Implementing Learning Contracts in a Computer Science Course as a Tool to Develop and Sustain Student Motivation to Learn

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Abstract

A learning contract is a written agreement collaborated between a student and a lecturer. It describes what is to be learnt, how it will be learnt, and how that learning will be evaluated. This paper assesses the implementation of learning contracts on 57 undergraduates registered in a second year computer science course called Document Markup Languages in the RMIT Bachelor of Computer Science and Bachelor of Information Technology external programmes conducted at Taylor’s University. The learning contract was used as a learning tool in the coursework component (three individual assignments) of the course. Data on the students’ motivation to learn the course, prior to the implementation of the learning contracts, and their motivation to learn after the implementation of the learning contracts were collected from a qualitative pilot questionnaire and quantitative standard questionnaire based on the theory of planned behaviour. The results indicated an increase in students’ motivation to learn and share their practical results between students and their lecturer. Results also indicated an increase in students’ self-learning when using learning contracts. The conclusions from the analysis of the pilot and standard questionnaires supported each other. However, the limited time per student with the lecturer, and the students inexperience in using learning contracts especially in the initial stage, was an impediment on both parties. In spite of the limitations, learning contracts help develop and sustain student motivation and has the potential to be used in other computer science courses.

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1. Introduction

One of the graduate capabilities that a student in the RMIT Bachelor of Computer Science and Bachelor of Information Technology external programmes conducted at Taylor’s University is expected to develop, is accepting the responsibility for life-long learning. Hence, the programme delivery emphasises on self-directed learning (SDL). With SDL, the student takes the initiative and the responsibility for what occurs. Students are able to select, manage, and assess their own learning activities. This is also evident in the delivery of the coursework component for a second year elective course for both the RMIT programmes, called Document Markup Languages (DML). In general, this course covers in-depth knowledge and application of the eXtensible Markup Language (XML); the international standardized markup language designed for use on the World Wide Web. The coursework component comprises 3 individual assignments whereby students must create their own XML documents and their corresponding vocabularies, transform their XML documents for presentation on the World Wide Web, and write programs (Java or PHP) to manipulate their XML documents; given a real-world scenario.

From past experience however, some students are very reliant on the lecturer’s guidance and have problems in integrating theories with practice. The lecturer often faces difficulties when trying to address the individual needs and learning styles of students. Apart from this difficulty, both the RMIT degree programmes are currently being phased out from Taylor’s University; i.e. these two degree programmes are no longer offered as part of the programmes available at the university, as of 2013. The implication of this phasing-out process is that there are less electives for the students to choose from, and many students elected to take DML simply because they may have no other option available, even though they may not have wanted to do this elective in the first place. This indicates that there may be students who are unmotivated to do well in the course because of low self-efficacy; which leads to lack of confidence that he or she can do the assigned work. Therefore, approaches that promote self-directed learning must be employed to develop and sustain students’ motivation to learn DML.

1.1. Literature Review

From the perspective of education, the term motivation is defined as the stimulus for the desire to learn something. In the context of course delivery, this usually refers to stimulating students’ interest in the course content, or what is known as intrinsic motivation. (Nilson, 2010) suggests that an educator should want to induce a genuine fascination with the course, a sense of its relevance and applicability to life and the world, a sense of accomplishment (for its own sake) in mastering it, and a sense of calling to it. Apart from intrinsic motivation, there is also extrinsic motivation. (Nilson, 2010) defines extrinsic motivation as external to one’s feelings about the course itself; like the expectations of significant others, such as parents, spouses, employers, and teachers, and because of a course’s earning potential.

It is not always possible for an educator to affect extrinsic motivation, but it is possible to enhance a course’s intrinsic appeal to students (Nilson, 2010). (Hobson, 2002; Levin, 2001; Svinicki, 2004) mentions that intrinsic motivators are often more potent than extrinsic ones. There have been several studies enquiring university students’ opinions of what makes them want to learn, to allow educators to have a good understand what students think motivates them. Among those critical factors include the active learning strategies employed and instructor’s rapport with the students (Sass (1989)). Hobson (2002) identified critical factors to motivate students based on positive and negative motivators. Hobson (2002) suggests that the most powerful positive motivators to be the instructor’s positive attitudes and behaviours, a cohesive course structure, a student’s prior interest in the material, the relevance of the course content, and the appropriateness of the performance measures. As for the most negative motivators, these include a poor learning environment, boring or irrelevant course content, and a student’s prior disinterest in the material. Hence, even though an educator is unable to control their students’ attitudes before they start a course, an educator does have control in deciding the organization and delivery of the course, its contents, and the assessment components.
In the context of computer science as a course, there are significant challenges for students to be motivated to learn. In an effort to understand student motivations, attitude-behaviour theories and models are from time to time used in teaching and learning research. One such theory is the theory of planned behaviour (TPB) (Ajzen, 1991). According to the theory, human behaviour is guided by three kinds of considerations: beliefs about the likely consequences of the behaviour (behavioural beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may facilitate or impede performance of the behaviour (control beliefs). The following figure is a schematic representation of the theory:

![The Theory of Planned Behaviour (Ajzen, 1991)](image)

In simple terms, to predict whether a person intends to do something, we need to know whether the person is in favour of doing it (‘attitude’), how much the person feels social pressure to do it (‘subjective norm’) and whether the person feels in control of the action in question (‘perceived behavioural control’) (Francis et al, 2004). If these predictors are improved, then the chance that a person will intend to do a desired action can increase. In the context of a student attempting to complete his/her coursework for example, the student’s actual decisions and actions in doing the coursework are examples of intentional behaviour.

1.2. Adopting the Model to Practice

Biggs (1989) proposed that teaching can be enriched via an interactive means whereby students are involved in the learning process as early, and as much as possible. In the context of motivation, Biggs (1988) maintains that students should be aware not only of their specific “cognitive resources” but also of their “intentions” (p. 187). Linda Nilson (2010) also mentions the following on motivating students: “Allow students some voice in determining the course content, policies, conduct rules, and assignments. If they have input, they will feel more invested and responsible for their learning.”

Linnenbrink and Pintrich (2002) and Collins (2000) propose that a learning contract can be an effective approach to address the limitations, earlier explained in the introduction section. Fox (1983) states that a learning contract specifies what is to be learned, and how learning will be verified. A learning contract is a written agreement collaborated between a student and a lecturer. It specifies the student’s learning objectives (“What are you going to learn?”), resources and strategies (“How are you going to learn it?”), target date(s) for completion (“When will each task be completed?”), evidence/output (“How are you going to know that you learned it?”), verification (“How are you going to prove that you learned it?”) and evaluation (“What is the educator’s feedback?”).
By implementing learning contracts in the DML coursework component, it would provide the students with the means to leverage their strengths and minimize their weaknesses, encourage them to take greater ownership of their coursework, and ultimately, develop and sustain their motivation to learn the course for the whole duration of the semester.

1.3. Aim of the Study

In this paper, the authors used learning contracts in the coursework component of a second year computer science elective course called Document Markup Languages (DML) in the RMIT Bachelor of Computer Science and Bachelor of Information Technology external programmes conducted at Taylor’s University. The learning contracts were used to determine whether it could be an effective tool to develop and sustain student motivation to learn DML. The authors also explored which components of student motivation, based on the theory of planned behaviour, learning contracts showed a significant influence in, and why. The study would focus on the following components: attitude toward the behaviour, perceived behavioural control and intention. Subjective norm is removed from the study as it is not a relevant factor to study with regards to the effectiveness of learning contracts. Subjective norm has also been reported as the weakest predictor of intention. Deci & Ryan’s (1985) self-determination theory also explained why attitudes had a greater influence on results compared to subjective norms; in their paper studying the predictive ability of the Theory of Planned Behaviour on graduate school applicants. The self-determination theory states that persons are more determined in goals they selected themselves rather than by others. One external factor; goal-setting (performance goal) is also included in this study.

2. Methodology

This study introduced the use of learning contracts to students (n=57) enrolled in the Document Markup Languages (DML) course. This study was conducted as a mixed method research with sequential analysis. The mixed method approach allowed the researchers to actively participate with the students in the following areas: the actual experience of using the learning contracts in the coursework component, preparation and facilitation of the students, and at the same time the data collection (Donaldson, 1992); collect, analyse and mix both qualitative and quantitative data in a single study or series of studies in order to understand the problem better (Creswell & Clark, 2007); and achieve complementarity of data: qualitative data are used to illuminate numbers, and quantitative data add more precision to data presented in words or pictures (Greene et al. 1989, Johnson and Onwuegbuzie 2004).

The first part of this study was to administer a pilot questionnaire in the first lecture session for the semester, to allow the researchers to elicit salient beliefs; an important role in developing a TPB-based questionnaire. The students’ responses to a series of open-ended questions were documented and content analysis was conducted to identify themes. The results of this pilot questionnaire would also allow the researchers to generally gauge students’ initial motivation to learn this course.

The second part of this study involved the development and implementation of the learning contracts for the coursework component. The development and implementation cycle for this part of the study consisted of the following three steps: planning and establishing the contracts, applying the learning contracts (repeated a total of three times for each of the three individual assignments) and evaluating the effectiveness of the learning contracts. For the purpose of this study, the learning contract template was provided by the lecturer, based on the structure recommended by McAllister (1996). Students set their own learning objectives, resources and strategies, target dates, evidence and verification and discuss their learning contracts with their lecturer within a week of each assignment’s issued date. The objectives to be achieved, evidence and verification were discussed and negotiated and agreed between students and the lecturer. Once agreed, both the student and lecturer signed the learning contract; the original kept by the student and a copy kept by the lecturer. This process was repeated for the remaining two assignments as well. Figure 2 below is an example of a student’s learning contract:
The third part of this study was the development and implementation of a 31 item student motivation questionnaire to analyse the effectiveness of the learning contracts in developing and sustaining students’ motivation to learn DML; and in order to collect quantitative data. The questionnaire was designed to assess variables associated with the use of the learning contracts in the coursework component of the DML course; derived from components of the Theory of Planned Behaviour (see Fig. 1), and from the results of the pilot questionnaire with the students. The items within these sections investigated the students’ attitude toward doing DML, perceived ability to do DML, intention and performance goals. The same questionnaire was administered twice; one at the beginning of the semester (week 1) before learning contracts were introduced to the students, and one at the end of the semester (week 14); to allow the researchers to obtain information about individual change that may or may not occur for the four motivational factors evaluated in this study.

Upon completion of the questionnaire the students were again subjected to a short open-ended questionnaire to identify if the learning contracts had helped them or not in their coursework, how the learning contracts had helped
them, and/or why the learning contracts did not help them. More importantly, the final questionnaire was conducted to support the findings of the quantitative data analysis, and vice versa.

3. Results

3.1. Pilot Questionnaire

The students were asked the following questions, and told by the researcher that there were no right or wrong answers; and the researcher was merely interested in their opinions:

- Q1. Was DML one of your first choice electives for this semester? (to determine intention)
- Q2. Have you always wanted to take DML as one of your elective courses? (to determine salient behavioural beliefs)
- Q3. Do you feel that it is important to take DML, and if so, why? (to determine salient behavioural beliefs)
- Q4. Do you feel that it is not important to take DML, and if so, why? (to determine salient behavioural beliefs)
- Q5. What do you intend to achieve at the end of the semester for this course? (to determine intention and performance goals)
- Q6. Were there any other factors or circumstances that affected your decision to take DML as an elective? (to determine salient control beliefs)

Based on the responses from the pilot questionnaire, DML was not the first choice elective for a majority of the students, for that particular semester. Majority of the students felt that learning DML was important because the knowledge can be applied in other areas and is related to other technologies, the content is current, interesting and useful, the knowledge is required in my future / when I work, it teaches me about problem-solving and in-depth knowledge in this subject is advantageous. No student felt that learning DML was not important. Majority of students intended to achieve good grades and in-depth knowledge on DML at the end of the semester. The factor that affected their decision the most in taking DML as an elective for the semester is that there was no other option available to them. The findings from the pilot questionnaire were used to create the items in the student motivation questionnaire.

3.2. Student Motivation Questionnaire

The student motivation questionnaire consisted of 31 items; divided into four sections: “Attitude toward doing DML”, “Perceived ability to do DML”, “Intention” and “Performance goal”. The items with the following two conditions were highlighted: items with at least a 5% increment in the mean score; and items with a decrement in the mean score. Table 1 illustrates the “Attitude toward doing DML” items and the mean score before and after the implementation of learning contracts:

<table>
<thead>
<tr>
<th>Item in Questionnaire</th>
<th>Mean (Before)</th>
<th>Mean (After)</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel good about going DML class.</td>
<td>3.68</td>
<td>4.02</td>
<td>9.15</td>
</tr>
<tr>
<td>I know I will enjoy DML lesson.</td>
<td>3.65</td>
<td>3.74</td>
<td>2.62</td>
</tr>
<tr>
<td>I think that learning DML is important because the content is useful as a</td>
<td>4.04</td>
<td>4.30</td>
<td>6.51</td>
</tr>
<tr>
<td>Computer Science / Information Technology student.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think that learning DML is important because it stimulates my thinking.</td>
<td>3.42</td>
<td>3.81</td>
<td>11.33</td>
</tr>
<tr>
<td>In DML, I think that it is important to learn to solve problems.</td>
<td>3.65</td>
<td>3.77</td>
<td>3.20</td>
</tr>
<tr>
<td>In DML, I think it is important to participate in inquiry activities.</td>
<td>3.53</td>
<td>3.79</td>
<td>7.40</td>
</tr>
<tr>
<td>In DML, I feel it is important that I am given the opportunity to satisfy my</td>
<td>3.70</td>
<td>3.94</td>
<td>6.33</td>
</tr>
</tbody>
</table>
own curiosity.
I feel that the content I will learn in DML is interesting.  
I think the knowledge I gain from DML will be used in my future.  
I find the DML coursework interesting.  
I have natural interest in DML related knowledge.  
I have a strong desire to learn the course content in DML on my own.  
I have a strong desire to perform well in the DML coursework.  
I have a strong desire to understand the materials presented in DML.  
I have strong desire to learn more about DML outside of what is taught in the classroom.  

Nine items show at least 5% increment in the mean score; strong indicators that learning contracts may have contributed to the significant increase in the mean score. Item five indicates that interest in DML increased, and more students became interested in DML by the end of the semester. Item seven reported a significant increase in how students managed to really understand the importance of the course. Items eight and nine are also strong indicators of the learning contract’s ability to enhance self-efficacy. Three survey items showed a decline in the mean score after implementing learning contracts in the class. The decline may indicate that they either perceived the course as hard or easy for them by the end of the semester.

Table 2 illustrates the “Perceived Ability to do DML” items and the mean before and after implementing learning contracts.

<table>
<thead>
<tr>
<th>Item in Questionnaire</th>
<th>Mean (Before)</th>
<th>Mean (After)</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am mostly able to do my DML assignments.</td>
<td>3.63</td>
<td>4.04</td>
<td>11.32</td>
</tr>
<tr>
<td>I am able to participate in DML lessons.</td>
<td>3.98</td>
<td>3.91</td>
<td>-1.70</td>
</tr>
<tr>
<td>My efforts in the coursework are responsible for how well I do in the DML coursework.</td>
<td>4.33</td>
<td>4.17</td>
<td>-3.76</td>
</tr>
<tr>
<td>Whether the DML content is difficult or easy, I am sure that I can understand it.</td>
<td>3.77</td>
<td>3.72</td>
<td>-1.29</td>
</tr>
<tr>
<td>I am not confident about understanding difficult DML concepts.</td>
<td>3.02</td>
<td>2.98</td>
<td>-1.29</td>
</tr>
<tr>
<td>I am sure that I can do well on the DML assignments.</td>
<td>3.86</td>
<td>3.96</td>
<td>2.53</td>
</tr>
<tr>
<td>No matter how much effort I put in, I cannot learn DML.</td>
<td>1.79</td>
<td>1.74</td>
<td>-2.50</td>
</tr>
<tr>
<td>When activities are too difficult, I give up or only do the easy parts.</td>
<td>1.98</td>
<td>1.98</td>
<td>-0.19</td>
</tr>
<tr>
<td>During DML activities, I prefer to ask other people for the answer rather than think for myself.</td>
<td>2.07</td>
<td>2.09</td>
<td>0.72</td>
</tr>
<tr>
<td>When I find the DML content difficult, I do not try to learn it.</td>
<td>1.75</td>
<td>1.83</td>
<td>4.30</td>
</tr>
</tbody>
</table>

Question 5, 7, 8, 9, and 10, are presented as reverse scored items; the decline in the mean score is a positive change in perceived ability and the increment in the mean score is a negative change. Four items showed a positive change after implementing the learning contracts; with one item showing more than 5% increment in the mean score. This can be contributed to the use of the learning contracts; which is explored further in the results from the post-implementation questionnaire. The survey items that showed negative change were not significant.
Two items were presented in the questionnaire for “Intention”. Table 3 illustrates these items and the mean before and after implementing learning contracts.

Table 3. Mean comparison on Intention to do DML before and after implementing Learning contract.

<table>
<thead>
<tr>
<th>Item in Questionnaire</th>
<th>Mean (Before)</th>
<th>Mean (After)</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I plan to continue to take DML-related courses.</td>
<td>2.98</td>
<td>3.28</td>
<td>9.86</td>
</tr>
<tr>
<td>I will be taking a DML-related course next semester.</td>
<td>2.81</td>
<td>2.89</td>
<td>3.09</td>
</tr>
</tbody>
</table>

Both showed increment in the mean score; with one item showing more than 5% increment after implementing the learning contract. In the “Performance Goal” section, there were a total of 4 items. Table 4 illustrates these items and the mean before and after implementing learning contracts.

Table 4. Mean comparison on Performance Goal before and after implementing Learning contract.

<table>
<thead>
<tr>
<th>Item in Questionnaire</th>
<th>Mean (Before)</th>
<th>Mean (After)</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I participate in applied elective courses like DML to get a good grade.</td>
<td>3.61</td>
<td>3.40</td>
<td>-5.80</td>
</tr>
<tr>
<td>I participate in applied elective courses like DML to perform better than other students.</td>
<td>3.16</td>
<td>3.19</td>
<td>1.06</td>
</tr>
<tr>
<td>I participate in applied elective courses like DML so that other students think that I'm smart.</td>
<td>1.86</td>
<td>2.00</td>
<td>7.55</td>
</tr>
<tr>
<td>I participate in applied elective courses like DML so that the teacher pays attention to me.</td>
<td>1.93</td>
<td>1.98</td>
<td>2.53</td>
</tr>
</tbody>
</table>

One item showed a decline in the mean score. This may indicate that students no longer thought the main goal for them was to just obtain a good grade, but there may be other reasons as well. This is explored further in the post-implementation open-ended questionnaire. Three items showed increment in the mean score; with one showing more than 5% increment. This may be an indication that although the perception of the course is that it is a challenging one, the students felt that managing to complete the coursework well, would be a real achievement to the student. Apart from this, the verification section in the learning contract allowed peers to verify a student’s work prior to the final submission, and this may have been a contributing factor to the increase as well.

3.3. Post-Implementation Open-Ended Questionnaire

At the end of the semester, an open-ended questionnaire was administered to the students to also identify if the learning contracts had helped them or not in their coursework, and to support the findings of the quantitative data analysis. The two questions asked were “Did the learning contracts help you in the coursework? If yes, why?”, and “If you answered ‘no’ to the first question, please provide reasons why”. 35 students responded yes, 16 responded no, and 6 students were not present when the questionnaire was administered.

The following table is a compilation of the reasons provided:

Table 5. Students’ Response for the Post-Implementation Questionnaire

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Served as a useful guide for the assignment</td>
<td>I didn’t really refer to it all the time.</td>
</tr>
<tr>
<td>helped me communicate with my lecturer</td>
<td>It was extra work</td>
</tr>
<tr>
<td>made the assignment easy to understand because I set the objectives myself</td>
<td>I found it very tedious / difficult / boring to do</td>
</tr>
<tr>
<td>it helped me see the learning objectives of this course very clearly</td>
<td></td>
</tr>
<tr>
<td>I was able to focus on areas that I was weak in</td>
<td></td>
</tr>
<tr>
<td>I know from the beginning of the assignment what</td>
<td></td>
</tr>
</tbody>
</table>
Possible reasons why there were students who did not benefit from the learning contracts: they felt that they did not have enough quality time with the lecturer, some of these students may be high-achievers who are already highly motivated individuals, the frequency of applying the contract may have been too high (one contract per assignment); the use of learning contracts was still a challenge to these students.

4. Conclusion

In conclusion, implementing learning contracts in a computer science course can develop and sustain student motivation to learn; with respect to attitude towards doing DML and intention. There is significant increase between the results of the questionnaire administered before the implementation of learning contracts, to the results after.

The results of this study also indicate an interesting trend. There is a significant increase in students’ attitude and intention towards learning DML, but at the same time, there is a decline for the following factors: perceived ability and performance goals. The decline in these two factors may be contributed to several reasons. The students overall view of the DML course as an easy course may have changed from the beginning of the semester towards the end it. By the end of the semester, the students viewed the course as challenging and difficult. But, the increase in students’ attitude and intention towards DML may have been because students wanted to learn more about the course as weeks went by as they found the content interesting and worthwhile, even though it was perceived to be a challenging course. Another contributor to the decline could be the lack of one-to-one contact with the lecturer, who had to oversee, support and facilitate 57 students in the evaluation and approval of the contracts. Meetings and discussions with the lecturer were not regular throughout the semester. The decline may also be caused by the students’ inexperience in using learning contracts; it was never applied to any of their other courses. Students struggled to apply their skills of self-directedness towards the creation of the learning contracts.

5. Recommendations

From the results of the study, several recommendations would like to be made by the researchers. The pilot study should be expanded further. The study indicates that there does not seem to be any significant increase in student’s perceived ability to do DML, and students’ performance goal. However, the number of respondents is too small to make a generalized assumption of this result. A large sample size is required to confirm this, or otherwise.

The implementation of the learning contract needs to be refined further: apply one learning contract to be used for all assignments, identify in the earlier stage students with difficulties in establishing their contracts, and meeting regularly with individual students throughout the semester.

It is also recommended that learning contracts be applied to computer science courses with a higher percentage allocated for the coursework component as compared to the final examination; or for courses which consists only of coursework. It is also highly recommended to courses with a smaller intake of students. However, learning contracts can be applied to larger classes with the assistance of e-learning platforms that cater for one-to-one virtual communication. This in itself is a possible area for further research; use of learning contracts in a virtual
environment. It is also suitable for large classes whereby there is more than one educator involved in the delivery of the course.

Motivation is not a simple concept to define, nor is the student motivation questionnaire used in this study void of improvement. More items need to be included to examine attitude and intention. Further research into attitude and intention should also be carried out with more computer science courses, and with a larger sample size. By this method, it is possible to determine if the results would be similar, or discipline-specific. Another potential avenue of research is to apply a different student motivation questionnaire, and compare the results of this research to one that uses a different theory of motivation. The Science Motivation Questionnaire (Glynn et al) which is based on the social cognitive theory; also assesses components of students’ motivation to learn science in college and high school courses. The results of this comparison would provide valuable insights into a similar study such as this. The researchers also recommend that questionnaire should be re-administered two weeks before the semester ends, or the week where the last topic is to be presented, and not in the last week of the semester or when the topics have all been presented, as conducted in this study to improve the results of the data analysis.

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