Development of an application with process feedback to enhance student-centred learning

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The project aims to achieve student-centred learning through an adaptive learning and assessment application (tool) incorporating real-time ‘process feedback’ capability, using branching models within learning activities and assessment tasks. A prototype previously developed for assessments was tested as a proof-of-concept in 2012. This prototype focused on providing feedback on ‘product errors’. Student evaluations on the process identified the need to integrate real-time feedback on ‘process errors’ to assist students’ understanding of their mistakes. Further development introduced the capability to adapt learning and assessment modules to meet the needs of lecturers and students. The application was integrated into the University’s Learning Management System (LMS), resulting in: flexible learning approaches, increasing participation of students from different backgrounds, motivating learning, and improving learning effectiveness through self-directed approaches.

Keywords: process feedback; student-centred learning; adaptive learning and assessment tool

Introduction

Formative assessment processes linked to timely feedback are widely recognised as an important part of the learning process (Brown, 2004) and are increasingly acknowledged as beneficial to low-achieving students (Boston, 2002), while timely feedback guides students in their learning (Pellegrino, 2001). Providing ‘real-time’ feedback (integrating immediate feedback within activities) has the potential to improve the effectiveness of the assessments by using a self-directed learning approach (Liberatore, 2013) and increasing the learner’s responsibility for their own learning at their own pace (Armstrong, 2012). It further enhances the students’ confidence in their individual capacity to learn. Integrating feedback within assessment tasks leads to a feed-forward process for summative assessments (University of Tasmania, 2011).

In the current learning environment, there are a number of examples of assessment and feedback tools with varying designs of integration. Many of these tools are aimed at automated marking systems with ‘product feedback’, where feedback is provided on the end result of a task (Balter et al., 2013). They are increasingly being utilised in assessments in order to reduce marking time and plagiarism (Koike et al., 2006; Browne, 2002). However, such applications have limited use in improving student-centred learning. Some of the online learning and assessment platforms incorporate ‘Quiz’ tool capabilities with feedback; however they lack the adaptability to provide integrated ‘Learning’ and ‘Dynamic Assessment’ tools. Although there are other high cost tools developed and utilised for adaptive tutorials in individual units (Prusty et al., 2009; Tashiro, 2014), they tend to be unit-specific. Thus, there is a need to have a common ‘tool provider’ that can be customised to meet the individual needs of various units and applications, but which integrate the functionality of learning and assessment into the University’s Learning Management System (LMS). This will increase consistency in the use of online assessment tools accessed by the entire university’s community, assisting both learners and assessors.

Objectives

The authors previously experimented with an iterative approach in assessment tasks to enable students to learn and apply concepts in problem-solving by providing an opportunity to practice and learn at their own pace and self-assess their own errors (Edathil et al., 2013). Although students’ performance levels improved, it was evident that the approach lacked the capability to locate the errors or to assist the students in addressing them.

In line with Baeten et al. (2010), this project developed an adaptive learning and assessment application (tool) with a ‘process feedback’ functionality (formative feedback given during the process of learning and/or assessment) to further enhance student-centred learning outcomes. This was achieved by providing feedback during the process rather than at the end of the assessment. The application was designed as a branching model, enabling its use as a learning activity or an assessment task. As a result, constructive alignment between learning outcomes, learning activities, and assessment tasks was achieved (Biggs & Tang, 2007). This ‘process feedback’ functionality provides prompts to self-direct students along pre-defined ‘way points’ in the process of their learning. Real-time instantaneous feedback is provided iteratively to self-assess and guide students through their progression in learning rather than acting purely as a tracking process. The application was initially trialled and verified using engineering units involving problem-solving activities; however it will be extended to non-engineering units in the future.

Methodology

The authors recognised the need to develop a common application that can be integrated into the university's LMS platform Desire2Learn (D2L)© enabling its use by the wider learning and teaching community across the university and which will also enhance the effectiveness of the online delivery of courses. As a result of this need, a Learning Tools Interoperability (LTI) compliant web application (Learning Tools Interoperability, 2014), consisting of a branching model learning and assessment tool was developed and integrated into the university's LMS platform using the Application Programming Interface (API) 'Valence' (Valence, 2014).

In the design phase, three modes of the tool were created as shown in Figure 1. The 'fully guided learning mode' gives step-by-step instructions to the student in working towards the final answer and is primarily for student revision and learning purposes. The other two are both assessment modes that record marks and contribute towards the unit's assessment. The 'partially guided mode' allow students to receive hints and steps to progress to the final answer. Selection of this mode results in the reduction of a predetermined percentage of marks to reflect the assistance accessed. The third 'not guided assessment mode' simply provides students with feedback in the form of the final solution, without any ongoing hints or steps.

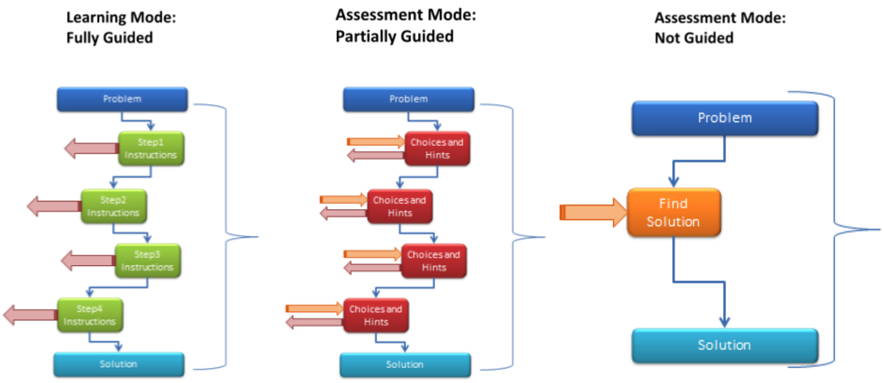

Figure 1: The three different assessment modes

Figure 2 shows an example of the fully guided learning mode. On the left hand screen is a multiple choice question with four answers to select from. The final step in the solution process (in this case Tab 3) is the default setting. If the students are unable to answer the question, they can click on Tab 1 (see the right hand screen in Figure 2), which will provide them with the first step to solve the problem. If they are unsure of this step, clicking on the 'light-bulb' at the bottom of the screen will result in a pop-up window providing a hint. Once students complete step 1, they proceed to step 2 by clicking Tab 2 and so on.

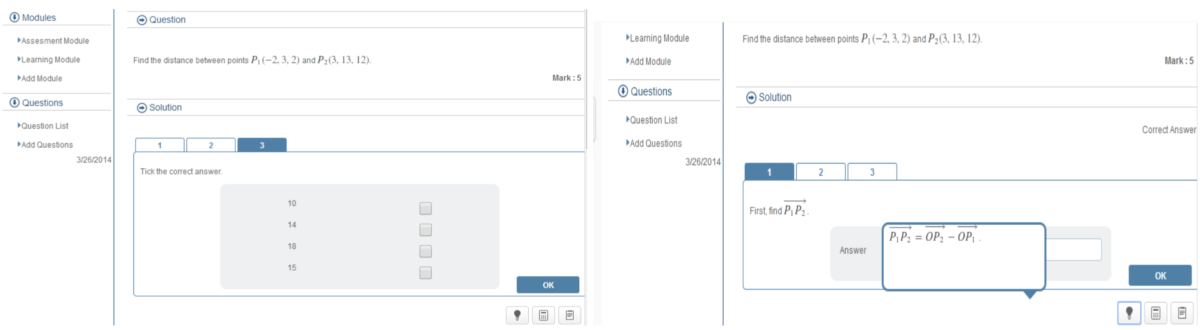

Figure 2: An example of the fully guided learning mode

Results and discussions

An online questionnaire consisting of a number of five-level Likert items and descriptive questions were used to collect comments on the effectiveness of the process feedback application. An invitation to participate in the survey was sent by email to 103 undergraduate first year maritime engineering students resulting in a 62% response rate. Statistical analysis using SPSS (version 21) was carried out. Over two-thirds of the respondents were 'fresh' high-school graduates under 20 years of age, while around one-third were international students.

Table 1: List of Likert items in the questionnaire

Item No	Item (description)
Y1	Generally I am an enthusiastic user of information and communication technology (ICT) and the online environment.
Y2	The integration of information and communication technology (ICT) and the online environment into learning and teaching is beneficial to my studies.
X1	These online assessments/learning tools were effective in helping my learning.
X2	It provided the ability to locate own errors during the process of either learning or assessment.
X3	These online assessments/learning tools helped my understanding of basic and advanced concepts in the unit.
X4	I enjoyed learning while doing these guided online assessments.
X5	I prefer to use the hints.
X6	I feel more confident after attempting the guided online assessments.
X7	I think this approach should be used in all units of study.
X8	I think there would be consistency if all units used this approach.
X9	I attempted (prefer to attempt) the online assessments at home rather than at the university.

Table 2: Students' attitude towards technology

Item	SA (%)	A (%)	SWA (%)	N (%)	SWD (%)	D (%)	SD (%)
Y1	20.0	53.3	15.0	6.7	5.0	0	0
Y2	18.3	51.7	18.3	8.3	3.3	0	0

SA: strongly agree; A: agree; SWA: somewhat agree; N: neutral; SWD: somewhat disagree; D: disagree; SD: strongly disagree

Table 1 lists the survey items while Table 2 illustrates the students' general attitude towards technology. Only 5% somewhat disagreed with the statement "Generally I am an enthusiastic user of information and communication technology (ICT) and the online environment.", whilst 3.3% disagreed with the statement "The integration of information and communication technology (ICT) and the online environment into learning and teaching is beneficial to my studies." This is in agreement with Hennessy (2007), who states that using ICT engaged students more directly and enhanced their grasp of underlying concepts. This would be expected since the majority of the test sample was young students who are technologically savvy.

Table 3: Effect of the online assessment

Item	SA (%)	A (%)	D (%)	SD (%)	NA (%)	*p*-value
X1	28.8	61.0	5.1	0	5.1	0.002
X2	21.7	65.0	10.0	0	3.3	0.237
X3	31.7	58.3	6.7	0	3.3	0.063
X4	16.7	63.3	15.0	0	5.0	0.137
X5	15.3	45.8	30.5	1.7	6.7	0.274
X6	23.7	67.8	3.4	1.7	3.4	0.723
X7	24.1	48.3	13.8	6.9	6.9	0.229
X8	15.8	59.6	14.0	3.5	7.1	0.325
X9	29.3	51.7	8.6	5.2	5.2	0.587

SA: strongly agree; A: agree; D: disagree; SD: strongly disagree; NA: not applicable

Table 3 shows the students' responses to the online assessment. It is encouraging to note that almost 90% of the cohort agreed that the online assessments were effective in helping them to learn the topics and found that the online assessments helped them understand both basic and advanced concepts. This is in agreement with the findings of Shute and Kim (2013) that adaptive systems, such as the trialled application, enhance student learning. A high percentage of students (86.7%) indicated that the online assessment tool provided them with the ability to locate their own errors during the learning and/or assessment processes. This was one of the core aims of the project. Surprisingly 32.2% of the respondents preferred not to have hints during their solution process. This may be due to students who were competent in those areas and hence not requiring the hints, remembering that hints during the assessments penalised the students, albeit by a small percentage. Around 91.5% felt more confident in the area of study after completing the assessment tool, an indicator that the tool was achieving its desired outcomes.

The survey also asked the students to describe how they used the learning tool in their unit. The responses varied with students using it to develop different aspects of their learning, possibly based on their perceived weaknesses and requirements. Comments included "I used it to prepare for my exam through revision", "To assess my own understanding of the concepts in the unit", and "It helped me recognise where I was continuously making mistakes". Responses to the question on what they liked about using the learning tool included "The hints provided are very helpful in solving the problems", "I could quickly find out where I went wrong and correct it", and "Step by step instructions if you had no idea how to do the question".

Conclusions

This paper describes an integrated process feedback tool developed to be used across different disciplines and faculties within the University's LMS. The tool provides real-time feedback to progressively guide students during their learning and assessment phases, enhancing self-directed learning. Surveys on students using the tool clearly showed that they improved their comprehension of the subject matter and gained confidence in their ability to solve problems. The tool is sufficiently flexible to enable assessors from different fields to develop assessments for students from varying backgrounds. It is planned to develop additional features such as voice-recording, uploading of videos, and creating generic templates. These will be trialled on a range of units.

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Please cite as: Edathil, S., Chin, C., K., H., Zank, S., Ranmuthugala, D., & Salter, S. (2014). Development of an application with process feedback to enhance student-centred learning. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ascilite Dunedin 2014* (pp. 394-398). https://doi.org/10.14742/apubs.2014.1177

Note: All published papers are refereed, having undergone a double-blind peer-review process.