THE SHAPE OF INFORMATICS: A UK PERSPECTIVE

Su White
Electronics and Computer Science,
University of Southampton
Southampton, UK
+44(0)23 8059 4471
http://www.ecs.soton.ac.uk/~saw/

Alastair D. Irons
School of Computing, Engineering and Information Sciences
University of Northumbria
Newcastle upon Tyne, UK
+44(0)191 227 3603
alastair.irons@northumbria.ac.uk

ABSTRACT

The term Informatics is not widely used in UK Higher Education. Computing, Computer Science and Information Science are more commonly used descriptors and many other variations exist. Approximately five percent of departments concerned with the discipline actually use the word Informatics in their title, whilst UCAS, the UK organisation which centrally manages university undergraduate applications, does not include Informatics in its subject index.

However the various fields of study encompassed by the European instantiations of the Informatics discipline are widely researched, taught and studied throughout UK Higher Education. If we are to successfully pursue international collaboration, then understanding the realisation of the discipline in the UK and how it relates to understanding in other countries, is important and necessary to support constructive future discussion, planning and action.

This paper presents data collected via surveys of existing practice, individual interviews and group discussions. It offers an analysis of current practice alongside speculation as to the future direction of our fields of study in the short and medium term.

Keywords

Computers and education, Informatics education, Curriculum design.

1. INTRODUCTION

The data used for this paper was collected during 2006. Part of the data was collected through interviews conducted as part of an initiative in the UK to identify agendas for change in Information and Computer Science Education. The initiative was working to establish and build collaboration between departments in the discipline across seventeen institutions in the South of England and the wider UK Information Science and Computer Science communities. It was funded by the UK Higher Education Academy Subject Centre for Information and Computer Sciences (HEA-ICS)[1].

Further data was collected via a survey and workshop discussions with academics drawn from across the UK who are active in the ICS education community. Information has also been drawn from The Council of Professors and Heads of Computing (CPHC)[2], and from statistics gathered using official sources in the public domain including the Universities and Colleges Admissions Service (UCAS)[3] and the Higher Education Statistics Agency (HESA)[4].

2. CONTEXT AND TERMINOLOGY

Practitioners in UK academic departments concerned with education in computer science, computing and its allied subjects and fields of study soon learn that their European counterparts are likely to be based in a department or faculty of Informatics (spelt appropriately for their local languages). However such practitioners might be hard pressed to provide a clear and detailed explanation of how the curriculum and its associated student learning activities and outcomes differ across Europe.

Turning to an encyclopaedia definition of informatics [3] we find that, "Informatics is the science of information. It studies the representation, processing, and communication of information in natural and artificial systems. Since computers, individuals and organizations all process

[1] Higher Education Academy Subject Centre for Information and Computer Science (HEA-ICS) http:// www.ics.heacademy.ac.uk/

[2] The Council of Professors and Heads of Computing (CPHC) http://www.cphc.ac.uk

[3] Universities and Colleges Admissions Service (UCAS) http://www.ucas.ac.uk/

[4] Higher Education Statistics Agency (HESA) http://www.hesa.ac.uk/

information, informatics has computational, cognitive and social aspects. Used as a compound, in conjunction with the name of a discipline, as in medical informatics, bio-informatics, etc., it denotes the specialization of informatics to the management and processing of data, information and knowledge in the named discipline".

Academics recognise that what we teach in the UK falls within these parameters, and yet we will also understand that this is not quite all that we do. Definitions with more direct links to university curricula are perhaps more acceptable.

There are a number of official sources outside the UK which can be used to provide a useful frame of reference, work has been done by UNESCO (United Nations Educational, Scientific and Cultural Organization), IFIP (the International Foundation of Information Processing) and the ACM (Association for Computing Machinery) each has provided a definition of subjects which fall within the area. UNESCO's framework for an informatics curriculum developed jointly with IFIP in 2000 states that informatics refers to "a diverse, yet related family of domains".

The list includes including computing, computer science, computer engineering, information systems, management information systems, computer information systems, software engineering, artificial intelligence or AI, information technology or IT, information and communication technology or ICT [7]. The UNESCO curriculum was to some extent motivated by recognition of the international importance of Informatics. Alongside the range of sub fields within the discipline, it suggests that we might simply equate informatics with computing science. This has clear similarities with the domains identified for the ACM Computing Curriculum, computer engineering, computer science, information science, information systems, information technology, software engineering [9]. The curriculum is collaboratively developed and has included involvement from the UK, and some UK institutions develop their curriculum with reference to the ACM standards.

In the UK the official subject categorisations are defined by a set of codes which are used for statistical analysis, determining bands of funding and as a means of identifying like groups of teaching interests for quality assurance purposes. The categories defined by these codes are as follows computer science, information systems, software engineering, artificial intelligence, others in computing sciences, and others in mathematical & computing sciences. At a national level the whole of the subject area is also sometimes referred to as Information and Computing Sciences (ICS). This naming convention is associated with academic and educational development initiatives which take place under the auspices of the Higher Education Academy (HEA).

Figure 1 below has drawn together these understandings and is designed to illustrate ways in which informatics is realised in the UK.

	degree names	**example specialisms**	**broad areas typical faculty groupings**	
continuum continuum continuum	computer engineering	digital systems	engineering	**continuum continuum continuum**
	software engineering	Internet computing		
	computer science			
	computing	artificial intelligence	science and maths	
	information science	computer games technology		
	information systems			
	information and communication technology (ICT)	computer forensics	social science and business studies	
	information technology (IT)	web technologies		
	information management	e-commerce		

Figure 1 – Informatics in the UK

The actual organisation of taught programmes is discussed in greater detail in section three below, however as is common in our subject, we need to contend with de facto standards alongside agreed and published standards. What we understand to be the domain for study is necessarily determined by the names which are used to describe and market our taught programmes. In the UK undergraduate and taught masters courses range from heavily theoretical computer science, through to more vocational and application oriented courses in computing. Computer science courses are typically those which have a core scientific/technical foundation, and late stage specialisms which may be closely aligned to relatively current research agendas in the discipline. Course titles and module content may also be chosen which have names likely to be recognised by students, or perhaps appeal to them in a marketing sense. During the late 20th century there emerged numerous variations on multimedia degrees, whilst in the UK today specialisms which have emerged include interactive computer entertainment, computer games technology, forensic computing, web technologies and e-commerce.

3. EXISTING PRACTICE

Existing practice can be determined by identifying and analysing the range of degrees offered, the relative popularity of the offers and the actual curriculum areas offered for study.

3.1 Types of programme

As implied in section two there is a wide range of variation across UK institutions in terms of the balance between theoretical, formal and practical approaches. The style of programmes offered by different institutions can be roughly cast across four dimensions; accredited/non accredited and classical or modern. Many programmes fall within boundaries determined to some extent by the accreditation of professional and statutory bodies. In the UK these bodies are the British Computing Society (BCS) and the recently constituted Institution of Engineering and Technology (IET), previously the Institution of Electrical Engineers (IEE). Courses of study include many programmes which might be considered "classical" and thus relatively theoretical in UK terms but which may be more practical than many of their European counterparts. Some UK programmes are more contemporary or modern are also often multidisciplinary. Such programmes may also have clear vocational intentions, for instance, including work placements as an explicit requirement of the programme.

The curricula which have been considered include:

- two year foundation degrees, a relatively new and small offering;
- three year undergraduate degrees (BA and BSc, BEng), the most frequently occurring;
- four year undergraduate masters degrees (MEng);
- one year post-graduate masters degrees (MSc).

In addition, the ICS area as a whole is one which experiences frequent changes, necessitating a fast moving curriculum which tries to keep apace of technological advances. However, popularity of the subject area has changed over time; currently student numbers appear to be declining. As a consequence, ways of increasing the appeal of our subject areas to potential students has become a regular subject for academic discussion. Furthermore, a number of disciplines within the field have been included in the group of subjects which have been nationally identified as being "strategic and vulnerable" [4]. These additional factors may have major implications for the focus and content of programmes of study within our subject area both in the near and distant future.

3.2 Student numbers and choices

In the academic year 2004-05 there were a total of 132,580 recorded by HESA within the computing and related discipline areas[5]. This figure covers all undergraduate and postgraduate students, and both full and part time mode of study.

Using the UCAS course descriptions for 2007 as a guide, it is possible to gain some indication of the relative distribution of study areas, although the numbers should not be taken as definitive since there are many overlaps. However they can be used as an indication of the way in which computing and related areas are presented to would be students. The largest number of courses within the discipline area are found under the computing heading, information studies and information science are less numerous, Information Technology is least numerous. Most students study single honours degrees, and UK higher education continues the tradition of high levels of specialisms which is begun in secondary schooling. A small number of students take joint honours degrees, and a small number of universities offer modular degrees where students choose a range of subjects rather than studying a specifically designed coherent programme.

According to the UCAS undergraduate level information for 2007 one institution in the UK offers "Computing Informatics" as a BSc degree, another has "Web Informatics", it is possible to take "Informatics with a Foundation Year" and just one University offers simply Informatics BSc. A few other universities offer Health Informatics, Music Informatics, Physics and Chemistry with Informatics; one Scottish university offers a range of arts and humanities subjects with an informatics core. However, this is just a small proportion of the 91 institutions whose computing degrees are accredited by British Computer Society in UK. No accounts or analysis of these experiences have yet been published in the UK, although an interesting account of the introduction of an informatics curriculum has arisen from some work at Irvine in the US [5].

3.3 Sources of Change

The Higher Education Academy for Information and Computing Sciences supports educational and staff development across the subject area. The centre has identified priorities in Policy, Curriculum Development and Learning and Teaching. The latter is concerned with issues associated with a wide area encompassing activities such as pedagogic research, classroom methods and management,

[5] http://www.hesa.ac.uk subject areas covered computer science, information systems, software engineering, artificial intelligence, others in computing sciences, and others in mathematical & computing sciences.

and understanding and enhancing student learning. The centre's work is wide ranging, designed to create an information and activity hub for an active community of academics engaged with these matters.

The name which is given to the subject area has been much discussed by senior academics in computing. The Council of Heads and Professors of Computing (CPHC) is the subject body for university computing in the United Kingdom. It exists to promote public education in computing and its applications and to provide a forum for those responsible for management and research in university computing departments. Members of CPHC actively discuss ways of taking the discipline forward, ensuring its sustainability and continuity and ensuring that the discipline contributes to the greater good of science and society. The role and future of informatics education is also a key agenda for the CPHC's Learning Development Group (LDG). The group aims to address strategic pedagogic issues in the domain of informatics. The LDG promotes the identification and discussion of strategic learning and teaching issues in informatics and identifies and shares good pedagogic practice in the informatics community. They seek to support academics and practitioners in learning and teaching activities by focussing on the strategic management of learning and teaching issues and innovations.

CPHC is concerned about the image of computing and computer science and as such has debated ways in which to make the subject interesting to potential students, challenging to existing students and stimulating for those who wish to pursue a career in computing. Despite the ubiquity of computing there are serious problems about how the discipline is perceived by the public and by potential students. Many students study ICT at school and think that because they can play computer games, create a spreadsheet or design a PowerPoint presentation they know all there is to know about computing and will not benefit from studying the subject at university. It is incumbent upon CPHC as guardians of the subject to promote the positive, interesting and relevant aspects of the subject. The debates about what constitutes the subject and what is important in the subject continue to take place.

3.4 Academics' Perspectives

Data collected through interviews with colleagues and during workshop sessions at the HEA-ICS 2006 conference have been used to identify some of the matters which are considered to be important to academics. The data has been clustered under three areas of Curriculum, Policy and Learning and Teaching. The items are presented below.

3.4.1 CURRICULUM

Some academics express a concern that their teaching is "over burdened with Computer Science theory". It was pointed out that our curriculum spans Computer Science, Information Technology, Multimedia, Library and Information Science, Information Sciences, Electronic Publishing and Knowledge Management. Further discussion would probably extend this list. External expectations were an issue "How do we achieve and appropriate balance between education and training?" There were related concerns about the administrative demands caused by the need to maintain quality standards. Finally returning to content, one question frequently raised was "What is the role of programming in curriculum?"

3.4.2 Policy

Many policy issues were raised. Key areas of concern were related to declining student numbers and an imbalance in the proportion of male and female students, and a similar imbalance in the gender distribution of academic staff. Associated issues included enhancing the public reputation of the discipline. Colleagues were concerned to improve school liaison and to increase recruitment levels. In matters of the perception of the discipline, colleagues were concerned that the school experience of ICT mislead students' understanding of the content which university students study and the skills, knowledge and understanding which are gained and developed by undergraduates.

3.4.3 Learning and Teaching

Issues associated with the need to deal with student plagiarism can be considered from both a policy and teaching and learning perspective. Issues which colleagues raised included "How do students go about learning, and how do we engage students more?" Colleagues pointed to the need to "Think beyond assessments" and to focus on "project work and integrated assessment. Associated this was a concern to identify "The relationship between student learning and feedback." In terms of classroom techniques colleagues asked "What techniques are most appropriate for which topics?" and "How can we exploit and understand new and emerging technologies?" Environmental factors raised included a demand for "Rethinking physical learning environment", and "understanding the relationship between the physical environment and motivation of students".

4. CURRICULUM COMPONENTS

Although the analysis of the UK experience of informatics starts from the curriculum, it is important to take into account the related factors of organization, student experience and context. Figure 1 below, summarises the extent and interrelationship of the various components of the curriculum and field of study.

The framework has four distinct areas; 1) Course Content; 2) Course Organisation; 3) Student Experience; 4) Context. The framework laid down in the diagram can be used to analyse current practice by considering activities in relation to the four components. This content analysis can complement analysis of programmes classified within the framework of accredited/non accredited and classical or modern.

<table>
<tr><td>Course Content</td><td colspan="3">Curriculum
(tracks technology and research)
may be constrained by accreditation
may be driven by market forces
may be influenced by other stakeholders</td><td>Course Content</td></tr>
<tr><td>Course Organisation</td><td colspan="3">Degrees->modules
modes of study</td><td>Course Organisation</td></tr>
<tr><td rowspan="2">Student Experience</td><td>Before Study
↓</td><td>During Study
↓</td><td>After Study
↓</td><td rowspan="2">Student Experience</td></tr>
<tr><td>Perceptions</td><td>Methods and Mechanisms to enable learning</td><td>Application and Use</td></tr>
<tr><td>Contexts</td><td colspan="3">Local Factors
National Agendas</td><td>Contexts</td></tr>
</table>

Figure 2 components of the field of study

Consideration of the way in which factors which exist at each level are driving change and determining the relationship between the classic core and the modern derivatives can help elaborate an understanding of UK experience. Further analysis of contexts and the perceived needs within the area of student experience can be used to suggest which drivers for change are most likely to have the greatest impact, and thus the likely nature of change in the short and medium term.

There is significant existing work which maps the informatics curriculum some has been from a general educational perspective, some have also had a particular agenda to consider the use of new technologies for teaching [6]. Explorations of Informatics resulting from work done for UNESCO have been published by Mulder and van Weert [7, 8, 11]. Figure three below shows the contents on their proposed informatics curriculum.

1	Representation of information
2	Formalism in information processing
3	Information modelling
4	Algorithmics
5	System design
6	Software development
7	Potentials and limitations of computing and related technologies
8	Computer systems and architectures
9	Computer-based communication
10	Social and ethical implications
11	Personal and interpersonal skills
12	Broader perspectives and context (includes links with other disciplines)

Figure 3 – a proposed informatics curriculum [7]

5. Some Possible Futures

Debate sometimes exposes the tensions which come from the twin perspectives of research and teaching. The name given to the discipline is pulled at the extreme between the extent to which it can encompass the research interests of academics against the extent is communicates meaningfully to would be undergraduate and taught post graduate students. Such discussion also turns on consideration of the future of the discipline in face of falling student numbers and perhaps therefore an associated decrease in departmental size. Such factors ensure a regular return to this topic of sometimes heated discussion. It is interesting to note that in the UK greater use is made of the term informatics when it refers to research groups, and academic endeavour than in the taught curriculum.

One perspective sometimes given consideration is that the future of the discipline may be predicted by the plethora of informatics studies in other which began in the science area, but is extending across technology, social science and arts and humanities. Large national and international projects have caught the imagination of researchers and public alike. Blends of informatics seem endless; arts and media informatics, bio informatics, construction informatics, forensic informatics, health informatics, humanities informatics, medical informatics, music informatics, social informatics, social and business informatics and veterinary informatics can all be studied at UK universities. Perhaps the future for our discipline may be in multi-disciplinary, informatics where the most significant part of informatics is as part of the fabric of multidisciplinary studies, leaving a small core to study the discipline in its own right much in the way that maths exists.

At the same time we may see the emergence, or perhaps evolution of a new science to supersede computer science. An unprecedented change in our information processing practices has resulted from the introduction and use of the World Wide Web. Refinements to the web, the increasing use of semantics and the everyday applications of web two are being accompanied by technological developments which are in turn educating successive generations as a by product of social practice. Activities such as tagging pictures captured on a mobile phone and then blogging and tagging the surrounding narrative can demonstrate one aspect of informal learning (introducing meta data and associated concepts). In effect technology for some is so pervasive that it will inevitably impact on their interpretation of the world, and if they are scientists and engineers it will also impact on their educational expectations and needs.

6. CONCLUSIONS, REFLECTIONS AND FUTURE WORK

The development and evolution of informatics as a research area promises some sort of future for the discipline, even if we cannot accurately predict the details of that future. These changes will necessarily impact on university level education. Increasing pan European collaborations in research need to be complemented by educational collaborations. This trend can only be accelerated by the demands of administrative changes brought about by activities such as the Bologna agreement. In the area of computer science educational research the potential gains of collaborative working and learning are being demonstrated by activities such as the Disciplinary Commons [2, 10]. These activities are acknowledged to have impact beyond the scope of the original project domain in terms of information sharing and understandings of practice

Much work remains to be done in this area if we are to build up a realistic pan European picture of the current shape of informatics. This discussion could be considerably enhanced by a detailed knowledge of the actual numbers of students studying the different types of computing degrees. CPHC could play a useful role in gaining this data. With the help of some international collaboration it might then be possible to go forward and gain a deeper insight into the undergraduate experience, both in terms of nature of the degree and relative distribution of core and specialist study areas. If researchers are successful in establishing a “Science of the Web” [1] and thereby clarify the research domains which are determining the syllabi we use in Informatics Education, then it is likely that we will be working full tilt to modify our programmes and tailor our curriculum to equip our students to be the researchers and informed decision makers of the future. That said we need to be beginning to design the future form of informatics which we desire right now.

7. REFERENCES

[1] Berners-Lee, T., Hall, W., Hendler, J., Shadbolt, N., Weitzner, D.J., Creating a Science of the Web. Science 11 August 2006 313:5788 (2006) 769 - 771

[2] Fincher, S., Lister, R., Pears, A., Sheard, J., Tenenberg, J., Young, A., Multi-Institutional Teaching Communities in Computer Education.

[3] Fourman, M., Informatics. In: Feather, J., Sturges, P. (eds.): International Encyclopaedia of Information and Library Science. Routledge (2002) extended version at http://publish.inf.ed.ac.uk/publications/online/0139.pdf

[4] HEFCE, The Roberts Report on Strategically Important and Vulnerable Subjects: HEFCE 24/05. Higher Education Funding Council for England, Bristol (2005)

[5] Kay, D.G., van der Hoek, A., Richardson, D.J., Informatics: A Focus on Computer Science in Context. Proceedings of the 36th SIGCSE technical symposium on Computer science education (2005) 551-555

[6] Montgomery, T., Informatics Knowledge Mapping and Curriculum Design: A Clear Role for IFIP and UNESCO. Teleteaching’98: Distance Learning, Training & Education Proceedings of the XV IFIP World Computer Congress (1998) 747–758

[7] Mulder, F., van Weert, T., IFIP/UNESCO's Informatics Curriculum Framework 2000 for Higher Education. UNESCO, Paris (2000)

[8] Mulder, F., van Weert, T., Informatics Curriculum Framework 2000 for Higher Education. Proceedings of Conference on Educational Uses of information and Communication Technologies, pp151-156, at 16th World Computer Congress, Beijing, August (2000) 21-25

[9] Shackelford, R., McGettrick, A., Sloan, R., Topi, H., Davies, G., Kamali, R., Cross, J., Impagliazzo, J., LeBlanc, R., Lunt, B., Computing Curricula 2005: The Overview Report. ACM SIGCSE Bulletin 38:1 (2006) 456-457

[10] Tenenberg, J., Wang, Q., Using Course Portfolios to Create a Disciplinary Commons across Institutions. Journal of Computing Sciences in Colleges 21:1 (2005) 142-149

[11] van Weert, T.J., Mulder, F., Modern Curriculum Development for Informatics (Computing Science). Proceedings of the IFIP TC3/WG3. 1&3. 2 Open Conference on Informatics and The Digital Society: Social, Ethical and Cognitive Issues on Informatics and ICT (2002) 285-296