Embedding Professional Skills in the ICT Curriculum

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This paper reports on a preliminary investigation into the technology and techniques for designing and managing higher education programs in Information and Communications Technology (ICT). The approach outlined is based on the Skills Framework for the Information Age (SFIA) and is informed by data arising from the Australian Computer Society (ACS) Computer Professional education Program (CPeP). It is intended that this work will inform subsequent research to improve dialogue between Industry Advisory Boards, Professional Societies, and their academic partners as they design, implement, and accredit higher education programs in ICT. It is further intended that this will contribute to the development of ICT curriculum that is aligned with industry expectations and prepares ICT graduates for professional practice. Future directions for improving SFIA based curriculum design and facilitating better stakeholder communication and collaboration are discussed.

Keywords: ACS, SFIA, skills, competencies, portfolio, badges, accreditation

Introduction

The Skills Framework for the Information Age (SFIA) is a standardised approach for defining Information and Communications Technology (ICT) skills and the level of autonomy and responsibility at which ICT professionals practice them (SFIA Foundation, 2011). In particular, the framework defines generic skills plus an additional 96 ICT skills that are classified hierarchically by category and sub-category. Further descriptors are defined that indicate the levels of autonomy and responsibility at which skills are practiced based on a seven-level scale. Level 1 denotes that a skill is practiced in a manner in which an individual follows others. At the other end of the scale, Level 7 denotes that a skill is practiced with a high level of autonomy and responsibility in which the ICT professional sets strategy and inspires and mobilises stakeholders.

The Australian Computer Society (ACS) uses SFIA as the basis for the certification of ICT professionals in Australia. ACS requires that Certified Professionals operate at SFIA Generic Level 5 (ACS, 2012a). At this level, ICT professionals demonstrate a high standard of practice and advise stakeholders on a range of items including design alternatives, scope, and standards. The ACS further requires that Certified Professionals demonstrate in-depth knowledge of ICT skills at SFIA Level 5 in a given specialism, in addition to possessing the breadth of ICT knowledge defined in the Society's Core Body of Knowledge (CBOK) (ACS, 2012b). It is also necessary for Certified Professionals to undertake 30 hours of professional development annually to maintain professional certification. Professional development hours are logged electronically by ACS members and linked to SFIA skills and levels on the ACS web site.

There are several pathways leading to Certified Professional status (ACS, 2012a). One of these is graduating from a higher education program accredited by ACS or a regional authority that is a signatory to the Seoul Accord, in addition to working in the ICT industry for 18 months following graduation and successfully completing the ACS Computer Professional education Program (CPeP) (ACS, 2012a). This postgraduate program embeds the development of SFIA skills at Levels 5 and 6 and is a key element of the course design.

Background

Skill frameworks and competency standards similar to SFIA are well defined by many professional bodies (CPA Australia, 2004; Engineers Australia, 2013; Nursing and Midwifery Board of Australia, 2013). Such professional competencies have been mapped to higher education curriculum, institutional graduates attributes, and the assessments used to measure their attainment (Merritt, Blake, McIntyre, & Packer, 2012; Oliver, 2013). Rather than being a tic-the-box exercise, embedding professional skills and competencies into the curriculum should be done as part of a holistic educational design. In the case of ICT, for example, it has been argued that SFIA should shape learning activities and assessments that provide for the practical application of skills (Bailey, 2012). However, few publically available examples exist to demonstrate how this can be achieved.

While curriculum mapping for professional competencies generally takes a tabular format (Bailey, 2012; Oliver, 2013), some preliminary work has been undertaken to explore how SFIA skill sets can be visualized graphically. For example, von Konsky, Hay and Hart (2008) used spider diagrams to visually compare the intended SFIA skills developed by undergraduate degree programs and the level at which they are practiced to that of entry level positions in industry. Similarly, Armstrong (2011) used a square grid containing SFIA skills, with each grid cell colour-coded to represent SFIA levels. This was done as a means to visually compare the suitability of candidates for available positions against selection criteria that were similarly coded.

Increasingly, students are using e-Portfolios to collect and reflect on artefacts related to the development of professional skills and graduate attributes (Hallam, 2009; Jones & Lindley, 2010; Oliver, von Konsky, Jones, Ferns, & Tucker, 2009). It has been argued that a personal portfolio containing artefacts generated by an applicant is the only truly authentic competency measure (Palmer & Ferguson, 2008). However, these must be unpacked and vetted against a framework to demonstrate alignment with specific professional skills. Digital badges are an emerging technology that may significantly impact this. With badges, a trusted authority can unpack and vet an e-Portfolio against a framework such as SFIA. Based on this, the e-Portfolio holder receives digital badges that are linked to an authenticating server to verify skill attainment in electronic resumes and *curricula vitae* (Phelan, 2012).

SFIA in the ACS Computer Professional Education Program

ACS Members are eligible to enrol in CPeP which embeds SFIA, during which they complete a *Professional Practice* component in addition to three core subjects and an elective (ACS, 2013a).

For example, students reflect on attainment of SFIA skills under the guidance of a mentor over a period of up to 52 weeks. During that time, students maintain an e-Portfolio and an online reflective journal (Jones & Lindley, 2010). The journal represents an opportunity to reflect on CPeP learning activities and consider how these will inform future practice as an ICT professional. The e-Portfolio is used to store artefacts demonstrating attainment of the intended learning outcomes, and forms the basis of a student self-assessment against the SFIA generic skills. Each student's mentor evaluates the self-assessment to confirm the generic SFIA level identified by the student. The use of digital badges is currently under consideration. If implemented, this could be used by students to attest to attainment of SFIA skills using software available on the Moodle Learning Management System based on Mozilla Open Badges (Moodle, 2013; Mozilla Foundation & Peer 2 Peer University, 2012).

Similarly, specific SFIA skills are embedded into core and elective subjects (ACS, 2013b). For example, an elective subject called *Green Technology Strategies* develops specific SFIA skills in the context of environmentally sustainable technologies (Worthington, 2009). The specific SFIA skills developed in this subject are: Emerging Technology Monitoring, Business Process Improvement, Strategic Application of Information Systems, Procurement, and Conformance Audit.

The authors are currently analysing SFIA data from CPeP and conducting interviews with graduates to ascertain the work readiness of early career professionals as a component of a larger funded research project. This project will also consider further tools and technologies based on SFIA to enhance the design and management of ICT higher education programs that engages all stakeholders.

A Model for Embedding SFIA into the ICT Curriculum

Based on the authors' experience with SFIA and CPeP and given preliminary results arising from this study, a broad model for embedding SFIA skills into the ICT curriculum is depicted in Figure 1. This model will be further elaborated as a result of workshops and focus groups involving ICT educators and industry representatives in conjunction with this research project. The preliminary model involves a feedback loop with four stages.
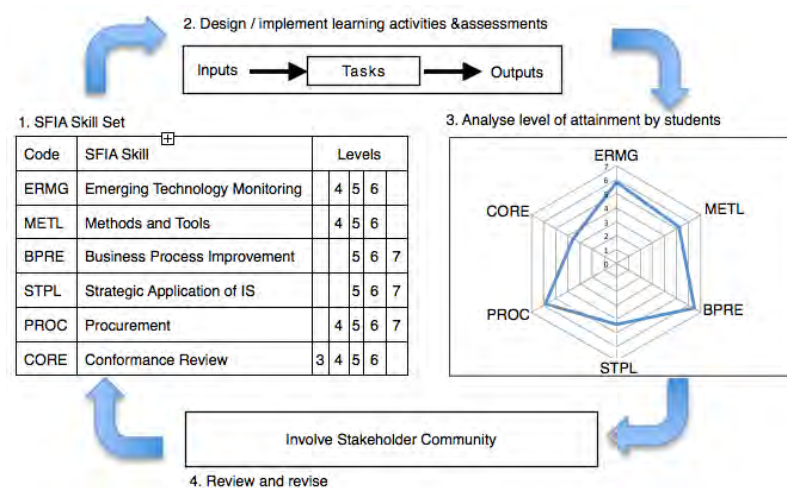

Figure 1: Using SFIA in designing and communicating higher education programs

Stage 1: Identify the SFIA skills set for each unit in the context of the subject content. Consider the design of a hypothetical new unit on green ICT broadly based on the CPeP *Green Technology Strategies*. Six specific SFIA skills for the unit are shown in Figure 1, along with the levels for which each skill is defined in the SFIA framework.

Stage 2: Design and implement learning activities and assessments that develop the identified SFIA skills. This can be facilitated by a noun and verb analysis of the SFIA skill descriptors. An analysis of verbs in the descriptors suggests tasks. Nouns are related to the inputs into and outputs from learning tasks.

For example, the SFIA Skill Descriptor for the Emerging Technology Monitoring (ERMG) skill is shown below, modified to identify relevant verbs in bold and nouns in italics (SFIA Foundation, 2011):

> The **identification** of new and emerging *hardware*, *software* and *communication technologies* and *products*, *services*, *methods* and *techniques* and the **assessment** of their *relevance* and potential *value* as business enablers, improvements in cost/performance or sustainability. The **promotion** of emerging technology *awareness* among staff and business management.

This skill does not explicitly refer to green technologies, but is none-the-less directly relevant to a unit on green ICT. In that context, the noun-verb analysis suggests three formative learning activities involving the identification, assessment, and promotion of green technologies within a business. Potential activities leading to a range of artefacts suitable for inclusion in e-Portfolios that demonstrate attainment of this SFIA skill could take many forms. Student reflections in the e-Portfolio place these artefacts into context and consider how they will inform future behaviour and beliefs. It is natural to consider that learning activities should lead to written reports. Written analyses and recommendations are authentic in the sense that they are often fundamental in setting business strategy and policy. However, they do not necessarily demonstrate other attributes of an ICT professional, including relevant teamwork and communication skills. Potential learning activities and artefacts for the hypothetical unit in this example include: 1) discussion forum brainstorming on green computing issues based on workplace experience and other sources, leading to a collaborative wiki summarising findings; 2) a written report containing an analysis of introducing green technologies for a hypothetical business; 3) oral presentations in which speakers champion the benefits of adopting green ICT technologies. These tasks produce a range of formats well suited for inclusion in student e-Portfolios. These include links to the wiki showing outcomes from brainstorming and collaboration, reports containing written analysis, and oral presentations

captured on video.

Adopting green technologies would also likely involve business change and impact procurement. This suggests that further design iterations are appropriate to consider combining other SFIA skills into planned learning activities.

Stage 3: Analyse student attainment of SFIA skills. Learning activities should be designed to target specific SFIA levels. For example, CPeP generally targets SFIA level 5 or 6. An analysis of student reflections and learning artefacts should be conducted to determine the extent to which the intended objectives have been met. This analysis can be conducted visually as described by von Konsky, Hay and Hart (2008) or Armstrong (2011). Stage 4: Review and revise the curriculum. Developing ICT as a profession requires the involvement of all stakeholders (von Konsky, 2008). While they should be involved throughout the design, implementation and review of higher educations programs, it is particularly important to involve them when reviewing and revising the curriculum. It is indicated that SFIA has the potential to promote effective communication amongst stakeholders, and will be the subject of further research by the authors.

Conclusions

This paper has identified a preliminary strategy for embedding SFIA into the ICT curriculum with the intention of producing work ready graduates who are prepared for initial practice as ICT professionals. The strategy makes effective use of tools and technologies to support ICT education, particularly focused on providing a common framework and nomenclature based on SFIA. The work described will lead to subsequent research involving recent CPeP graduates, representatives from industry and academia, and envisions a future where the roles of emerging ICT professionals is shaped by higher education institutions in partnership with relevant stakeholders.

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