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Five Principles for DSR Based Curriculum Development

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EXTENDED ABSTRACT

Most information systems (IS) programs have a strong design component, including aspects of software engineering and organizational development. This work explores how Design Science Research (DSR) (Hevner et al. 2004) can be used to drive IS curriculum development. Specifically, we report on the use of DSR to inform the design of a Computer Information Systems curriculum and pay specific attention to five design guidelines that emerged from the work. The study takes its departure in the 2013 merger between Uppsala University – the oldest university in the Nordic countries (est. 1477) – and Gotland University College – the youngest tertiary institution in Sweden (est. 1998), through which the latter became Campus Gotland at Uppsala University. Through the merger, the Software Engineering (SE) department at Gotland was incorporated in the Department of Informatics and Media within the Faculty of Social Sciences at uppsala University and was assigned the task to develop its two-year undergraduate diploma program in SE into a three-year IS bachelor's program.

The new bachelor program at Campus Gotland was planned to start in the autumn of 2016. A market analysis, conducted early 2015, showed that an IS bachelor education was more likely to attract students than the program currently offered. The new program, however, would be designed so that students could still get a higher diploma in software engineering after two years of study, should they so desire. This way the program could be attractive to the old target group as well as to a new group of students interested in a Computer Information Systems (CIS) bachelor – i.e. a technically oriented IS degree (cf. Abraham, 2013; Longenecker, Babb, Waguespack, Janicki, & Feinstein, 2015). A series of workshops with industry representatives, with which the department had longstanding working relationships, vindicated that a CIS profile matched local competence needs.

The curriculum design project was setup as a design science research (DSR) project (Hevner et al., 2004). In DSR, the *relevance* cycle suggests that the practice domain serves two important roles. First, it provides practically grounded problems that can be addressed through design. Second, it provides an arena for validating the design in terms of how well it solves the practical problems identified. To achieve this dual goal, a series of five workshops – taking place every two months – were organized with the teaching staff and representatives from local companies and government agencies. The purpose was to get a better understanding of the needs in the region in terms of required graduate skills and to get feedback on the emerging curriculum, i.e. the learning outcome, the overall structure, detailed course content, and a plan for industry collaboration. The four major employers for IS professionals at Gotland, including two government agencies and two companies, participated in all workshops with 2–4 delegates each. The workshops resulted in a series of notes that informed the curriculum design process.

In keeping with the DSR rigor cycle, a literature review was conducted focusing the last five years of publications in the *Journal of Information Systems Education* (JISE) and *Information Systems Education Journal* (ISEDJ). Articles were selected based on a reading of the abstracts, identifying articles dealing with curriculum design in general, and CIS curriculum design in particular. In addition, a Google Scholar search on ‘curriculum design’ was conducted to identify additional relevant papers. 30 articles were identified that explicitly provided input on issues related to curriculum design. In addition, the Swedish higher education ordinance was factored in to the process.

Curriculum design was informed by the relevance and rigor cycles outlined above. It was early recognized that there was a need to synthesize the comprehensive list of articles and rich input from practice into manageable design support. Therefore, as early drafts of the curriculum emerged, reflections were made and design principles were articulated. The design principles were communicated to staff and discussed within the department, and continually used in the design work, leading up to the five principles presented below.

First, **P1: the stage setting principle**, stating that early modules in the course should promote the students’ understanding of higher education, stimulate the student to establish effective study habits, and encourage productive cooperation between students and staff. Experiences from staff in both Uppsala and Gotland signalled a need for appropriate ‘stage setting’ early in the course. Students are often unaware of the expectations they face at the university. Further, there is a discrepancy in students’ motivation and background knowledge. The stage setting principle aims at addressing such discrepancies, thus better preparing students for their continued education. In addition, and in keeping with AIS 2010, stage setting means a thorough initial focus on foundations of the IS and SE field, before moving on to more advanced courses.

Second, **P2: the learning space principle**: The learning environment - both its social and technological components - should facilitate student creativity, interaction and learning. Despite the importance of the learning environment, it is often peripheral or neglected in curriculum design. Arguably, the learning environment is extra important in IS education, to a large extent dependent on technology as well as collaborative work. The environmental principle has both a technical dimension and a social dimension. In terms of the technological environment, we agree with Topi et al. (2010, p. 2), stating that “It is paramount to the success of Information Systems programs that adequate technical support is provided.” Based on our feedback from industry, this is important not only to facilitate lab work, it is also a way for students to prepare for the technological environment in their future workplace. In addition to the technological environment, the learning space as a whole is important to consider. Learning spaces should promote interaction between students, and interaction with faculty (Wulsin Jr., 2013). Further, student learning spaces should be available in proximity to classrooms and faculty offices to promote face-to-face interaction and direct feedback to students. Well-reflected learning spaces are in line with learner-centered teaching in IS education, as outlined by Saulnier et al. (2008).

Third, **P3: The professional practitioner principle**, stating that in order to prepare students for professional work, their training should promote both their abilities to (i) collaborate with others in a work context, and (ii) to efficiently utilize professional tools used in real-life information systems development environments. Humphreys, Babb and Abdullat (2015) report that industrial board members highlight teamworking skills, time management skills, critical thinking and problem solving skills, and skills in written and oral communication. Their findings resonate well with the statements from industry representatives at Gotland, who also stressed that students need to be better prepared for the technologies used in professional development environments, such as tools for requirement management, source code control, testing and continuous integration. The wish from industrial representatives was that our students were familiar to modern development tools and work practices. Finally, students should have the opportunity to interact with professionals and professional environments as part of their training.

Fourth, **P4: The academic recognition principle**: *The curriculum should conform to state-of-the art conventions of the IS discipline*. The department aims for international recognition in the information systems field; in research as well as in education. Therefore, it is important to factor in the 'AIS 2010' core curriculum (Topi et al., 2010) into the design process. Following the resemblance of our SE/IS approach to Computer Information Systems (CIS), the principle in this case also means that we have factored in CIS curriculum literature into our design process (Abraham, 2013; Longenecker et al., 2015). We also consider this principle important from the student perspective: Our students should become familiar with the IS field, i.e. its professional organisations, its conferences, its journals, and its academic standards.

Fifth, **P5: The R & D integration principle**, stating that *insofar as possible, research and design should be taught as two sides of the same coin*. IS research topics are not easily integrated into undergraduate education (Davidson, 2011). Despite apparent similarities between IS design/development and research activities, IS education tends to separate systems design and research into two worlds conceptually. By training students in DSR from the inception of their education, starting practically and by a progressive introduction of research philosophy, we aim at integrating design/development and research training throughout the program. Given the aim of DSR to integrate design and research, it is a logical step to utilize DSR frameworks in student training to prepare them better for research.

Principles 1 and 2 vindicate the commitment to design in the sense that design always starts with a period of understanding the design context and the problem environment (i.e. stage setting) and that design work requires environments that promote creativity, inspiration and interaction between stakeholders (i.e. learning spaces). Principle 3 corresponds to the DSR relevance cycle, i.e. that the curriculum should support the students' understanding of – and interaction with – professionals and professional environments. Principle 4 corresponds to the DSR rigor cycle by introducing the students to the core of the knowledge base, an understanding of research norms, and proficiency to navigate the knowledge base. Principle 5 supports the students' to form a conception of research in general, and the DSR process as a whole.

The research reported here constitutes a contribution to the IS education discourse in two ways. First, it explores a DSR approach to curriculum design (and research into curriculum design). Second, it proposes a set of design principles, based on literature as well as informed by industry stakeholders that summarize a set of focal areas to consider when developing IS courses or modules.

To make AIS journals as widely accessible as possible, it is important that the articles can easily be read and printed by computers without multimedia capability. Authors are encouraged, however, to include multimedia material where appropriate. Such material is made accessible through hyperlinks.

REFERENCES

Abraham, S. N. M. N. (2013). "Ten Year Assessment of Learning Outcomes of a Computer Information Systems (CIS) Program". *Information Systems Education Journal*, *11*(6), 50.

Davidson, E. J. (2011). "'Hey professor, why are you teaching this class?' Reflections on the relevance of IS research for undergraduate students". *European Journal of Information Systems*, *20*(2), 133–138.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). ”Design science in Information Systems research”. *MIS Quarterly*, *28*(1), 75–105.

Humphreys, S., Babb, J., & Abdullat, A. (2015). ”Where do Student Outcomes Begin? Developing Professional and Personal Management Skills as a Strategy for Student Success in the First Computing Course and Beyond”. *Information Systems Education Journal*, *13*(6), 4–26.

Longenecker, B., Babb, J. S., Waguespack, L., Janicki, T., & Feinstein, D. (2015). ”Establishing the Basis for a CIS (Computer Information Systems) Undergraduate Degree Program: On Seeking the Body of Knowledge”. *Information Systems Education Journal*, *13*(5), 37.

Saulnier, B. M., Landry, J. P., Longenecker Jr, H. E., & Wagner, T. A. (2008). ”From teaching to learning: Learner-centered teaching and assessment in information systems education”. *Journal of Information Systems Education*, *19*(2), 169.

Topi, H., Valacich, J. S., Wright, R. T., Kaiser, K., Nunamaker Jr, J. F., Sipior, J. C., & de Vreede, G.-J. (2010). IS 2010: ”Curriculum guidelines for undergraduate degree programs in information systems”. *Communications of the Association for Information Systems*, *26*(1), 18.

Wulsin Jr., L. R. (2013) ”Classroom Design - Literature Review”. Working report at Princeton University.