

Alternative Assessment in Information Systems Engineering Education

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ABSTRACT: *The complexity of our world is calling for models of education that break away from the traditional "delivery of information" paradigm towards "knowledge creation" approaches that value activity, interaction, self-learning, communication, responsibility and team work. We describe a real case where Learning Contracts and Portfolios were combined within an Information Systems course for 5th year Informatics Engineering undergraduates. Students were asked to submit a contract that specified the learning activities they were prepared to carry out – from traditional essay writing and literature reviews to the organization of seminars that engaged professionals from the field – and then build up their Portfolios with the results of their endeavours and their meta-cognitive reflections on the knowledge gained, both individually and collectively. The instructor played three roles: the traditional one, of presenting the major topics of interest and mind mapping the important relationships; the role of an advisor, as students progressed in the activities described in their individual Learning Contracts; and the role of an evaluator of the activities, as they were described and entered into the Portfolio. This provided the students with quick formative feedback and with a picture of the build up of their grading on the subject. Since the Portfolios were created as openly available web pages, the students were encouraged to visit each other's Portfolios and to act as peer reviewers of each other's work. This reviewing not only contributed to increase the readers' own bodies of knowledge, but also promoted a sense of responsibility for the build up of collective knowledge. This, in turn, influenced the quality of their contracted activities, since they were encouraged to improve those activities on the basis of the comments and suggestions received and of the stimulus sparked by their discussions. The paper describes in detail the valuable insights on this approach, its merits and problems, as well as some student suggestions and hints for improvement. The implications for the development of a supporting software tool are also discussed.*

1 INTRODUCTION

In these days of growing complexity and unpredictability, where knowledge and skills keep failing to respond to unpredictable defiance, one of the main challenges of engineering education is that of exploring learning contexts that value autonomy, responsibility, activity, interaction, communication and team work, and thus become capable of preparing the future professional for to the difficulties of such a world.

It is currently recognized that innovative learning contexts fulfilling those requirements are difficult to build within the traditional "delivery of information" paradigm of most universities. However, when innovative faculty attempt to explore more constructivist approaches to learning, they generally stumble on the barrier of assessment. How can we assess learning outcomes that result from the exploration of complex, organic, learning environments?

This paper describes the case of an Advanced Information Systems course for Informatics Engineering undergraduates where assessment has been carried out combining two key concepts of adult education that comply with constructivist approaches to learning: learning contracts (Knowles, 1975, 1984, 1986) and learning portfolios (Klenowski, 2002; Gathercoal, 2002).

A learning contract is a personal written commitment where a student specifies his/her learning objectives for a period of time, in a given course, and clarifies the activities he/she is prepared to carry out in order to satisfy those objectives. A learning portfolio is a collection of the assignments produced by a student, in a given course, to demonstrate success in satisfying the learning objectives of the course. In this sense, and in spite of the fact that they are not often seen used together, learning contracts and learning portfolios are two quite complementary learning tools.

One essential element of learning portfolios, apart from the assignments produced, are the introspective reflections the students carry out – and include in their portfolios – clarifying what they have learned and what they plan to do next to improve their knowledge and skills on the subjects being learned. The reflections in a portfolio can be produced in connection with each major milestone of the course, one per milestone, or they can be carried out periodically (weekly or fortnightly) summing up the gains obtained in such periods. In spite of difficulties the students tend to experience, in the beginning, to produce such reflections, they are of absolutely critical importance, because of the role they play in developing the metacognitive ability of the students, through the process described by Donald Schön as “reflection on action” (Schön, 1986). They are also clear indicators of levels of achievement, when scales of educational objectives, such as Bloom’s taxonomy, are used (Bloom, 1956).

In the remainder of this paper we will start by briefly describing the background and characteristics of Learning Contracts and Portfolios. Then, in section 3, we characterize the course subject to which these learning tools were applied. Section 4 explains, in detail, how the Learning Contracts and Portfolios were articulated in order to promote learning of the subject. Assessment is addressed in section 5, just before closing with a discussion of results and some final remarks.

2 TOOLS TO BREAK AWAY FROM DELIVERY

Assessment should be understood not only as a means for the analysis of learners performance but mainly as a fundamental element of the teaching-learning process. Building on this idea, assessment should be structured to support different functions, but mainly to monitor individual progress and identify individual difficulties, aiming for the global development of the learner. Thus, the learning experience can be improved if assessment methods are deployed not only as evaluation techniques but also as guidelines to support the learning process as a whole. Learning Contracts and Learning Portfolios represent two of the tools to break away from the delivery paradigm in learning assessment.

2.1. Learning Contracts

Tough the conceptual origin of Learning Contracts (LC) may have been stimulated by Dewey’s ideas and traced back to the first quarter of the 20th century, the most fascinating definition of LC is the one provided by M. Knowles: “It is a truly magical way to help learners structure their own learning” (1980, p. 238).

As pointed out by research on adult learning (Toughs, 1979, in Smith, 1982; Knowles, 1980), there is enough evidence that what learners learn by their own initiative is learnt in a more deep and permanent way than what they learn by being taught. In this line of thought, individuals may take full responsibility for those learning experiences in which they engage just for pure personal development. Thus, these learning experiences may be carried out completely with only a loose structure. However, in an academic context such as Information Systems Engineering Education, the aim is to provide or improve the individuals’ competency to perform in a certain job or profession, envisioning the needs and expectations of the profession peers and of society in general.

LC develops as an instrument for negotiating a reconciliation between external and internal needs and expectations, between societal and individual interests (Loacker & Doherty, 1984, in Knowles, 1984). Thus, LC develop in the learner a sense of ownership of the learning plan, by providing the means for making the planning of the learning experience a mutual project between the learner and the learning facilitator (teacher, tutor, peers or other).

According to Knowles (1980; 1986) the development of a LC engages a 9 step plan: 1. Diagnosis of learning needs (learner assesses the gap between where he is currently and where he wants to be); 2. Specifying learning objectives (learner translates the identified needs into learning objectives that describe what is to be learnt); 3. Specifying learning resources and strategies (learner describes how he intends to accomplish each objective); 4. Specifying target dates (learner establishes deadlines to

complete each learning objective); 5. Specifying evidence of accomplishment (learner describes the evidence he will collect to indicate the degree he has accomplished each objective); 6. Specifying how the evidence will be validated (learner describes the criteria he proposes the evidence to be validated by and the means to do so); 7. Reviewing the Learning Contracts with consultants (get the LC first draft reviewed by peers or the learning facilitator to get feedback); 8. Carrying out the Learning Contract (implement the contract though it may be revised at any time) and 9. Evaluating learning (learner gets assured that he learned what he proposed to by evaluating the adequacy of the evidence and validation data). In their essence, LC represent an alternative structuring for learning, by replacing a content plan with a process plan, content with context, teacher-centred with learner-centred.

The above stated ideas allow us to realise that dealing with wide differences within groups of learners, helping learners clearly understand the goals of a learning activity, helping learners to develop more of a sense of personal commitment towards learning activities, sharing responsibility in evaluating learning outcomes, are some of the most common problems affecting teaching-learning that LC help solving. Furthermore, the explicit goal of LC is that of producing lifelong learners, by providing the opportunity to increase the learners' responsibility and creativity in the learning process.

The concern for a more individualised assessment, respectful of the learners' needs, expectation and cognitive style, pointed out the need for complementing LC with another self-directed learning and assessment tool: Learning Portfolios.

2.2. Portfolios

Literature review offers several definitions of Learning Portfolios (LP) that in spite of minor differences converge into the idea that a LP represents the collection and selection a learner does of the work developed (includes all the material found relevant for the learning process) along an established assessment period, enhancing the steps taken along the learning path and evaluating the learners' progress and identifying the problems faced (Barret, 2000a; Damião, 1996; Education Office Research, 1993).

Alongside with the aims of Learning Contracts, the development of a Learning Portfolio requires from the learner a greater commitment and responsibility for its own learning process. Thus, LP claim for a redefinition of the roles played in the teaching-learning process. In this sense, the learner takes on the responsibility for the main tasks of LP development (Barret, 2000b): 1. To collect (the learning materials); 2. To reflect (on the choices made, their relation to the learning goals and on how the work developed); 3. To project (define new goals according to the progress made and the next achievement envisioned) and 4. To present (show the work done by sharing the LP).

As for teachers, they now embrace the role of learning facilitators, providing the space and the tools the learner needs to take full responsibility over its own learning process through commitment and motivation to continuous learning. Other than the learner and the teacher, peers co-star in the LP development, by providing feedback on the work shared in the LP; thus, either with a formative or a grading nature, peer feedback is fundamental for the creation of knowledge and the consolidation of internalised learning. Other than promoting the redefinition of roles, resorting to LP also aims to: actively engage learners in the assessment process; optimise learners' performance; increase self-improvement in learning; promote a holistic view of learners' development and, support teachers' decision making.

In spite of the model used, some key elements should be present in every LP, namely: the learners' goals; table of contents; guidelines for the selection of learning materials; work samples; feedback from peers and teachers; reflection 'moments'; explicit evaluation criteria and, good practices examples.

Following on the previous ideas, it becomes clear that LP have implicit a continuous restructuring and re-evaluating dynamic organised around 3 major dimensions and that their use provides the opportunity to explore and reinforce the links between different learning experiences, to create something tangible to share the results of learning and, above all, to reflect on the learning process (Figure 1).

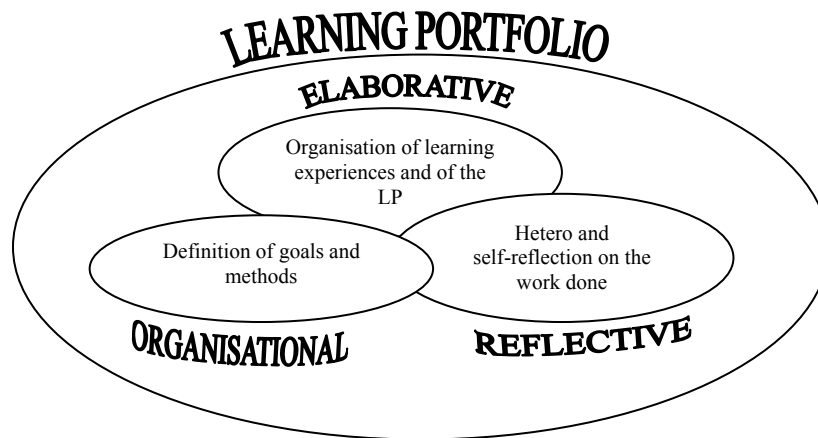


Figure 1 – Major Dimensions of a Learning Portfolio

Having in mind shared knowledge creation, the LP represent an instrument of reflection about learning that also allows the learner to document, register and structure its own learning, restructuring the working methods and learning goals and facilitating the deployment of self-guidance and self-development strategies.

3 REVIEWING THE SUBJECT

In Portugal, undergraduate engineering courses are five years long. The learning techniques we describe were applied to *Advanced Information Systems*, a non-mandatory course that students can take in the 5th year. The purpose of this subject is to build the knowledge and skills required to act as Chief Information Officer (CIO), or Head of Information Technology, in a large or medium organization (CSI, 2004). Given today's heavy reliance of organizations on their information systems, strong demands are placed on those holding this position. They need to be able to: study fast changing alternative technologies, in order to make informed choices; to effectively interpret management and business concerns and translate them into orientations for Information Technology (IT); to assess staff and contractors; and to understand the broader context of social, cultural and political issues affecting the technical solutions to deploy.

The course is attended by twenty to fifty students. All of them are proficient in IT, thus enabling the extensive use of email and web technology. As with all other courses in the Department of Informatics Engineering of the University of Coimbra, this subject has its own web site for syllabus, summaries, reading materials, assignments, links and bibliography, and a dedicated mailing list subscribed by all course students and faculty.

4 MAKING THE GRADE

At the beginning of the semester, the plan and all reading materials for the course are made available at the web site. The relevance and relationships between each major topic are briefly described in class. The students are taught about Learning Contracts and Portfolios and asked to prepare their own Learning Contract, specifying the activities they propose to engage into to meet the goals of the course. This document, based on a template provided at the site, must describe a minimum set of activities and, for each, provide a deadline, a brief explanation of its relevance for the learning context, needed resources, and the proposed strategy to carry it out. Finally an estimate of the man/hour effort required to complete each task is explicitly asked for, to promote awareness of the total workload and of the need for timely management of the self-learning process.

The students are given a broad latitude of decision regarding which activities to carry out. These can range from traditional essay writing and literature reviews, to class presentations, or the organization of seminars that involve professionals from the field. The themes can also differ from those in the course plan, as long as they are proved relevant for the education of a future CIO.

Contracts are reviewed by the instructor and either accepted or returned to the students with feedback for revision. Upon acceptance, the students enter the Learning Contract as the first document in their web based Portfolio. Links to all the Portfolios are made available at the web site. Since the instructor will

frequently visit all Portfolios, to assess completed tasks, a standard format is desirable, so a template for the web based Portfolio is supplied at the course web site. An example Portfolio can be seen in Figure 2

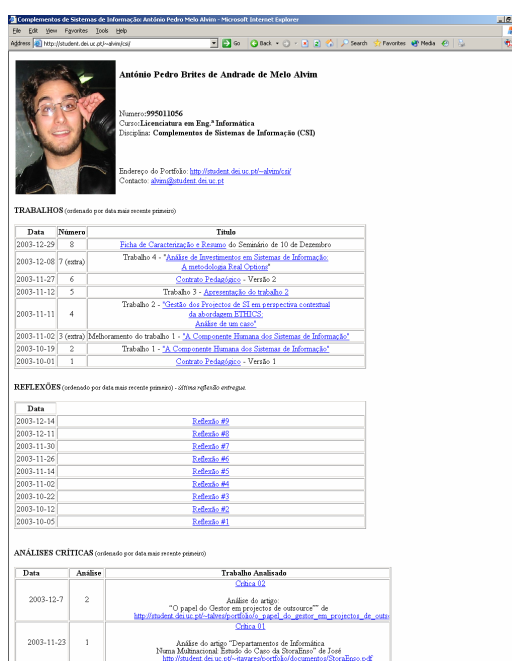


Figure 2 – Example of a web based Portfolio

Once accepted, the Learning Contract provides the terms against which the student will be evaluated. Under exceptional circumstances, however, the instructor may allow for revisions to this agreement, to accommodate for unforeseen circumstances, such as calendar constraints of invited speakers.

While students proceed with the contracted activities, the instructor plays two different roles: that of the traditional lecturer, addressing the major topics of the course; and that of the advisor, during open-lab sessions where students can seek counsel. Open-lab time is also used by the instructor to visit the Portfolios at the various deadlines specified in the contracts, to obtain and assess the corresponding deliverables. On a periodic basis, the instructor also looks for another mandatory category of documents – the student's reflections.

In our course, the reflections were produced periodically, summing up the gains obtained fortnightly. Each reflection was time stamped. It indicated the period covered and contained a self-assessment of the work carried out since the last reflection, with an indication of the knowledge and competencies gained, plus an evaluation of any deviations from the previous plan. Each reflection took the form of 10/2 report, that is, of a report that took no longer than 20 minutes to write and no longer than 2 minutes to read. To provide some guidance to the student, a template for writing reflections was available at the course web site.

Although there is a baseline Portfolio that corresponds to the minimum required effort to pass the subject, supplementary activities can be considered. Peer-reviewing of other colleague's portfolios is particularly encouraged as a form of gaining additional marks. To stimulate cooperation rather than competition, when a student receives a criticism and reviews the corresponding assignment, taking into account that criticism, the resulting improved assignment also receives additional marks. The immediate benefits are an increase in the reviewer's knowledge and an improvement of the original author's work, as the comments from the peers, their suggestions and the insights sparked by their discussions are taken into account in the improved versions of the assignments. But reviewing also promotes a sense of responsibility for the build up of collective knowledge, as it forces taking the perspective of an evaluator that is accountable for his/her role as such. The experience, in turn, affects the way in which the student playing the role of an evaluator perceives his/her own subsequent work.

5 ALIGNING THE ASSESSMENT

Assessment is a corner-stone of any educational endeavour, since some kind of mark of the performance of participants is usually required. It is important, however, to design the assessment mechanism with the same care put into the learning process, to avoid the risk of subverting its goals. For instance, it is all too easy to destroy any attempt to promote responsibility for managing the self-learning if timely assessment indicators are not provided or if deadlines are neglected.

Our assessment model draws on two major components: the evaluation of the activities described in the Learning Contract, whose deliverables are entered in the Portfolio, and a written exam. However, to reward sustained commitment during the semester, the test is not mandatory for students topping an average of 80% across all Learning Contract activities. Conversely, the test alone cannot substantially improve a poor accomplishment during the semester, since its mark is averaged with the Portfolio grade. The Contract is also enforced by penalizing late submissions by a percentage of the total mark.

A key feature of our assessment mechanism is a permanent awareness, by the students, of how well they are performing. Each one is permanently assigned a grade, calculated as the running average of the marks obtained for the Contract's activities, as they are carried out. After the evaluation of each activity entered into the Portfolio, the student's grade is updated and publicized. During the open-lab classes the students have the opportunity to review their recent assessment, and, thus, get immediate feedback on what to improve for the next task.

As an incentive to accomplishments beyond the basic performance, the baseline Learning Contract accounts for only 85% of the maximum possible grade. The remaining 15% are accessible only to those wishing to go beyond that minimum. This means engaging in additional activities. Since the mark for the remaining 15% of the maximum grade is the average of the marks in the extra activities, the student must weight their quantity and quality against the desired grade. The option of doing additional work is also open to students wishing to improve a less than satisfactory grade in the baseline portfolio.

6 DISCUSSION AND FINAL REMARKS

Students embraced this learning and assessment model with noticeable enthusiasm. The freedom to choose which activities to engage in and to select the themes to address (as long as they were relevant for the subject) translated into high motivation. The majority of them prepared Learning Contracts that went beyond the minimum baseline. Several very relevant topics that were not part of the original subject plan were identified, studied and presented. High quality work was submitted by several students. The build up in quality was also noticeable for those students that used the open-labs to find out flaws in previous work, so as to avoid them in subsequent tasks.

By the end of the course, 33% of all enrolled managed to top the 80% average across all Learning Contract activities, so as to be allowed to dismiss the written test. Another 28% passed the subject after the exam. The average grade of all passed students was 70%. It is interesting to note that, from the 39% that failed the subject, 86% of them were no-shows or early drop-outs, who abandoned immediately or after the first deadline.

The initial enthusiasm of the students must be taken into account by the instructor when accepting the Contracts, as it often leads to an overestimation of the feasible workload. The burden on the evaluator is also noticeable: Portfolios must be frequently accessed – according to the deadlines specified in the various Learning Contracts – and deliverables must be timely graded, so feedback can be available for students to incorporate in their next task. This load raises natural concerns on the scalability of this approach for a greater number of students. The evaluator's role can be eased if an appropriate software tool is available for demanding chores, such as deadline control, grade management, Contract revision and peer-review tracking. That tool is currently in the process of being developed.

Students suggested additional tunings, such as the ability to discard the worst grade and replace it with the mark of an extra task. Typically, the worst result corresponds to the first contracted activity, as students adjust to the model and levels of exigency of the evaluator. Accordingly, this desire to have a second go with better preparation seems commendable and can be admitted without compromising the overarching goals. A second suggestion called for the compulsory introduction of at least one group activity in the Contracts.

We currently believe that the peer-review's role should be further strengthened. One possibility is to make this a mandatory requirement to access the higher 15% of the maximum possible grade. Ways of using this peer-reviews to help the evaluator in the grading is under analysis.

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