CONTRACTING TO LEARN: AN EVALUATION OF THE EFFECTIVENESS OF LEARNING CONTRACTS IN SUSTAINABILITY EDUCATION

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Abstract

It is axiomatic to say that assessment drives learning. It has also been reported that students who are given a measure of freedom in determining how to undertake their assessments experience greater levels of motivation, increased satisfaction, and richer learning outcomes. The ultimate expression of these tenets would therefore result in students being given the opportunity to design their own learning experiences set within the context of a particular knowledge domain, something that learning contracts set out to achieve. This paper reports on an evaluation of the effectiveness of such an approach when it was applied to "design and the environment", utilising longitudinal measures of student satisfaction together with an assessment of the impact of the course upon students thinking. It also includes facilitator reflections, thereby completing the stakeholder evaluation, concluding that learning contracts can be an effective approach given careful design and an appropriate context.

Keywords: learning contract, sustainability, assessment, evaluation.

Introduction

At the University of Newcastle a programme restructure allowed the development and delivery of a "Design and the Environment" course to a multidisciplinary cohort including full-time on-campus students and distance learners. They came from design and technology education, engineering, industrial design, construction management and architecture programmes, located at diverse, remote locations (some of which were international).

The course redesign was underpinned by a number of key principles. Firstly, the role of a designer would be pivotal in shaping not only the instant appeal or otherwise of an artefact but also the long-term costs and consequences of owning and operating it, both for the owner/user and for the wider community. Secondly, it would be possible for a student from a particular discipline to define appropriate problem boundaries, which should address the nature of the environmental impacts, appropriate assessment mechanisms, and the generation of design alternatives that will minimise the environmental impact. Thirdly, the accepted norms for one discipline could reasonably be expected to differ somewhat from those of another discipline.

The last issue posed a challenge to the course designers. Historically the students who took the course as an elective were expected to adopt the norms of the group for whom it was a core element of their programme. However the increasing acceptance of holistic approaches to problem-solving within science and society suggested that the development of a generic, trans-disciplinary understanding of sustainable design was desirable.
Developing a generic template for sustainable design suitable for the multiple disciplines within the cohort presented challenges. Firstly, it was necessary to accommodate the attitudes and expectations of clients for their services, whilst concurrently identifying the availability and nature of decision support tools to assist them during the design process. Secondly, their designs needed to be acceptable to the end users (who might be different from their clients), including the consequences of their design decisions. Moreover, it was necessary to recognize the extent to which it is cost-effective or indeed even feasible to conduct an accurate assessment of the life-cycle costs. Lastly, the template had to accommodate the differences in the nature of the artefacts generated by the students in the assessment process, ranging from a full-size model or even a working prototype, to a documented graphical model.

The objective was to produce environmental generalists who shared a common understanding of what it meant to be an environmentally aware designer, whilst continuing to address the range of discipline-specific constraints presented by the group.

Assessment Driving Learning: The Case for Learning Contracts

It has become axiomatic to say that assessment drives learning (Hedberg and Corrent-Agostinho, 2000). This is reflected in the design of undergraduate programmes in the School of Architecture and Built Environment at the University of Newcastle in Australia, where Problem Based Learning is widely used across the disciplines of architecture, construction management and industrial design. Whilst each programme uses unique assessment strategies, they all embrace constructivist theory, encouraging each student to create their own knowledge as they solve complex problems (Savery and Duffy, 1994), empowering them to take charge of their own learning. The challenge becomes one of finding an assessment mechanism that drives student learning and knowledge creation, signposting its professional relevance.

Learning contracts are a mechanism by which students can be empowered to take command of their own learning, negotiating a range of matters including topics to be covered, criteria for assessment, and the nature of their assessment product (Knowles, 1986). Yet the use of Learning Contracts in the context of professional education has tended to be limited to postgraduate courses and self-directed Continuous Professional Development (Williams and Williams, 1999). This School had considerable experience of using learning contracts in design courses. Their introduction was in response to student feedback, and their use met with an enthusiastic response (Williams and Williams, 1999).

Such a mechanism was proposed for the course “Design and the Environment”.

The Course Content

The course content was conceived using a systemic perspective of the design process. This formed the basis for both content selection and course structure. This approach was driven by the idea that the designer was subject to a variety of influences that often competed with each other for attention and predominance, and that (s)he was constantly making decisions that balanced one with another. When drawn as a Venn diagram (Figure 1) it is possible to see that the eventual solution to the design problem lay in a decision space at the intersection of all the influence domains (shaded black). These influences were made explicit in the course outline, and reflected in the course outcomes.

However, the novelty of this course lay in the fact that students designed their own learning experiences, including the criteria against which their work was to be assessed. Figure 1 describes a situation where all of the influences are given equal prominence. However, the fact that they are set in the context of a learning contract environment indicates that they in turn are influenced by the learning experience. In practical terms, this meant that the student was at liberty to choose to assign different weightings to each influence, and to articulate them in their learning contract. Furthermore, the range of issues contained within “each influence” group could themselves be subject to relative weightings. The role of the “Assessment Rubrics” are critical to this phase of the process as they both guide the students in the development of their design as
well as assisting them to frame their item specifications to align with the assessment requirements. The first page of the learning contract provides the venue for the students to articulate their intentions through their item specifications and the assessment weightings assigned to each, and this is done through the variable scales with defined parameters to retain the integrity of the course learning outcomes. A completed first page of the learning contract can be seen in Table 1: this was an initial example completed in week 3 by the lecturer to illustrate the principles involved. Later in the course it was used as the point of departure to discuss the ways in which the issues articulated in it could be refined to best reflect the student's research and experiences, and thereby maximise their assessment outcomes.

![Figure 1: Influences on the Course Design](image)

Naturally, the negotiations concerning the individual learning contract would be conducted with the course coordinator. However it was felt that presentations in a group situation could provide powerful feedback for individuals, and therefore it was decided that a group seminar would be undertaken in the early weeks of the course. Group feedback would help the students understand whether their strategies to achieve learning outcomes were clear, understandable, and achievable. It would also help surface alternative strategies and techniques, both in terms of the learning contract and the assessment product (Knowles, 1986).

The eventual outcome of the students' learning experience, agreed upon with the lecturer, and enshrined in their individual learning contract would look more complex and "messy", reflecting the inherent complexity and "messiness" of real world problem-solving. Above all, each student's solution would be unique, representing their understanding of the issues and the relative importance of each to the generation of a holistic design solution. This would eventually be reflected in the mix of assessment items and weightings nominated by the student in their learning contract.

Once a student had documented what (s)he intended to achieve it was possible for them to propose strategies to make this happen. Due consideration would need to be given to resourcing these outcomes, in terms of human and material resources, tools and techniques, as well as time. The use of project planning techniques, such as Gantt charts and method statements were recognised to be both helpful and appropriate. These would include performance specifications that allowed both the student and the assessor to gauge the extent to which the evidence presented met with the agreed performance specifications.
Evaluation

The primary evaluation of any course should consider the quality of student learning as evinced by assessment submissions. In this regard the cohort’s work displayed both rigour and innovation across a widely diverse range of contexts (see Figure 2). Projects were as varied as concrete reinforcement stools, particulate-capturing exhaust systems for motorbikes, recycled cardboard furniture, software to monitor and control domestic power and water consumption, grey water reuse systems, green buildings, and various textile-based products. The overwhelming majority of them were supported by detailed audits of current environmental issues associated with their chosen design problem, together with an assessment of life cycle impacts. These were predominantly conducted using Eco-IT 1999 software.

Quantitative and qualitative feedback was obtained on the students’ experiences of the course using two mechanisms: Student Evaluation of Courses (SEC) questionnaire, which is mandated for all courses, and; Student Evaluation of Teaching questionnaire, which is voluntarily used by staff wishing to obtain detailed feedback on their performance. Whilst the former is standardised the latter can be customised to address specific issues of interest and can include free responses to open ended questions. All quantitative responses are given on a 5 point Likert scale where 1 = strongly disagree and 5 = strongly agree. In this SET open response questions asked for three best points, two worst points and one area for improvement in the course. Evaluation of the course also included unsolicited feedback obtained in tutorials and student emails. A total of 38 students were enrolled in the course, all of whom were given the SEC. 14 students were distance learning enrollees who were not given the SET. 16 on-campus and 3 distance learning students completed questionnaires. The results are summarised in Table 2, which also contains the last set of SEC results for the old course.
Table 1: Front page of a completed Learning Contract

<table>
<thead>
<tr>
<th>Assessment Item</th>
<th>Item specification (negotiated)</th>
<th>Item weighting (negotiated, insert value)</th>
<th>Item grade (cols 4/6)</th>
<th>Final item grade (cols 3/5)</th>
<th>Item rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project plan (5 - 10%)</td>
<td>List of key activities and milestones required to complete the project together with time estimates for each and completion deadlines. These will be presented in a Gantt chart.</td>
<td>10%</td>
<td>0</td>
<td>0</td>
<td>Rubric</td>
</tr>
<tr>
<td>Project model prototype (10 - 40%)</td>
<td>I am going to produce a model of a generic university course delivery system that is taught online. It will be based on the development of a Blackboard course template. The objective will be to include paperless delivery of course materials, interaction with students, and assessment. Test of the prototype will be carried out by both teaching and student assistants.</td>
<td>40%</td>
<td>0</td>
<td>0</td>
<td>Rubric</td>
</tr>
<tr>
<td>Project documentation (10 - 40%)</td>
<td>The final documentation will be of the course structure, relevant policies and evidence of compliance, development of Blackboard, etc. The environment settings for the course will be based on an evaluation of materials (e.g., paper, printing, etc.) as compared to the costs (computers, electricity, supplies, printing, etc.). This will reflect the life cycle costs associated with computer ownership and power generation, as offset by savings in student travel and campus assuming distance learning delivery. The balance of any carbon deficit associated with the course will be funded in terms of carbon credits purchased from accredited sources.</td>
<td>20%</td>
<td>0</td>
<td>0</td>
<td>Rubric</td>
</tr>
<tr>
<td>Evaluation/Reflection (10 - 40%)</td>
<td>The final evaluation of the course will be a weekly basis that records reflection on action, together with reflection on the course and any portfolio where appropriate. These will enhance the quality of feedback. The final evaluation will evaluate the final grade relative to the ideal specification for the project module.</td>
<td>10%</td>
<td>0</td>
<td>0</td>
<td>Rubric</td>
</tr>
<tr>
<td>Seminar presentation (20%)</td>
<td>Powerpoint slides including notes that outline the key concepts and tools to be included in the course, together with an overview of the concepts included in the environmental evaluation. The presentation will include my Gantt chart.</td>
<td>20%</td>
<td>0</td>
<td>0</td>
<td>Rubric</td>
</tr>
</tbody>
</table>

The terms of this learning contract have been agreed upon for completion by:

**Completion date:** 5 Nov 07

**Student name:** Graham Brewer (the student)

**Student number:** 723456

**Course coordinator:** Graham Brewer

**Date:** 12 Aug 07

**Signature:**

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Table 1: Front page of a completed Learning Contract
Figure 2. Student projects: urban cycle station, exhaust system, power and water control and monitoring software, and cardboard furniture.
Table 2. Summary SEC and SET results.

<table>
<thead>
<tr>
<th>Question (source)</th>
<th>Mean (cohort)</th>
<th>SD</th>
<th>Mean (old course, no distance learning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As a result of studying this course, I have improved my knowledge of the topics/material covered (SEC)</td>
<td>4.5 (on-campus)</td>
<td>0.632</td>
<td>3.47</td>
</tr>
<tr>
<td></td>
<td>4.0 (distance)</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>The substance of this course was intellectually challenging (SEC)</td>
<td>4.3 (on-campus)</td>
<td>0.447</td>
<td>3.24</td>
</tr>
<tr>
<td></td>
<td>4.0 (distance)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>The following components used in this course were well organised, providing an effective learning experience (SEC)</td>
<td>4.6 (on-campus)</td>
<td>0.629</td>
<td>3.41 (across all components)</td>
</tr>
<tr>
<td>Lectures</td>
<td>4.0 (distance)</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Tutorials</td>
<td>4.3 (on-campus)</td>
<td>0.837</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.0 (distance)</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Online support (Blackboard)</td>
<td>4.5 (on-campus)</td>
<td>0.756</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.7 (distance)</td>
<td>0.557</td>
<td></td>
</tr>
<tr>
<td>Overall I am satisfied with the quality of this course (SEC)</td>
<td>4.4 (on-campus)</td>
<td>0.814</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>3.7 (distance)</td>
<td>0.557</td>
<td></td>
</tr>
<tr>
<td>This course has increased my understanding of the environmental impact of product design decisions (SET)</td>
<td>4.5</td>
<td>0.484</td>
<td></td>
</tr>
<tr>
<td>This course has exposed me to a wide range of environmental sustainability issues (SET)</td>
<td>4.7</td>
<td>0.464</td>
<td></td>
</tr>
<tr>
<td>This course will impact upon the way in which I conduct my professional practice (SET)</td>
<td>4.3</td>
<td>0.583</td>
<td></td>
</tr>
</tbody>
</table>

These results indicate a consistently high regard for the conduct and outcomes of the course and the mechanisms employed by it. More importantly the specific SET questions regarding the impact of the course on the students’ environmental awareness and, most particularly the impact it has had on their intentions in regard to professional practice returned highly favourable results. The comparison with SEC results for the previous course was particularly encouraging, justifying the course re-design. It should be noted that whilst the response rate for the external students was disappointing, thus limiting its usefulness, it was not unusually low relative to other distance learning courses.

There were plenty of positive comments in regard to the diversity of topics considered during the course:

“Oh yes, keep these lectures coming – they’re why I took this course – to be exposed to wider issues outside my experience” (industrial design student, on the usefulness of broad ranging topics).

“I didn’t realise what there was to it... I mean you hear about Kyoto and its familiar, but what does it really mean? The stuff on the impact of restaurants and food well I mean...... I will be teaching that to my kids” (food tech teacher, relating course content to future teaching practice).

“Never mind that, my flatmates are wondering who keeps switching the lights off all the time!” (architect, commenting on behaviour change as a result of the course content).

“This course has really opened my eyes” (SET comment).

And in terms of the learning contracts:

“It was strange at first but then you get the hang of it. It forces you to think about what you are trying to do” (technology teacher).
“Yes once you understand your way around it, it is quite simple and it lets you know where you are going and what you’ve got to do” (food tech teacher).

“I think the freedom is the thing I like most about this. Normally we get told what we are going to do and it’s all the same” (industrial design student).

In terms of impact on future professional practice:

“I am thinking about my own teaching and how to include this!” (SET comment).

Finally some unsolicited email comments.

“I am looking into getting a patent for my product – I’ll let you know how I get on, thanks for the awesome course.” (Unsolicited email from student).

I enjoyed the course immensely and really think it should have been a core subject for Industrial Design as I think there wasn’t enough emphasis on sustainability until our final year. Thanks again.” (Unsolicited email from student).

By way of example it is useful to consider the way in which a prototype car washer that harvests and uses grey water, and a computer generated model of a carbon neutral dwelling may be assessed. In the first instance each student will produce a design brief, define the boundaries to their environmental assessment, identify appropriate environmental assessment metrics, and state what their deliverables will achieve in terms of functionality, quality, purpose, etc. These will be articulated on the front page of their contract, but these statements will have been informed by the performance attributes given to them in the marking rubrics on subsequent pages of the contract (see Table 3 for example). In the case of the car washer the student might simply wish to demonstrate that the idea works, with little regard to aesthetics, or the eventual design of a production version. By contrast the building design will be articulated in a near professional standard computer model that could be used to drive construction of the real building. Once each student has clearly specified what it is that they intend to produce, and obtained staff sign-off on it, they know exactly what it is that they have to do in order to reach a stated performance band. Lecturer approval reflects both the proposed quality and degree of difficulty involved in the project model/prototype, and will be considered together with the project documentation, which includes the environmental impact analysis for the project. Some students will opt to focus on one area more than the other, and indeed some projects will demand this as can be seen in the earlier examples. In all cases students will be counselled to play to their strengths.

As a result of student feedback and staff experiences a number of minor changes are likely to be made to the learning contracts for next year. The first involves a reduction in the number of assessable items, achieved by rolling into one both the project plan and seminar presentation, and the project documentation and reflection/evaluation. The second requires a rewording of the project model/prototype rubric to remove references to ‘production-ready’ as this implies that high

<table>
<thead>
<tr>
<th>IDE2461 Design and the Environment: Model/Prototype Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSESSMENT CRITERIA</td>
</tr>
<tr>
<td>Workmanship</td>
</tr>
<tr>
<td>Function</td>
</tr>
</tbody>
</table>

Table 3. Example rubric.
levels of performance are conditional upon achieving this – something that concept prototypes will never achieve.

Conclusion

The use of the learning contracts in this course has proved effective in raising student awareness of the learning outcomes and what is required in their planning to achieve the outcome. Students’ initial response is one of concern but by the end of the semester they have responded well to it. It appears that the factor that most influenced the students’ acceptance of the learning process was the highly structured assessment rubric. The ability to be able to set different assessment parameters and see the difference the changes made to their overall assessment profile provided them with a better insight into managing their planning. The concept of the learning contract has provided the flexibility to make a course, which consists of predominantly elective students, both relevant to their context as well as maintaining the integrity of the environmental design content.

References