A Menu of Graduate Skills – The Specification of Degree Level Skills for Construction and Surveying Students

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Key words: Built Environment Skills Menu, Key Skills, Cognitive Skills, Professional Skills, Performance Indicators, Level Descriptors.

ABSTRACT

This paper discusses research work undertaken at APU to identify and recognise the skills developed by construction and surveying students. Although students do develop a range of skills while studying at university, these are often not formally recorded or recognised. There is a rapidly growing need to formalise and identify these graduate skills. The Quality Assurance Agency (QAA) are currently developing Benchmark statements for construction and surveying students. This work will add to the debate.

From the research work it is proposed to establish a universally accepted menu of undergraduate skills appropriate to both the conventional academic mode of study and the increasingly important work-based learning environment. The focus of the research is the development of a Skills Menu which groups undergraduate competency under the headings of Key Academic Skills, Generic Cognitive Skills, and Personal and Professional Skills (See Appendix I). This menu is then matched against current learning and assessment strategies at APU. The paper concludes by an evaluation of the Skills Menu by academic staff, recent surveying graduates and employers.

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1. BACKGROUND TO BUILT ENVIRONMENT DEGREE LEVEL QUALIFICATIONS

The development of the Built Environment courses at Anglia Polytechnic University (APU) has been informed by the UK National Qualification Framework for Higher Education (Quality Assurance Agency, 2001). This provides a framework for Higher Education in line with the Dearing Report (Dearing, 1997) which describes the student experience in terms of student learning outcomes. These outcomes are categorised in terms of the required:

Knowledge and understanding of specific disciplines (e.g. law)
Key or transferable skills (e.g. communication)
Cognitive skills (evaluation)
Personal skills (managing time)
Professional skills (ethical considerations), and
Practical vocational skills (setting out)

This skills are specified in terms of three distinct levels of study, these are:

Certificate Level C (120 UK credits)
Intermediate level I (120 UK credits)
Honours Level H (120 UK credits)

A full Honours degree at a UK university would consist of a total of 360 credits; typically comprising 120 credits at each level. The challenge for higher education is to specify in detail exactly what these levels imply. This paper endeavours to try to identify the nature of academic levels studied by university undergraduates in terms of both the knowledge and skill required for construction courses.

2. RESEARCH METHODOLOGY

The initial research idea stems from the need to identify the skills that students develop while studying at university. Much of the literature published on this subject discusses the need for key skills such as communication, teamwork and use of information technology, without actually specifying them in any detail. What are these skills and what is the appropriate level of development for construction students? The purpose of this study is to identify in detail the exact nature of developing these skills at university level. A review of potential research methodologies was undertaken. After an initial literature review, the approach has been to undertake a pilot study during the academic year 1999/2000 with selected colleagues at APU

to establish an outline menu of skills that they felt their students needed to develop. This included a list of higher level cognitive skills appropriate to construction students. All construction staff at APU then used a version of the list, detailed in Appendix I, to help them identify skills for their particular modules. They were asked to add any additional skills not shown on the list. Thus the menu evolved over a two-year period to its current state. A discussion paper was then developed to inform the design of built environment courses during 2000/2001. The resulting 'Built Environment Skills Menu' was used as a central aspect of a number of 'Focus Groups' of the employers, students and recent Built Environment graduates, to establish the appropriateness and value of the Menu.

3. THE NATURE OF BUILT ENVIRONMENT QUALIFICATIONS.

Built Environment Pathways should aim to:

1. Deal with ethical, economic, legal, technical, social, environmental and scientific issues in a professional manner.
2. Encompass employment-related skills and requirements preparing students for the workplace.
3. Fulfil the needs of the individual, professional disciplines, and society as a whole.
4. Demonstrate the strong connection between academia and the world of employment.
5. Focus on the process of learning rather than the product, enabling students to develop the ability for life-long-learning.
6. Have a high cognitive content

Construction courses should be designed to ensure that students can demonstrate the ability to:

1. Acquire a sound knowledge of the concepts and principles appropriate to their professional discipline.
2. Acquire a competence in solving problems of a vocational orientation.
3. Select appropriate knowledge, skill and techniques to solve discipline related problems.
4. Adapt and contextualise knowledge, skills and strategies to provide satisfactory outcomes to meet client needs.
5. Distinguish between client wants and needs.
6. Take personal responsibility in a professional context.
7. Employ decision-making skills.
8. Make sound judgements based on available evidence.
9. Judge the value of available evidence, recognising bias and vested interest.
10. Distinguish between, belief, perception and the evidence-based reality.
11. Communicate effectively when dealing with clients and other professionals.
12. Cope with unpredictable circumstances and contradictory information.
13. Engage in critical reflection and learn from experience.
14. Balance technical and human demands.
15. Challenge conventional wisdom and received opinion.

16. Synthesise ideas and create innovative solutions to problems.
17. Think logically and critically to produce well reasoned arguments.
18. Investigate and research a given topic.
19. Formulate research methodologies and strategies in line with aims and objectives.
20. Competently perform their acquired skills in the context of their chosen profession.

From this outline list it is possible to provide additional guidance to students by specifying a Built Environment Skills Menu from which students can select the skills they wish to develop. This menu is also of value to course design teams. The skills menu draws from the work of the Qualification Curriculum Authority (QCA, 2000) on key skills Level 4, the work undertaken by Loughborough University on their RAPID Progress File (Maddocks, 1999), and the Hertfordshire Integrated Learning Project (HILP) (Honeybone, 2000). See Appendix I for details of the menu.

The extent to which students need to demonstrate these particular skills or attributes will depend on their stage of study at degree level. However, it is not a matter of objectively tackling a selected number of these at each stage, all can be addressed to a greater or lesser extent at any level. To use the teamwork example again, it is not the intention that the skills menu is defined at any specific level, but that students can draw on the menu at a level that is determined by the nature of the task and stage of their development.

Built Environment modules at APU (APU, 2001) have been designed using the following structure.

APU Level B - Certificate modules (National Framework Certificate, level C)
APU Level D - Diploma modules (National Framework Intermediate Level I)
APU Level H - Honours Degree modules (National Framework Honours Level H)
APU Level M - Masters modules (National Framework Masters Level M)

These levels can be characterised by the following range of performance indicators and descriptors:

1. The Nature of the Task/Evidence
2. The Balance of Knowledge and Skill
3. The Nature of the Module
4. The Degree of Application and Contextualisation of Knowledge and Skill.
5. The Balance of Ownership and Control

Skill development is an essential part of the subject matter of Built Environment modules. It should form the core activity for teaching, learning and assessment strategies. Problem-based learning and project-oriented vocational work provide ideal opportunities for students to demonstrate the full range of the skills listed in the Built Environment Skills Menu. The following statements give an overall guide to the required level of skill at each stage.

3.1 The Nature of the Task/Evidence

The degree to which students need to achieve the pathway outcomes will depend on the stage they are studying. Figure 1 illustrates the level changes graphically. It must be stressed that these changes in level are relatively small, particularly between B, D and H, in the sense that they all must be achieved at undergraduate level. However, the nature of evidence will change from relatively straightforward and well-established facts at level B, to complex, conflicting and contradictory evidence at level H and M.

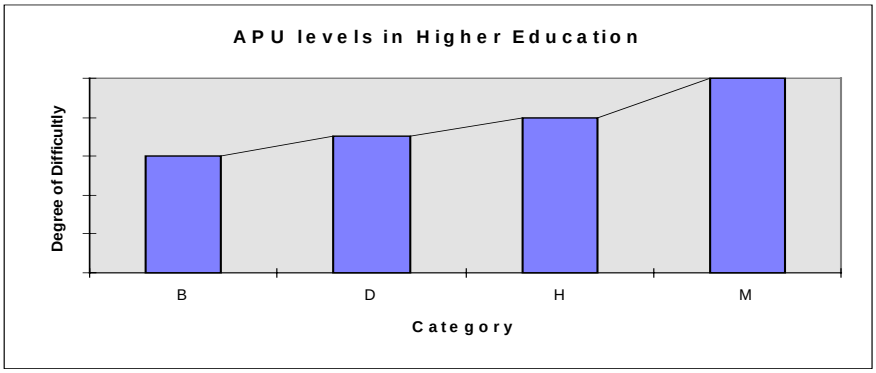

Figure 1 - The Degree of Difficulty of the Task related to APU Levels

At level B students would be expected to demonstrate:

- A level of knowledge of the fundamental facts, concepts and principles within their particular discipline that would enable them to take informed decisions about the nature of the subject.
- An ability to understand the process knowledge of how to perform discipline related tasks that they might be expected to undertake as a junior member of a professional team.

In assessment at level B students would be expected to draw from a body of knowledge to produce a quality of product, that would be fit for internal publication within a construction firm. By way of example, a junior member of staff might have to report to their supervisor and be required to produce a soils report, a report on the condition of a property and its services, detailed technical drawings or sketch plans, or a land survey report. They should also be able to design elements of buildings and measure quantities for estimating purposes.

At level D students would be expected to demonstrate:

- A level of critical understanding of the factual and process knowledge, concepts and principles that would enable them to engage in the decision making process.
- The ability to contextualise and apply their knowledge and skill in new situations within an employment context.

- An appreciation of the limits of their knowledge and how that may influence their judgement.
- A sound knowledge of methods of investigation and enquiry and an ability to evaluate and select the most appropriate method of solving problems.

Assessment at Level D requires students to produce work that would be fit for publication to a client. This may be in the form of a professional report to a client on the energy and environmental performance of existing buildings, or they may be asked to produce design proposals for sustainable architecture

At Level H students would be expected to demonstrate:

- The ability to acquire the level of knowledge and understanding within their discipline that would enable them to perform at a professional level.
- The ability to evaluate the validity of the available information and knowledge.
- The ability to deploy accurately the established techniques and methods of analysis that would enable the graduate to provide a professional service to a client.
- An ability to act as a member of a professional team.
- A quality and quantity of product that goes beyond client minimum requirements, providing evidence of a greater academic depth and width of study.
- An ability to select the most appropriate form of communication to convey their ideas.

Level H continues the professional approach of level D in increasingly more complex scenarios of business, design, and production. Students are expected to give sound advice to clients in an acceptable professional format of their choice. At level H students will be expected to balance client needs with that of the business needs of industry and the wider society as a whole, to provide creative solutions to real or simulated problems.

At Level M students would be expected to demonstrate:

- A comprehensive understanding of the current knowledge and methodologies in their chosen narrow field of study, much of which should be at the forefront of the discipline.
- The ability to explore the boundaries of such knowledge and techniques critically evaluating the validity of the available evidence.
- Originality in the application and contextualisation of their work.
- An appreciation of the limits of their investigation and the ability to critically evaluate current and historical research output.
- An ability to deal with complex issues from a range of perspectives both systematically and creatively.
- A sense of mastery of the subject matter.
- Self-motivation, initiative and a strong degree of personal responsibility.

3.2 The Balance of Knowledge and Skill

The changes in the relative importance of knowledge and skill as students progress through the undergraduate levels of their pathway are illustrated in Figure 2.

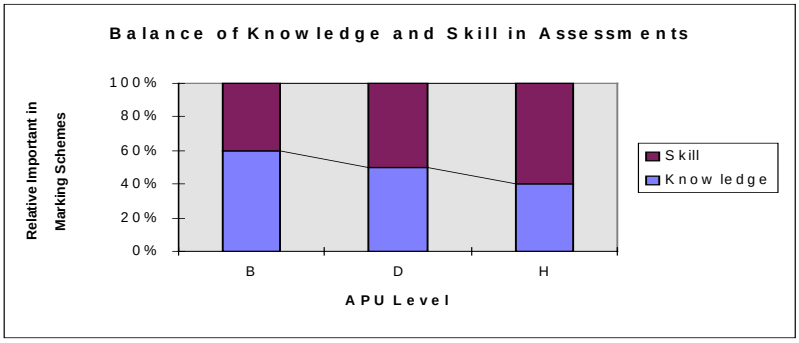

Figure 2 - The balance of Knowledge and Skill

At level B it is important that students gain a good understanding of the fundamental concepts and principles that underpin their discipline. The knowledge should be mainly factual, but students should also encounter the associated process knowledge. For example, they will need to 'know how to' undertake a range of techniques and methods, and the question 'why' should also be explored. This knowledge will represent about 60% of the content of the module. Students also need to be able to demonstrate the skills associated with the module. The remaining 40% of the module therefore can be devoted to the development of skills.

At level D the split should be about 50/50 and at level H, the main focus of the module and the assessment should be on how competent the student is in dealing with the subject matter and evaluating evidence. Thus the ratio will now have shifted to 60% skill and 40% knowledge base. These are not hard and fast rules, as the precise balance between knowledge and skill will vary with the nature of the module.

3.3 The Nature of the Module

Level B modules will tend to contain single aspect subject matter. Students need to begin their study with an understanding of the fundamental concepts of law, management, economics, mathematics, technology, materials and science. These single aspect modules form the basis of the Certificate level B modules. Students may also encounter a limited number of professional related modules to introduce the discipline.

At Diploma level, D modules are introduced to provide a more professional and inter-disciplinary focus. These modules require students to synthesis a range of information to formulate solutions to vocationally orientated problems. They will have to balance the technical, economic, social and environmental issues, when forming sound judgements within specific modules. At level H, students encounter multi-disciplinary modules providing the opportunity to deal with complex real world situations. Students should also be asked to re-

focus on the characteristics of their particular discipline and how they may best serve the needs of potential clients and society.

3.4 The Degree of Application and Contextualisation of Knowledge and Skill.

Level B in this context concentrates on developing the student's knowledge and skill within well-defined problem areas. Figure 3 illustrates that as they progress through level D to level H, students will encounter problems that demand the application of their knowledge and skill in new and unfamiliar situations.

At both level D and H these problems will be increasingly of a vocational and more complex nature. This contextualisation of their knowledge is the key mechanism for the deepening of student understanding.

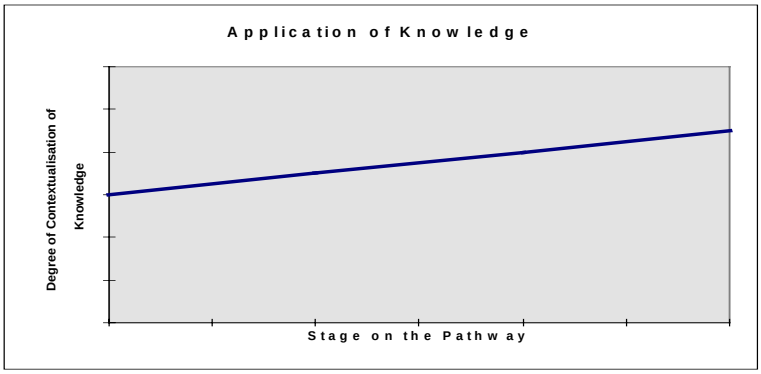

Figure 3 - Application of Knowledge

3.5 The Balance of Ownership and Control

Students are encouraged from the beginning of their studies to take responsibility for their own learning. However at level B, tutors provide a wealth of information and guidance for students to ensure that students have a very clear understanding of the tasks before them. Much of this advice and guidance is provided in module study guides. As students progress the amount of support is reduced. See Figure 4.

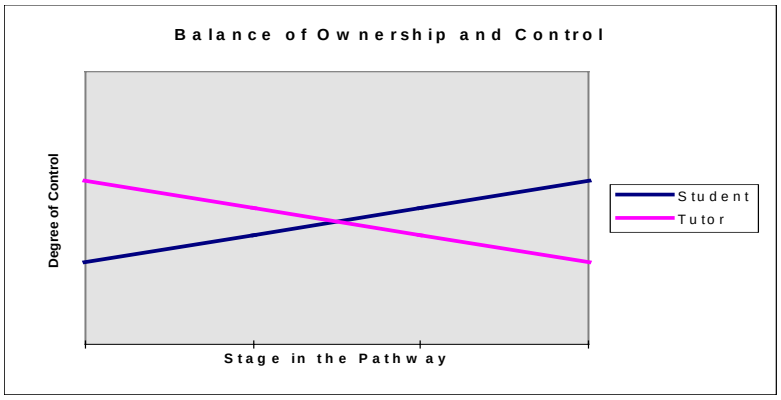

Figure 4 - The Balance of Control

4. EVALUATION OF THE SKILLS MENU

A version of this skills menu was first introduced to built environment academic staff at APU during the academic year 1999/2000. This early version had only six stems to each generic skill. Since then it has been changed and refined by action research to its current stage in line with comments and suggestions from staff. Thus the menu has evolved and will continue to evolve with use. It is a menu that has helped staff identify the skills associated with their particular module. During the following academic year (2000/2001) a version was shown to focus groups of local employers for comment. They were generally supportive of the approach and were particularly interested in the development of the vocational skills of:

- Information technology
- Teamwork, and
- Personal and professional skills.

They were less enthusiastic about the cognitive skills section but this may have been mainly due to a lack of understanding of some of the terms. They were also keen to stress the importance of:

- The use of plain English
- Understanding profit/client needs
- Being commercially aware and customer focused
- Instigating and managing change
- Recognising strengths and weaknesses
- Coaching and developing others
- Solving real work related problems
- Being competent in technical and management aspects

Versions of these skills have now been added to the Skills Menu. Employers also stressed the importance of the skills development occurring in the context of the work place. Indeed it was sometimes very difficult to separate the requirements of academia from the vocational needs of industry. The fact that employers felt that the development of the skills as defined by the Skills Menu was an essential part of any built environment programme was very encouraging.

The next group of people to view the Skills Menu was a focus group of recent APU Built Environment graduates. Although they had not seen the menu while studying at APU it was reassuring to note that they felt that they had developed most of the skills specified. This then begs the question ‘why bother specifying the skills in detail at all, when students seem to acquire them anyway'? It would appear that the nature of the tasks that students encounter while studying at university encourages the development of appropriate skills, even if the academic staff and students are unaware of the exact process. The graduates also indicated that they developed the following additional skills not currently specified on the menu, these were:

- An awareness of the needs and skills of other professional people within the construction industry
- The social skills of interacting with others
- Returning to study skills for mature students or study skills not encountered at school
- Building relationships with people from different backgrounds and cultures

It is encouraging to know that students can develop these additional skills alongside the more academic aspects of their work.

During the academic year 2001/2002, first year students were given a skills booklet based on the skills menu in Appendix I. As they complete their assignments they have been encouraged to select the appropriate skills from the menu to help them with their assessment. Students were asked to monitor their progress on skill development throughout the year, for evaluation. In addition, our work placement students will use the Loughborough RAPID skills management scheme following a pilot programme completed during 1999/2000. An evaluation of the effectiveness of the expanded use of RAPID will be undertaken.

As part of the implementation of the RAPID project (Maddocks 2000), a benchmarking exercise was undertaken at APU to ascertain the current perceptions of selected students on skill development. Two groups of construction students were chosen, Group A from the second year of our BSc programme and Group B, from the final year. These students were asked the following questions:

1. Are you aware of your current strengths and weaknesses in relation to key skills (see appendix 1 for details of skills)?

   83% of group A felt that they were aware of their abilities in the key skills. 75% of group B (final year students) felt that they were aware of their strengths and weaknesses. It is possible that when students reach the final year of the studies they become much more self-critical, and this could explain the fall in apparent awareness. When the survey was undertaken at Loughborough University 92% of cohort said that they were aware/very aware of their strengths and weaknesses in relation to 'key skills'. The higher awareness could be due to the higher profile of skill development work and communication processes at Loughborough. Skills development programmes at Loughborough have been running for a longer period than at APU.

2. Have you undertaken any formal skill development to help you with your studies?

   75% of Group A indicated that they had received no formal help outside their modules and 88% of Group B responded the same. It appears that to a large extent students are left to develop their skills on their own.

3. Have you been formally assessed on skills development during your course of studies?

5. KEY SKILL	6. FORMALLY ASSESSED – GROUP A	7. GROUP B
Communication skills	50%	90%
Numeracy skills	50%	50%
IT skills	70%	63%
Teamworking skills	30%	90%
Learning Skills	25%	25%
Problem-solving skills	40%	38%

The interesting finding with the final year group, is the perception that problem-solving skills are generally not formally assessed. This is a key skill that employers expect graduates to possess. It may be that the students had a very narrow view of what was involved in problem solving.

4. Have you received formal feedback on your competence in the skills identified?

8. KEY SKILL	9. FEEDBACK PROVIDED – GROUP A	10. GROUP B
Communication skills	80%	90%
Numeracy skills	50%	60%
IT skills	60%	60%
Teamworking skills	60%	90%
Learning Skills	50%	40%
Problem-solving skills	60%	50%

It is surprising and disappointing that some APU students perceive that they are not receiving appropriate feedback. The feedback on problem solving skills is particularly disappointing.

11. CONCLUSIONS

- The design of new university programmes needs to be guided by focusing on graduate skills as identified by the Dearing Report.
- Skills specification should also be informed by the QAA National Qualification Framework at certificate , intermediate and honours level.
- The Built Environment Skills Menu is a useful concept. The menu enables students to select specific skills to match tasks undertaken.
- Levels of study and skill can be characterised by performance indicators and descriptors. For example: the nature of the task or subject, the balance of the importance of knowledge and skill, the degree of application and contextualisation of knowledge and skill, and the balance of student/tutor ownership and control.
- The knowledge and skill developed at university needs to meet the requirements of industry.
- The group of built environment students tended to have developed the skills listed in our menu without necessarily being fully aware of the process at the time.

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Appendix 1 - **Built Environment Undergraduate Skills Menu**

Table 1 Key Academic Skills.

Key Skills
1. Communication
1.1 Producing written material in appropriate forms
1.2 Taking part in group discussions
1.3 Making presentations
1.4 Reading and responding to written material
1.5 Summarising text and making concise notes
1.6 Selecting and preparing graphical material
1.7 Receiving and responding to constructive feedback
2. Application of Number
2.1 Collecting, recording & presenting data
2.2 Understanding and interpreting numerical data
2.3 Tackling and solving mathematical problems
2.4 Modelling with mathematics
2.5 Statistically analysing data
2.6 Representing numerical data graphically
3. Information Technology
3.1 Accessing, storing and retrieving information
3.2 Producing and processing information
3.3 Converting data into information
3.4 Communicating through computer technology
3.5 Using construction related software packages
3.6 Using standard office software
4. Learning Strategies
4.1 Identifying learning needs and strategies
4.2 Developing appropriate study techniques
4.3 Developing plans to meet outcomes/targets set
4.4 Utilising a pro-active independent approach to learning
4.5 Engaging in good academic practice
4.6 Reflecting upon a range of learning processes/styles
5. Teamwork - Working With Others
5.1 Contributing to group activity
5.2 Promoting good working relationships
5.3 Identifying and fulfilling responsibilities within a group
5.4 Fostering supportive peer relationships
5.5 Recognising group strengths & weaknesses
5.6 Utilising group strengths & weaknesses
5.7 Criticising the work of others
5.8 Resolving disputes
5.9 Coaching and developing other team members
5.10 Providing team leadership

Table 2. General Cognitive Skills.

Generic Cognitive Skills
6. Intellectual (thinking) Skills
6.1 Assimilating, memorising and recalling knowledge
6.2 Contextualising knowledge to demonstrate understanding
6.3 Analysing problems
6.4 Solving problems
6.5 Making informed judgements based on evidence
6.6 Developing sound, well reasoned arguments
6.7 Engaging in critical verbal reasoning
6.8 Judging the value of the available evidence
6.9 Modelling complex real world problems
6.10 Evaluating conceptual ideas
6.11 Creating conceptual ideas
6.12 Utilising appropriate investigative & research methodologies
6.13 Questioning current theories and practice
6.14 Developing creative and innovative solutions

Table 3. Personal and Professional Skills.

Personal/Professional Skills
7. Self Management
7.1 Managing time effectively
7.2 Managing stress
7.3 Reflecting on past experience
7.4 Recognising personal strengths & weaknesses
7.5 Managing personal development
8. Interacting with Others
8.1 Negotiating
8.2 Persuading & motivating others
8.3 Utilising a professional, multi-disciplinary approach
8.4 Providing Leadership
8.5 Managing people
9. Organisational Management
9.1 Managing information and processes
9.2 Co-ordinating resources
9.3 Instigating change
9.4 Managing change
10. Professional Awareness
10.1 Acting in an ethical manner
10.2 Providing quality of process/product/service
10.3 Balancing client and commercial needs
10.4 Awareness of value for money
10.5 Considering health and safety issues
10.6 Awareness of environmental issues