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Proposal

Title:

Problem-based Learning Approach to the Curriculum Design of a Hybrid Business Information Systems Education

Abstract (maximum of 150 words):

Business Information Systems (BIS) is one of the fastest changing industries loaded with 'disruptive' technologies. It also forms the foundation of the current digitalisation wave (often termed the fourth or even fifth industrial revolution). Consequently, teaching of BIS at the third level is under constant pressure regarding the content of corresponding curriculums at both undergraduate and postgraduate levels. Furthermore, BIS education needs to consider digital and online options – especially under pressure from the COVID pandemic. To cope with the changing expectations of various stakeholders including potential employers this research work applied the Problem-based Learning (PBL) pedagogical approach as the methodological foundation to redesign the full BSc program of BIS education. PBL is applied through The Open Architecture Framework (TOGAF) to determine the professional 'need-to-know' content and skills that can be delivered in a flexible manner. To accommodate the resulting requirements online content sources can be seamlessly integrated into the teaching repertoire.

Key words: Business Information Systems, Problem-based Learning, online education, curriculum design, hybrid learning

Has this paper previously been published/presented elsewhere? No

Text of paper:

1. Introduction

Business Information Systems (BIS) is one of the fastest changing industries loaded with 'disruptive' technologies. It also forms the foundation of the current digitalization wave (often termed the fourth or even fifth industrial revolution). Consequently, its education at the third level is under constant pressure regarding the content of corresponding curriculums at both the undergraduate and the postgraduate levels. Other than the fast-changing nature of its target market a big challenge for a comprehensive BIS program and related curriculum is the resulting demand for a combination of up-to-date technical knowledge, organization-centred mindset, and adaptive skills.

Employability is traditionally (and narrowly) defined from the point of view of the labour market. However, from the point of view of student life after formal (institutionalized) education is not only about getting or even holding a job, but (in our supercomplex world – see Barnett, 1999) increasingly about what they need to face in the future. Graduates' employability thus should be approached from the perspective of what they might become in the future as they pass through their learning journey (O'Mahony et al., 2021). This life-long learning vision guides educators to consider that getting a degree is no longer about gaining some (often marginal) advantage in the job market, but third level learning should be about personal transformation (Savin-Baden, 2008).

Over the last decade two trends may be observed in the demand for BIS graduates who are typically hired to bridge the gap between IT and business. On the one hand some employers, especially SMEs expect graduates who can take on responsibilities almost right away (i.e. having a wide range of specific skills including programming or use of certain tools), while other organizations (mostly large and multinational ones) expect newhires to be flexible, with convertible skills (since they usually provide them with customized corporate training) (Nasir, 2020; Cummings and Janicki, 2020). From

the point of view of students, the continuous technological revolution leading to newer and newer solutions appearing with increasing frequency requires flexibility, creativity, and a fast adaptation to desirable behavioural patterns (Cook, 2019). The available information is almost infinite, sources of information are countless and change fast. It seems that traditional forms of knowledge transfer have become less efficient (Davidson, 2017). Students acquire a growing portion of their knowledge from sources outside educational institutions. For our youth (especially for those who arrive to a BIS BSc program) the world has become 'phygital', (Mamina and Tolstikova, 2020) where everything physical now has a digital equivalent. From physical reality they have moved to digital communication (Tolstikova et al., 2020).

Problem-based Learning (PBL) pedagogical approaches (Schmidt, 1983; Boud and Feletti, 1997) have been successfully applied at different levels of education and in different professional fields, most notably medicine (Barrows and Tamblyn, 1980). PBL may be used to redesign courses, could be the pedagogical foundation of full programs and curriculums, in fact, it is often cited as an option driving change even at the institutional level (Kek and Huiser, 2017). Therefore, PBL may offer an opportunity to address the threat of potentially increasing mismatch and misalignment between competences required by the IS industry labour market and current training contents offered and methods used by higher education institutions.

The work reported here considered PBL as the methodological foundation to redesign the full program of BIS education at the BSc level. The PBL methodology is applied through The Open Architecture Framework (TOGAF) (Open Group, 2018) to scaffold the professional 'need-to-know' content and skills enabling the curriculum to be delivered in a flexible manner. To accommodate the resulting requirements online content sources can be seamlessly integrated into the teaching repertoire. Therefore, this paper first reviews up-to-date teaching methods related to teaching soft computer skills. It also considers the requirements and opportunities related to an increasingly online-centred situation. Based on these challenges the paper lays down the foundation for a potential curriculum design approach intended to address all of the above issues in an integrated framework. To achieve transversal skills in this context, the role of available online sources and the application of hybrid (previously blended) learning methods are also investigated. The report ends with conclusions and acknowledgment.

2. Methodological approach

2.1. Enterprise Architecture Model as framework

The question how to educate professionals who are able to meet current and emerging expectations of their field drew different answers from different stakeholders (Topi et al., 2017; Bohler et al., 2020). Beyond its multidisciplinary nature, BIS is pedagogically characterized by a typically high ratio of seminars, the need for project focus, and the requirement of working in groups (Dubey and Tiwari, 2020). The research objective of this work was to consider the application of an advanced pedagogical approach combined with a systematic professional framework to address the employability challenge of BIS education programs at the bachelor level. To this end this section reviews the key ideas behind PBL and TOGAF as it forms the foundation of a comprehensive program-level redesign of said curriculum.

It was already realized by Zachman (1987, see also Sowa and Zachman, 2010 for an update) that costly ICT solutions often freeze the enterprise at the technological and application level applied at a given time. A need for a more flexible view of enterprise ICT led to the development of The Open Group Architecture Framework (OpenGroup, 2018).

TOGAF differentiates among several architecture domains (called the Enterprise Architecture Model - EAM): *business* architecture, *information systems* (data and application) architecture and *technology* architecture. For enterprises this view may be used to create a process of systematic redesign. In each domain there is a *baseline* and a *target* architecture, and a *gap analysis* can create a *roadmap* of

change. This way the organisation and IT management can follow a well-controlled and coherent development scenario over a strategic time horizon. The architecture development method (ADM) suggested as part of TOGAF is split into four phases: creating the architecture context; architecture delivery; transition planning; and architecture governance. This creates an opportunity for a customizable framework on the level of the desired granularity. The iterative architecture development, which means stepping through one or several *transition architectures* and on different *granularity levels* towards an advanced, integrated solution considers re-usability, standardization, interoperability, and portability at enterprise level.

2.2. PBL as T&L method

At the same time, the content of knowledge and the forms of teaching-and-learning (T&L) have also been changing. As a leading revolutionary approach Problem-based learning has emerged from constructivist didactics and builds upon students' preliminary knowledge, expectations and interest. For this the starting point of learning is a problem or an issue to solve and students first get familiar with it before learning the information necessary to create a solution. The method is characterized by student-centeredness, work in small group, the presence of the teacher as a facilitator, and the work being organized around the problem (Barrows, 1983). The method incorporates the gaining of knowledge with the development of general skills and attitudes. It also promotes the development of numerous important soft skills, e.g. communication skills, teamwork, problem-solving, independence, sharing information, and the respect of others (Wood, 2003). Since one of the starting points of the method is taking the students' individual differences (interest, preliminary knowledge, etc.) into consideration, it is typical that students are motivated to work, spend much time on their studies and intensively take part in course work - especially if they also have an opportunity to have a say in defining the problem (De Graaf and Kolmos, 2003).

Closely related to PBL – especially when online options are considered – is the so called 'flipped classroom' educational process model which is a form of blended learning. During the application of this instructional strategy preliminary, individual processing of the material of traditional lectures takes place first (typically online), which is then followed by an active classroom work also incorporating problem-based, cooperative methods (Lage, Platt and Treglia, 2000). In the interpretation of Bishop and Verleger (2013), during the preliminary preparation students process multimedia contents. According to Lo, Hew, and Chen (2017) this method is based on the use of online technology such that video teaching materials (prepared in advance in short portions of 8-15 minutes) should be watched by students. Then actual classroom work is composed of short lectures as well as problem solving exercises (individually or in small groups). According to the creators of the model (Bergman and Sams, 2012), watching the videos just before class is not enough for success. They find that real information processing and learning should take place at home and students are to arrive to class with notes and questions, which are checked and answered by the teacher.

3. Discussion of applying the methods

The TOGAF approach is built on architectural concepts, and it integrates the views of business, data, and technology at a system level along with recognizing the issue of transition. Therefore, TOGAF can be used as a guideline around which an evolutionary BIS curriculum design approach may be organized. While PBL – used at the program/degree or even institutional level – offers a pedagogical helping hand how to actually deliver such curriculum without falling back to the comfort of a deliver-memorize-and-test approach in the usual context of separated courses. Of course, to materialize such a proposal real-life case studies are essential. Hence, we consider PBL from two viewpoints: once as a vehicle building BIS curriculum on the basis of EAM, second, an appropriate T&L method during the curriculum implementation.

3.1. EAM reframes the BIS curriculum

The dimensions and the ADM process of TOGAF may be utilized as a backbone for BIS curriculum design because EAM is built on the strong correlation between IT technology and business management – both of which are equally key to BIS practice. Considering the curriculum as set of requirements that need to be met during the learning process, it is easy to see that such requirements may change by place, time, level of education, type of audience, and the way of implementation. Requirements might reflect professional viewpoints (similarly to the MSIS 2016 global competency model mentioned earlier), or the short-term interest of the job market, or long-term, future demand of the world of labour (that may be hard to predict). Therefore, similarly to the TOGAF philosophy, separation of requirements (or in the EU, competences) from implementation is a must.
In every stage of the architecture development method developers need to contrast the information technology solution with business objectives, processes, and maturity. This construct and the relatively low complexity level of EAM fits well with the idea of problem-based learning. Therefore, students may be posed an (organizational IS) problem and seeking solution(s) would force them to explore relevant concepts, information, and techniques while incurring required skills and competencies.

3.2. Advantages of this approach

EAM (TOGAF) enables BIS to be taught from the outset with a high level of complexity across business, information system and technology architectures. The distinction between baseline and target architectures leads to gap analysis, which leads to transition architectures (i.e. complex programme and project management). Carefully chosen levels of granularity support the adaptation of the curriculum to the target audience (both at the educational levels: bachelor, master, postgraduate) and within them from scope, business, logical design, implementation and/or operational perspectives.
Augmenting TOGAF with the latest pedagogical approaches can make the BIS curriculum to stay fresh, approachable, and ready for blended learning. This approach to curriculum design fosters self-evaluation in real-world environments where students can develop their own employability goals and reflect on competencies and capacities required by the recent employment opportunities. Students should have an inventory of expected skills (competencies and capacities) and represent their needs in relation to their actual standing. Self-evaluation thus becomes an integrated part of tracking progress and forms part of assessment practices – along with peer-evaluation in group (project) contexts. Students should be enabled to identify their own skill development needs and goals and to integrate them into their learning pathway (covering both curricular as well as co- and extracurricular activities) even beyond graduation (i.e. after their formal, institutionalized training).

3.3. Putting ideas into practice

One of the biggest challenges for educators who intend to use problem-based learning (especially for the first time) is the selection of appropriate cases or problems (Kek and Huiser, 2017). In BIS context, considering the many interdisciplinary implications, one may even start with a very complex, almost unsolvable problem, which then would need to be split into smaller issues first. Once the original problem was broken down into smaller ones, instead of being 'taught', students will study the business, its environmental and societal context, and its characteristics which, hopefully, will lead to even smaller sub-problems that are more feasible to solve. The expected final outcome is an outline of a working model. During this process – instead of studying material from isolated courses and dedicated lectures – students would need to learn business economics (including firm theory, sociology, regulations, and so on) and at every stage they will need to learn the corresponding IT technology part as well. The problem-solving process under this case-based framework will indicate where and when to introduce system design principles, and procedures, database design, business intelligence methods, or governance issues. It may depend on the timeframe of training, but at least two iterations are necessary. Student audience must confront the barriers of the (suggested) solution. This way they will also understand what the roles of maturity models, transitioning, and audit are –

thus getting a full picture of an organization and its information systems. The approach would especially be effective in a dual education (internship, work placement) context.

To put the above ideas to test, authors of this report have been working in cooperation with colleagues from three other international education institutions and an industrial partner. In the context of that project BIS BSc curriculum is to be designed around the popular problem-package known as the 'Smart city'. The above approach is applied through the following four hierarchical levels when it comes to shaping learning outcomes: "Jobs" (defined in relation to the TOGAF framework and industry practices, like business architect, technology architect, etc.), "Competencies" (knowledge, skills), "Topics" (narrower areas related to competencies), and "Content" (learning materials). "Jobs" are related to subtasks in the problem (case) which lead to required skillsets and knowledge areas. The Job instances refer to the different levels, e.g., business architect at scope level, technology architect at technical level and so on. With this structure students may access not only content that fits directly to the case but to those related to the given competency in a larger context (see https://labs.tib.eu/edoer/). Providing supporting educational content heavily relies on online material. Online content sources include free courses and material (which needs to be checked for quality and fit, of course), prepared videos (which require extra resources of time, money, tools, and expertise), real-time recordings of lectures as delivered (saved and may be edited for future use), as well as live online lectures. An(other) important question concerns how students are planned to be involved in this new curriculum design process as key stakeholders (of their own future). At the current stage of developing the new BIS curriculum or rather the new curriculum structure and guidelines, students (at the university of the authors) are already invited to participate through two ongoing pilots.

Implementation of the curriculum redesign incorporated digital media as students now typically have personal devices (such as laptops or mobile phones), therefore, they have access to various material anytime-anywhere. BIS requires pedagogies that increase and enhance student interaction, but it is clear already from the first few case studies (courses we have run so far) that teaching and learning through collaborative eLearning platforms and virtual classroom make it difficult to form groups, to work in teams or even exchange ideas and comments freely. While live video and audio solutions are usually augmented with less synchronous means such as text messages or sharing files, this still does not make up for lost personal proximity. To be successful in this setting of increased expectations and complexity (such as document sharing options and working on the same file together) lecturers could utilize ready-made materials but they also need best practices of running online classes. It can already be concluded that the flipped classroom pedagogical strategy requires a wide range of learning material to be available for students. This might be traditional means such as books and slide packages but also includes videos, blogs, podcasts, web pages, and other forms. Indeed, material produced by third parties should be considered. In fact, students, while studying outside the classroom may encounter, discover, and explore sources freely. The job of the teacher is to help them out how to be selective. They can *facilitate* quality checks over sources and material brought into class by students. In class, the normal PBL progresses through exploring the problem.

4. Conclusion

In light of the current educational context of Business Information Systems programs the proposition put forward in this paper has integrated up-to-date teaching methods with a comprehensive enterprise information management approach to offer a framework how to teach required soft skills at the meeting point of ICT and business. Considering an increasingly student-centred world augmented with extended online options the paper discussed ideas related to BIS curriculum design at the program level. This approach is capable of addressing the existing set of interrelated issues and challenges in an integrated manner. Indeed, in the context of an Erasmus+ project this framework has been put into practice and initiated the creation of a BIS BSc curriculum organized around TOGAF. The results will be able to lay down a solid foundation for BIS graduates which not only makes learning

visible, but also empowers students to be self-reflecting and ready for a lifelong perspective. Future challenge includes extending this approach to achieve full institutional change in cooperation with other disciplines, considering the blurring lines between strict disciplinary differentiation often termed 'liquidation' of historical knowledge areas.

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