. During this week the students undertake a peer assessment exercise for the preparation stage of the module.

TABLE II
ACTIVITY TIMETABLE

Week	Activity
1	Documentation issued
2	Introduction to module followed by presentation by last year's group winners.
3	Group meetings with staff (weeks 3-10)
5	Submit initial Group Action Plan for staff review
6-7	Refine Group Action Plan and continue preparation work
8	Submit final Group Action Plan
10	Submit all preparation tasks
11	Residential Field course

FIELDWORK

The residential field course component of the module lasts for 5 days. Students are expected to work in the field from approximately 9 am to 5 pm although they do have access to a workroom if required. Staff are available for consultation during the day but perform a more formal tour of the group areas during the morning and afternoon. During these tours they observe the operation and progress of the group and interaction between group members. They also receive a formal report on progress from the nominated leader of the group for that day. The student giving the report is assessed on their spoken communication skills.

After their evening meal each group is required to be available for, and arrange, progress meetings with a member of staff. During this meeting staff receive an oral report on progress from the group leader and discuss this progress and any difficulties with the whole group. All members of the group are encouraged to contribute to the discussions and are again assessed on their spoken communication skills.

Each evening is usually spent completing pro-forma reports on the component surveying tasks and preparing for the next days field activities. If major problems have been

encountered during the day the students may be allowed to return to the field so that they do not fall behind schedule too much.

Students are required to demonstrate that their work has met the specification by performing checks on all of their surveying and setting out work in the field. Major problems usually arise because they do not do this: they assume that their first attempt was successful, continue with activities only to discover later that their assumption was false. This work pattern often leads to a “roller coaster” ride of emotions and confidence, and many groups experience heated discussions on their path to learning the benefits of methodical work practices the hard way.

Invariably students discover that their preparation work was not as thorough or complete as it could have been. This, together with inadequate checking of fieldwork, often leads to late nights and early rises in an attempt to keep on schedule. By the end of the week most students are physically and mentally exhausted.

All fieldwork stops by the end of day 4. During the last day the staff assess the completeness and accuracy of the setting out work of each group. The students complete any outstanding reports, produce drawings and compile the final Group Field Course Report that addresses the success, or otherwise, of the group’s activities. As well as the success of the surveying tasks each group is asked to write a group critique focussing on an assessment of the operation of their group and their experiences of group working. A peer assessment exercise for the fieldwork stage of the module is undertaken together with a self assessment exercise for the student’s individual contribution to the group over the course of the whole module.

ASSESSMENT

The module is assessed by coursework. Several items of coursework, both group and individual, consisting of preparation work, calculations, progress and final reports in both written and spoken forms of presentation are assessed during the course of the module.

The relative proportions of marks are:

- 75% group (40% Group Action Plan and preparation work, 40% fieldwork, 20% Group Field Course Report all modified by peer assessment)
- 25% individual (25% each for individual effort and ability, attitude and professionalism, spoken communication skills, self assessment)

Marks for the Group Action Plan and preparation work are given for an optimal scheduling of surveying tasks given the group resources and the amount, relevance and quality of the preparation work.

The fieldwork is assessed by staff according to the following criteria:

- Teamwork and attitude
- Surveying accuracy
- Progress/completeness of the surveying work

The Group Field Course Report consists of eleven progress reports on individual surveying tasks, three A3 drawings, and a group critique. The students are responsible for allocating the report writing within their group. Reports and drawings are assessed for written and graphical communication skills as well as technical content.

Peer assessment plays a strong part in the module. The staff marks that are awarded for the Group Action Plan and preparation work, fieldwork and Group Field Course Report are all factored by peer assessment.

As part of the Group Action Plan each group is required to draw up a set of criteria that will be used to form the basis for their peer assessment. Although each set of criteria is unique to a particular group, some common items are:

- Attendance at group meetings
- Polite behaviour and respect for each others’ opinions
- Completion of allotted work on time.

Peer assessment is performed anonymously at the end of the preparation and fieldwork stages of the module. Each student is asked to allocate 100 marks to the *other* members of their group. The students are reminded to take into account the criteria that they had established as a group but, in addition, they are asked to justify the distribution of marks that they have given. The marks awarded to students by their peers are then collated to form a modification factor. If students are judged by their peers to have contributed an equal amount this modification factor would be 1. In practice, the modification factors for the preparation stage ranged from 0.39 to 1.43 in 2002.

Common justification reasons that are mentioned during peer assessment include:

- Punctual attendance at group meetings
- Amount and quality of effort/contribution to group
- Knowledge and ability in surveying
- Completed assigned tasks
- Missing deadlines
- Initiative: “only does what he is told and nothing more”
- Honesty: “said she understood but asked many questions afterwards”
- Expectations not matching reality

The factors for the fieldwork stage prove to be less variable and range from 0.45 to 1.29 although the majority of groups were in the range 0.93 to 1.07. This suggests that the residential nature of the fieldwork means that students are more likely to contribute.

Common justification reasons that are mentioned during peer assessment include:

- Motivation and positive attitude to work
- Team spirit, humour, effort

- Resilience and drive to complete work on schedule
- Confidence
- Patience
- Speed of work

In all cases, the justification of peer marks contains items that were not on the list of criteria originally set by the group. Inevitably many of the reasons given were taken for granted and therefore not specifically listed by the group members.

FEEDBACK

The students provide feedback on the operation of their group via the peer assessment exercises and the group critique contained in the final Group Field Course Report. Due to the work pressure on the final day this critique is often disappointing but some comments are:

- ‘The strengths and weaknesses of the members were identified, and in the case of strengths utilised and in the case of weaknesses compensated for.’
- ‘The aim of the field trip for me was to develop my strengths, turn my weaknesses into strengths as well as put my lectures into practice.’

During the self assessment exercise each student is asked to give themselves a mark based on their own assessment and to take the opportunity to reflect back on the SWOT analysis and discussion that they conducted at the start of the preparation stage of the module some eleven weeks earlier. In most cases this mark correlates well with the marks awarded through peer assessment and the staff’s assessment. Some of the comments that students make are:

- ‘... improving my ability to work in a group with people I wouldn’t normally work with.’
- ‘In terms of teamwork I can consider myself to be a leader and motivator.’ (supported from comments made from the peer assessment)

Oral feedback through informal discussions with students also includes problems with internal friction and arguments within a group when things didn’t go right, although two students said they felt they could act as a mediator and calm down tensions within their group. Some groups show a strong sense of competitiveness by going into the field at 06:00 and insisting on finishing the fieldwork on the last evening even though the staff have already assessed the accuracy of their work. In previous years there has also been strong competition between groups trying to be first to finish the work.

A standard Coventry University module questionnaire is used to solicit feedback at the end of the residential component of the module. Two questions specifically relate to the perceived benefits of the module to the students (2002 responses given here):

- 86% of the students consider the module to be an important part of their programme of study (12% thought it didn’t)
- 79% of the students thought the module was meeting its aims and objectives (the remaining 21% had no opinion).

Informal feedback is sought in addition to the quantitative feedback on the questionnaire. The students are asked to write 3 things that they liked about the module and 3 things that they *would* like in the module:

Likes:

- ‘Group work’
- ‘Practical course, you get to see the theory become reality’
- ‘Varied contact with different members of staff’
- ‘The work was challenging, which in the end gave me an enormous sense of satisfaction’
- ‘The fact that the course is based mainly off campus’
- ‘The way my group worked together and communicated well’
- ‘Using all the practical skills learnt during the year’
- ‘Learning skills from each other’

Would like:

- ‘More control over choice of group’
- ‘Less time working in the field’

PRIZE AND PRESENTATION

The importance of the skills developed in this module are well recognised by the civil engineering industry and the local office of a national consultancy company, W.A. Fairhurst and Partners, offer a financial prize to the best group performance.

During week 2, as part of the formal introduction to the module, a presentation is given by the best group from the previous year. This gives an overview of the module content and its aims, together with the experiences of the winning group – what they thought about the experience and some reflections on why they succeeded better than the other groups. After the group presentation a Director from Fairhurst emphasises the importance of the skills that are developed on the module to his company, and the wider civil engineering profession, before presenting them each with a certificate and cheque.

CONCLUSIONS

In the Field and Enterprise Skills module, the development of a wide range of skills is integrated with engineering studies. The module achieves high levels of performance from students. It puts them through an intense experience, in

circumstances that contrast strongly with their normal studies. It is a stressful experience, requiring long working hours: an environment in which natural leaders emerge.

It is seen as an excellent vehicle both for developing skills and for developing understanding and practical experience of surveying and setting out techniques. The approach is considered no less successful in teaching students about surveying than a field course in which aims are solely related to subject content, and yet is considered to be particularly successful in developing skills because of the subject-specific and practical context.

ACKNOWLEDGEMENT

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