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Abstract

This paper describes a process for determining the coverage of the generic attributes of graduates in the major curriculum documents IS'97 and ISCC'99. IS'97 is used as an example of the application of the methodology. The broader application of the methodology is in its replication to the programs of study offered at a tertiary institution and its comparison to international curriculum documents such as IS'97, ISCC'99 or the Australian Computer Society Core Body of Knowledge. A significant finding is the need for curriculum writers to explicitly state, in the curriculum documentation, how they will empower students to gain the identified generic attributes.

Introduction

Anecdotal evidence from Information Systems (IS) industry interviews and a study by Turner and Lowry (1999) suggest that tertiary curricula in IS do not meet the needs of industry; a situation that is likely to be mirrored in other disciplines. Educators of future professionals should be able to identify the depth of treatment given to the competencies of graduates, both required and desired by employers and professional bodies with specific reference to the discipline studied. This strengthens the role of universities, as a provider of professional education by aligning professional education with industry needs. This paper proposes a methodology that will allow the continual evaluation of the coverage of the generic capabilities within a specific program of study. The methodology involves the mapping of the generic attributes against the unit objectives to determine the depth of treatment given a set of generic attributes within a specific curriculum document. The Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems (IS'97) will be used to illustrate the methodology. The methodology may be also applied to identify the depth of treatment of the generic attributes as expressed in the Australian Computer Society Core Body of Knowledge (Underwood, 1996). The generic attributes selected for investigation have been identified and validated in related studies (Snoke and Underwood, 1998a; 1998b; 1999; 2000; 2001a; 2001b).

Aim and Significance of the Study

The aim of the study reported here is to illustrate a methodology for comparison of the interests of different stakeholders in IS curricula in relation to preferred generic capabilities. The study will be used to develop a technique for developing a more responsive tertiary curriculum that meets the needs of industry. Such a technique will enable institutions and curriculum developers to map their curriculum offerings against the requirements of professional associations to identify strengths and weaknesses in their curriculum. Consequently, they will be able to offer a curriculum that is more responsive to the local employment market.

Context

The phrase ***generic attributes*** is used to describe a core set of abilities and characteristics of an individual. It has many meanings, interpretations and synonyms such as generic skills, basic skills, qualities, knowledge and understanding and competencies (Moss and Liang, 1990; Stasz, McArthur, Ramsay and Lewis, 1993; Crebert, 1995; Doyle, 1996; Bradley, 1997).

The literature often refers to the concept of generic attributes as generic skills or competencies. Competencies may be defined as consisting of skills, attributes or abilities and understanding or knowledge. Understanding or knowledge is defined as the content or core body knowledge of a subject discipline that a person has acquired. Skills are the routine implementation of the acquired knowledge or attributes or capabilities. Attributes or abilities are the personal qualities that are applied by an individual to a specific task under a given situation.

The major IS curriculum documents IS'97 (Davis, Gorgone, Couger, Feinstein and Longenecker, 1997) and ISCC'99 (Lidtke, Stokes, Haines and Mulder, 1999) use the term generic attributes or competencies to be statements of content knowledge that the individual will possess at the end of a program of study. The generic attributes identified in IS'97 and ISCC'99 are shown in table 1.

Table 1. Curriculum Document Generic Attributes

IS'97 Exit Attributes	Attributes of an ISCC'99 Graduate
Communication	Personal Skills
Computer applications systems	Systemic-thinking skills
Information Technology and Tools	Problem-solving skills
Interpersonal Relationships	Critical-thinking skills
Management	Risk-taking skills
Problem Solving	Personal-discipline skills
Systems Development Methodologies	Persistence
Systems theory and Concepts	Curiosity
Professionalism	Interpersonal Skills
	Collaborative skills
	Communication skills (oral, written, listening, and group)
	Conflict resolution skills
	Technical Knowledge and Skills
	Information abstraction, representation, and organization
	Enterprise computing architectures and delivery systems
	Concepts of information and systems distribution
	Human behaviour and computer interaction
	Dynamics of change
	Process management and systems development
	Some Information Systems domain knowledge
	Use of computing tools to apply knowledge

These statements or attributes are much generalised descriptions of content or themes that a person should explore during the course of their education within the IS field.

To the authors' knowledge this study is unique, however there have been numerous studies conducted in other countries that identify the skill shortage of the IS profession. There exists much discussion as to the meaning of the terms competency, competent and competencies. A person by definition is defined to possess competencies if they are competent at a specified task under a given set of conditions on a specific date. The possession of a set of competencies does not necessarily imply that a person is competent at any task. Therefore a task of educators is to identify a minimalist set of qualities or competencies that will enable a graduate of an IS course to obtain employment. This paper equates generic competencies to generic attributes that a graduate possesses upon completion of their degree. They include the exit statements of competence but are not limited to these content related attributes.

Research Method

This study adapted an existing methodology used by MacDonald and Swearingen (1990) in their study of the coverage of the key issues in Management Information Systems (MIS) courses. The MacDonald methodology modified for this study consists of four steps: (1) identify the generic attributes of graduates, (2) select the texts used in the program of study, (3) analyse the texts with regards to the coverage of the generic attributes using the objectives from the texts set for the units within the programs of study, and (4) count of the number of generic competencies that are covered by each objective.

Step one involved an extensive Delphi study of both academics and industry representatives.

Step two involved the listing of the prescribed texts for each of the courses within the program of study.

Step three involved an analysis of the words listed in the objectives for each chapter of the prescribed texts used for the units of study, to provide a description of the IS discipline. This list of key words obtained from the prescribed texts was expanded with the addition of the Barki, Rivard and Talbot's Information System Keyword Classification Scheme (Barki, Rivard and Talbot, 1988) and used to describe the IS discipline.

Step four involved the mapping of the unit objectives against the generic attributes. This mapping process involved the use of the above-mentioned keyword lists from the unit objectives and a similar keyword list based on the generic attributes. A count of the number of times an objective referred to a generic attribute provided a numeric score that indicated its depth of treatment of the attribute within the course.

This mapping was validated by means of interviews with the lecturers who wrote the study guides from which the information was taken. 20 percent of the lecturers were interviewed and asked to validate the mapping of the objectives against the attributes. This was then tallied to give a relative indicator of the depth of treatment of each of the attributes within the program of study. These totals were mapped using a Kiviat chart for each course.

Worked Example of the Mapping Methodology

The following is an example of the methodology as applied to the unit IS'97.1, **Fundamentals of Information Systems** in IS'97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems (Davis et al., 1997)**.**

Step 1: Identify the keywords from the objectives, content description and assessment sections of the course unit outline. The unit objectives are listed in Appendix A. The keywords from the objectives are listed in Table 2.

Table 2. Unit Objectives Keywords

Explain	IS management	Concepts of implementing IS
Quality concepts	Ethical	Telecommunications career paths
Systems Theory	Legal	Individual decision making
ISO9000	Ethics	Elements of hardware
Empowerment	Goal setting	

From the content description and explanation and expectations section of the curriculum document, additional keywords are identified and added to the words identified from the objectives. These are listed in Table 3.

Table 3. Additional Unit Keywords

Timeliness
Programming languages
IS professionals
Interpersonal communication skills

Table 4 provides a combined list of key words from the objectives and the content and assessment sections of the unit outline.

Table 4. Course Unit Outline Keywords

Explain	IS management	Concepts of implementing IS
Quality concepts	Ethical	Telecommunications career paths
Systems Theory	Legal	Individual decision making
ISO9000	Ethics	Elements of hardware
Empowerment	Goal setting	Interpersonal communication skills
Timeliness	IS professionals	Programming languages

No specific texts are recommended for this unit. The methodology takes into account the recommended text by identifying the keywords at the beginning of each chapter.

The above criteria keywords are now expanded using a thesaurus developed from computer dictionaries, Barki-Rivard Keyword Classification Scheme for IS Research Literature (Barki et al., 1988; Barki, Rivard and Talbot, 1993) and the texts identified in the course unit outline to give the following list of words which will be used in the matching of the objectives against the attributes. This list is then validated via an interview with the presenter of the unit. Table 5 contains the expanded keyword list for this unit.

Table 5. Expanded Keywords List

Explain	IS management	Concepts of implementing IS
Quality concepts	Ethical	Telecommunications career paths
Systems Theory	Legal	Individual decision making
ISO9000	Ethics	Elements of hardware
Empowerment	Goal setting	Interpersonal communication skills
Timeliness	IS professionals	Programming languages
Organisational processes	Organisational dynamics	Organisational use of IS

Step 2: Identify the keywords from the generic attributes as identified by the industry and academic representatives that employ graduates from the courses. This was done by using the words from within the phrasing of the generic competency. Appendix B gives a sample of the keywords identified from the generic attributes for the attribute of written communications.

A similar process was performed to identify the keywords that would describe the information systems discipline in terms of content and other related topics. A list of words was compiled from Barki, Rivard and Talbot's **An Information System Keyword Classification Scheme** (Barki et al., 1988) as listed in the objectives for each chapter of the prescribed texts used for the units of study within the IS curriculum from the participating universities. These keywords were then used as search words within the texts that are used in the courses (MacDonald and Swearingen, 1990). The list of words from the texts became the vehicle for comparison with a second list compiled in a similar manner but based on the unit objectives as listed in the unit outlines. This will give a numeric value of the depth of treatment of the attribute within the course.

Step 3: Match the keywords from the objectives against the attributes.

The above keywords are now matched against the attributes to identify, which attributes actually relate explicitly in addition to those that have an implied relationship. This is shown in Table 6. Attribute numbers refer to the order in which the attribute was listed on the original Delphi study and does not indicate any importance or lack of importance of the attribute. Refer to Appendix B for a list of the attributes.

Table 6. Objectives and related Generic Attributes in IS'97.1, Fundamentals of Information Systems

IS'97.1, Fundamentals of Information Systems	Attribute Number
Explain systems theory and quality concepts	1, 22, 23
Explain methodologies to facilitate measurements to achievement of ISO 9000, Baldridge, National Performance Review and other quality standards	1, 8, 22, 23
Explain the elements and functional relationships of major hardware, software, and communications elements of information systems consisting of single PCs, LANs and/or WANs	1, 4, 22, 23
Explain the concepts of implementing IS coupled to re-engineering and continuous improvement	1, 22, 23
Explain the relevance of IS management aligning itself with strategic organizational processes	1, 22, 23, 12, 13
Discuss and explain the concepts of goal setting and individual decision making and achievement; explain the requirement of goal setting and personal decision making in empowerment in a work setting	14, 15, 16, 22, 23
Identify and explain telecommunications careers and career paths	25, 22, 23
Use professional code of ethics to evaluate specific IS actions	18
Describe ethical and legal issues; discuss and explain ethical considerations of software usage, sales, distribution, operation and maintenance	18, 22, 23

This step is repeated for each unit within the curriculum document.

Step 4: Count the number of times that the generic attribute is covered in all units within the program of study and plot this on a Kiviat chart as illustrated in Figure 1.

The result of the count of the generic attribute coverage for IS'97 is shown in Table 7.

Table 7. Objectives that relate to the Generic Attributes in IS'97

	Attributes	Total	Percentage
1	IS Knowledge	157	19.05%
2	Technologically Competent	74	8.98%
3	Reference Discipline Knowledge	27	3.28%
4	Related Discipline Knowledge	22	2.67%
5	Retrieve, evaluate, use information	4	< 1%
6	Define problems	15	1.82%
7	Analyse and evaluate solutions	19	2.31%
8	Quality of the solution	14	1.70%
9	Programming Language Knowledge	7	< 1%
10	Continued learning and intellectual development	3	< 1%
11	Time management skills	4	< 1%
12	Business operations, structured and orientation	3	< 1%
13	Profit motive of business	3	< 1%
14	Reflect on own strengths and weaknesses	3	< 1%
15	Ability to learn independently	2	< 1%
16	Self motivation	1	< 1%
17	Work independently	9	1.09%
18	Ethics	17	2.06%
19	Sensitivity to gender, culture and customs	4	< 1%
20	Curiosity About Technology	0	0.00%
21	Work as part of a team	16	1.94%
22	Written communication skills	194	23.54%
23	Oral communication skills	187	22.69%
24	Research skills	2	< 1%
25	Professional Development	1	< 1%
26	Embrace Change	4	< 1%
27	Interpersonal skills	8	< 1%
28	Operate in diverse environments	4	< 1%
29	Project Management Skills	20	2.43%
	Total number of objectives	824	

The process is repeated for the ISCC'99 curriculum document. The graph from the two curriculum documents are now overlayed on each other to allow for comparison graphically of the relative depth of treatment of each of the generic attributes. Figure Three shows the comparison of the IS'97 curriculum document as compared to ISCC'99.

Results and Discussion of Results

The above data is graphically represented in the Kiviat chart shown in Figure 1. The chart is a representation of the raw data count on a logarithmic scale to give a more meaningful interpretation of some of the larger differences between the counts.

This paper sought only to present a methodology for capturing, comparing and illustrating the consistency of operationalised goals with strategic or higher level goals. An explanation of the results will form the basis of future papers.

However, some obvious conclusions can be drawn from the data illustrated in Figure 1 and Figure 2 since the graphic presentations allow for the easy interpretation of the strengths and weaknesses of the curriculum documents. For example, it can be observed that some attributes feature to a larger or lesser extent. Of greatest concern is the number of attributes receiving at best superficial treatment with a number not even rated at all.

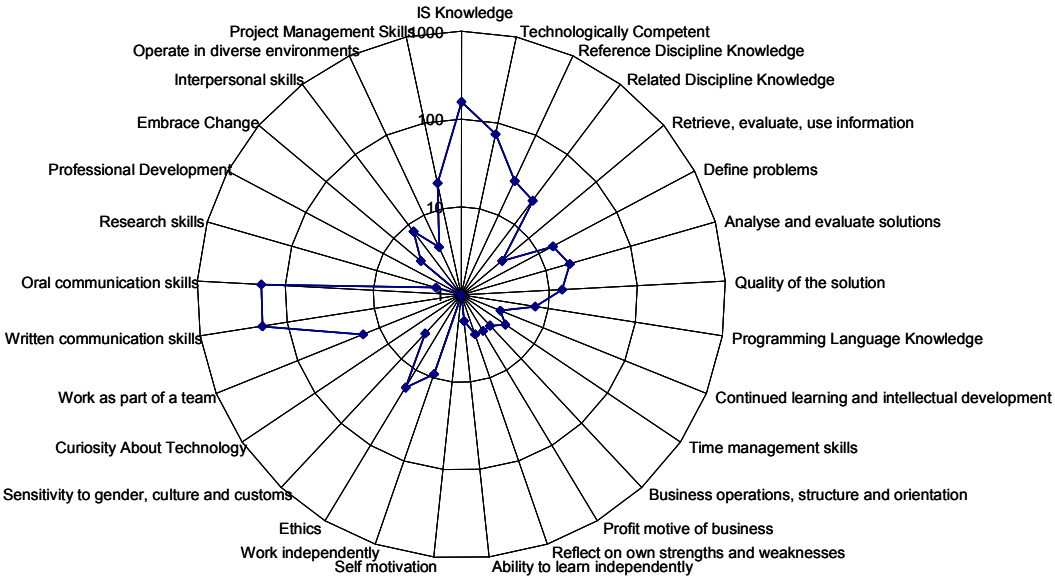

Figure 1. Generic Attribute Coverage within IS'97 (logarithmic view)

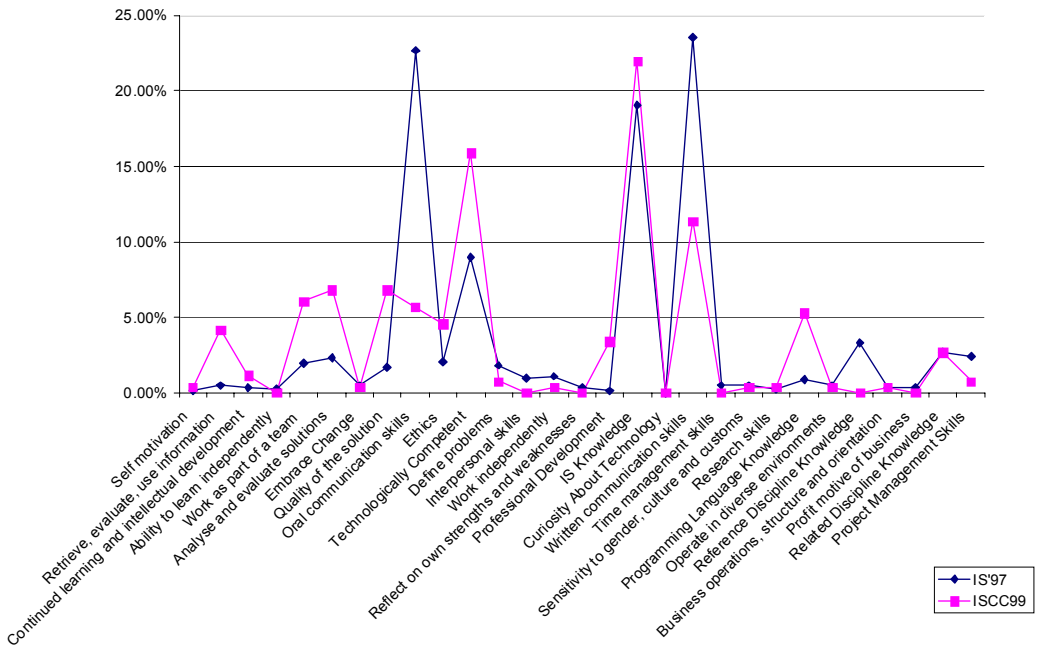

Figure 2. Coverage of the Generic Attributes in IS'97 and ISCC'99

Implications of the Results and Further Research

This paper has presented a replicable methodology of identifying the strengths and weaknesses of documentation associated with IS programs of study. These include the curriculum documents and course unit outlines. The replicable methodology presented in this paper may be applied to the body of knowledge from professional societies as well as the course unit outlines from individual universities.

One of the clearest implications of the results is the need for a consistent methodology of writing unit objectives so that they reflect the coverage of the generic attributes agenda. In order to do this curriculum writers will need to identify how they will empower students to develop their generic capabilities within a specific unit. Such attention to detail is essential in the increasingly legalistic world we encounter as students view the unit outline as a contract for learning. Students also use the unit outline to provide employers with information as to the content, skills, and other attributes developed and learned during their program of study.

A second implication is that universities, when they are redesigning or applying for reaccreditation of a program of study, will need to consult with the relevant industry body and members of the wider community that employs their graduates about the generic capabilities that are required in entry-level employees. Universities will need to repeat the Delphi study that formed the initial phase of this study, when they begin the process of industry consultation, as part of the continual curriculum evaluation process.

Further research has begun to identify the emergence of new generic attributes. An expanded study is being conducted involving students, academics and employers to identify emerging trends.

The methodology used to generate data for comparison is expected to be one of the most useful outcomes of the work, and should be replicable in other disciplines wishing to undertake similar curriculum evaluation in relation to the generic capability agenda.

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Appendix A
Course Details from IS'97 (Davis et al., 1997)

IS'97.1	**Fundamentals of Information Systems**
Scope	This course provides and introduction to systems and development concepts, information technology and application software. It explains how information is used in organizations and how IT enables improvement in quality, timeliness and competitive advantage.
Topics	Systems concepts Systems components and relationships, Cost / value and quality of information, Competitive advantage and information, Specification, design and re-engineering of information systems, Applications versus system software, Package software solutions, Procedural versus non-procedural programming languages, Object-oriented design, Database features, Functions and architecture, Networks and telecommunications systems and applications, Characteristics of IS professionals and IS career paths
	EXPLANATION AND EXPECTATIONS 2274 Students with practical end-user knowledge will study systems theory and quality concepts as an introduction to information technology concepts and information systems development. Structure and functions of computers and telecommunications systems will be examined. Standard systems purpose and organization will be introduced. 2278 The concept that information is of significance in stating and attaining organizational goals will be used as the basis for exploring the development of databases to store the information. Information systems will be introduced to process and communicate the information. The dynamic nature of organizations and the necessity for growth and re-engineering of the organization as well as its information systems will be presented and used as the motivator for understanding IS development methodologies. 2283 The development path for entry level to senior information systems professionals will be explained. Professional ethical expectations and obligations will be reviewed. The necessity for personal and interpersonal communications skills will be discussed.
	Students completing this course will have mastered the following learning units:
	1. explain systems theory and quality concepts (LO-0008)
	2. explain methodologies to facilitate measurements to achievement of ISO 9000, Baldridge, National Performance Review and other quality standards (LO-0046)
	3. explain the elements and functional relationships of major hardware, software, and communications elements of information systems consisting of single PCs, LANs and/or WANs (LO-0014)
	4. explain the concepts of implementing IS coupled to re-engineering and continuous improvement (LO-0058)
	5. explain the relevance of IS management aligning itself with strategic organizational processes (LO-0047)
	6. discuss and explain the concepts of goal setting and individual decision making and achievement; explain the requirement of goal setting and personal decision making in empowerment in a work setting (LO-0197)
	7. identify and explain telecommunications careers and career paths (LO-0077)
	8. use professional code of ethics to evaluate specific IS actions (LO-0117)
	9. describe ethical and legal issues; discuss and explain ethical considerations of software usage, sales, distribution, operation and maintenance (LO-0157)

Appendix B
Australian Generic Attributes

	Attribute
1	With respect to the IS discipline possess coherent, extensive, theoretical and practical knowledge
2	With respect to the IS discipline be technologically competent (the person is able to use the current technology competently)
3	With respect to the IS discipline possess theoretical and practical knowledge in at least one reference discipline which include behavioural science, computer science, decision theory, information theory, organizational theory, management theory.
4	With respect to the IS discipline possess the theoretical and practical knowledge of related disciplines. For example, business, law, education, data communications, computer science or leisure recreation
5	Retrieve, evaluate and use relevant information
6	Define problems in a systematic way
7	Analyse, synthesise and evaluate the various solutions
8	Consider the quality of the solution and its timeliness
9	Demonstrate practical knowledge and understanding in at least one computer language
10	Be able to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.
11	Time management skills
12	Knowledge of how a business operates, is structured or is orientated
13	Understand the profit motive of business
14	Ability to reflect on own strengths and weaknesses
15	Confidence about their ability to learn independently
16	Self motivation
17	Work independently
18	Value the ethics of the Information Technology profession
19	Sensitivity to differences in gender, culture and customs
20	Possess a sense of basic curiosity about technology
21	Work as part of a team in a productive and cooperative manner
22	Written communication skills
23	Oral communication skills
24	Research skills
25	Participate in on-going professional development
26	Embrace change and be obliged to engage in incremental improvement to keep up with the rapid change in technology
27	Interpersonal skills
28	Adapt to unfamiliar cultures and operate in a socially and culturally diverse environment
29	Project Management Skills