Automating formative and summative feedback for individualised paper-based accounting assignments

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This paper reports on the rationale behind the use of a unique paper-based individualised accounting assignment supported by a facility developed by the author utilising Microsoft's Excel spread sheeting tool. As students worked towards completing their assignment, the package provided each student with feedback on the accuracy of selected items in their solutions to a rule-based accounting problem. This immediate formative feedback provided sufficient indicators for the student to identify they had made an error and provided encouragement for the student to take appropriate corrective action until they were satisfied their answer was correct. Pedagogically, providing students with immediate feedback has been shown to enhance the acquisition and retention of knowledge from the learning process. Once the student was satisfied with their work, their submission was automatically marked by the assessment package according to the pre-set marking scheme. The marking package generated a detailed summary providing important feedback to students clearly identifying correct answers and specific problem areas enabling the student to review these aspects. The package also provided feedback to the teacher identifying the cohort's performance on each item in the assessment.

 Keywords: *individualised, automated, formative feedback*

Introduction

The provision of guidance and feedback to students has long been acknowledged as an indispensable component of an effective teaching and learning environment in higher education. The general consensus in the literature is for feedback to be useful to students the feedback needs to be timely and informative, during instruction and learning, and to engage the student resulting in effective knowledge acquisition.

This paper reports on the effect of using a computer-based application which analysed Accounting students' assignment answers and provided detailed, individualised formative and summative feedback. Personalisation of the feedback offers possibilities to deliver feedback that is the most appropriate for the user's expertise and cognitive abilities in general and, in particular, to their current moods and attentiveness. In addition, the package also provides feedback to the teacher on the performance of the student cohort as a whole, with a degree of detail and accuracy that exceeds the impressions usually gained through traditional marking, providing clear timely direction to troublesome aspects.

Feedback purposes

The literature on formative assessment over the past two decades contains a plethora of articles clearly establishing feedback as a key element in the formative evaluation process. The interest in formative assessment (see for example the recent articles of Gibbs and Dunbar-Goddett (2008); Miller (2008) and Taras (2008)) was stimulated by the work of numerous researchers including, inter alia, Hattie, Biggs and Purdie (1996) and Kluger and DeNisi (1996). In particular, the research findings of Black and Wiliam (1998) were important. Having reviewed 250 previous studies they confirmed the influence of formative assessment in raising the quality of student learning and achievement noting 'Formative assessment actively involves students in their own assessment and enables them to picture

their own learning in the light of an understanding of what it means to get better' (cited in Ecclestone, 2003, p.52). Whilst this may be a laudable objective, in the review of feedback provided to Business and Design students, Weaver (2006) identified a number of problems with feedback. Firstly she found that Business students received feedback too late to be helpful and hence the feedback often became summative rather than formative feeback (p.391). Secondly, Weaver found 'either the feedback does not contain enough to guide or motivate students, or they have insufficient understanding of academic discourse to interpret comments accurately' (p.391).

According to Black and Wiliam (1998), there are two main functions of feedback: directive and facilitative. Directive feedback is that which tells the student what needs to be fixed or revised. Such feedback tends to be more specific compared to facilitative feedback, which provides comments and suggestions to help guide students in their own revision and conceptualization. The literature revealed dozens of feedback types that have been subjected to experimental scrutiny— for example, accuracy of the solution, topic contingent, response contingent, attribute isolation, worked examples, hints, response specific, goal directed, immediately delivered and partial solutions. In addition, formative feedback variables such as student achievement level, task-level, and prior knowledge have been shown to interact with these feedback types and formats.

This assignment applied directive task-level feedback as opposed to general facilitative feedback. Task-level feedback typically provides more specific and timely (often real-time) information to the student about a particular response to a problem or task compared to summary feedback and may additionally take into account the student's current understanding and ability level. Pellegrino, Chudowsky, and Glaser (2001) suggest individuals acquire a skill more rapidly if they receive feedback about the correctness of what they are doing at the time. Consequently, one of the most important roles for assessment is the provision of timely and informative feedback to students during instruction and learning so that their practice of a skill and its subsequent acquisition will be effective and efficient.

Why use an individualised assignment?

Individualising assignments is a methodology that creates an unlimited set of numerically unique problems covering the same material. There were a number of reasons for choosing to adopt an individualised assignment format. Firstly, according to research cited in Kluger and DeNisi (1996), when feedback is provided to students in a norm-referenced manner comparing the individual's performance with that of others, students who perform poorly tend to attribute their failures to lack of ability, expect to perform poorly in the future, and demonstrate decreased motivation on subsequent tasks. McColskey and Leary (1985) examined the hypothesis that the harmful effects of failure might be lessened when failure is expressed in self-referenced terms — that is, relative to the learner's known level of ability as assessed by other measures. In their study, learners received feedback indicating that they did well or poorly on an anagram test, and this feedback was described as either norm-referenced (comparing the individual's performance with that of others) or as self-referenced (comparing performance with other measures of the individual's ability). They found, compared to norm-referenced feedback, self-referenced feedback resulted in higher expectancies regarding future performance and increased attributions to effort (e.g., 'I succeeded because I worked really hard'). Attributions to ability (e.g., 'I succeeded because I'm smart') were not affected. The main implication is that low-achieving students, or students with underdeveloped knowledge and skills, should not receive normative feedback but should instead receive self-referenced feedback — focusing their attention on their own progress. Sadler (2005, p,178) reaffirms this

position in putting forward the view 'the reference point for judging the achievement of a given student is that student's previous performance level or levels. What counts then is the amount of improvement each student makes'.

Secondly, plagiarism has been a major problem in the unit in which the study was undertaken. In accounting subjects, a key component of learning involves students submitting solutions to a well-defined single question. Across a number of units, students have been found acquiring other students' solutions to problems and then passing those solutions off as their own. Having 'slipped through the net,' or witnessing others not being found out, the likelihood of collusion is increased. This is cause for concern, particularly in view of the finding of Franklin-Stokes and Newstead (1995) that students have fairly relaxed attitudes towards cheating in relation to coursework: 64% of undergraduate student respondents admitted to having copied coursework with the consent of another student, while 72% admitted to allowing their coursework to be copied. Similar findings were reported by Dordoy (2002).

The assignment applied the principles of 'learning by doing' requiring each student complete their individualised assignment deriving a solution that was different from other students.

Automating the individualised feedback
Automatic feedback permits immediate feedback to every student and it is able to do this in a timely manner. This method of providing feedback is particularly useful when student numbers are high and resources are scarce. Individualising the assignment was achieved using a personal computer and Microsoft Excel to develop a single accounting problem from which a suite of problems using material selected from a range of topic-based exercises and problems in the prescribed text was developed. This suite of problems randomised a key numeric variable resulting in each problem having a unique answer. In this instance the student's own identity number was the unique variable.

Whilst automatic feedback can be standardized (every student receives the same feedback, e.g., knowledge of correct response) as mentioned above, lower achieving students, or those with poor underlying knowledge require adaptive feedback; feedback information which is specific to that particular student's answers. Automatic adaptive feedback requires a testing mode that permits automatic answer analysis. In well-structured fields (like accounting) where there is a clear ''right'' or ''wrong'' response, this form of testing and feedback provision is relatively easy to implement. Accordingly, in this study, realistic and relevant calculation problems with immediate, adaptive feedback were employed. As the feedback was meant to be task specific and to identify knowledge gaps, individualised feedback was provided not only showing whether an answer was right or wrong, but also provided details of the correct response.

Timing the provision of feedback
Similar to the previously mentioned feedback functions and variables (e.g., directive function and task-level variables), there are also conflicting results in the literature relating to the timing of feedback and the effects on learning outcome and efficiency. For decades researchers have been examining the effects of timing, mainly concerned with whether feedback should be delivered immediately or delayed (for example, Jurma & Froelich, 1984; Pound & Bailey, 1975; Prather & Berry, 1973; Reddy, 1969). The 'Immediately' may be defined as right after a student has responded to an item or problem or, in the case of summative feedback, right after a quiz or test has been completed. 'Delayed' is usually

defined relative to immediate, and such feedback may occur minutes, hours, weeks, or longer after the completion of some task or test.

Supporters of immediate feedback theorize that the earlier corrective information is provided, the more likely it is efficient retention will result (Phye & Andre, 1989). The superiority of immediate over delayed feedback has been demonstrated for the acquisition of verbal materials, procedural skills, and some motor skills (Anderson, Magill, & Sekiya, 2001; Brosvic & Cohen, 1988; Corbett & Anderson, 2001; 1989. The study by Epstein, Epstein and Brosvic (2001), and the follow up study by Dihoff, Brosvic, Epstein, & Cook, 2003) provided evidence that immediate feedback promoted the acquisition and retention of knowledge.

Key considerations in developing the individualised assignment were the immediacy of feedback and the ability of students to self-assess their work-in-progress. As students completed selected elements of the assignment they were able to self-check their progress by accessing the 'Key Figures' spreadsheet (Figure 1) available to all students in the unit through the web based teaching resource: Web Campus Edition (WebCE). When the student replaced the generic student number used in the downloaded spreadsheet with their student number, the spreadsheet automatically recalculated the data and displayed the appropriate values for that student. This enabled students to compare their answer and take corrective action, as necessary, whilst immersed in completing the assignment in line with the views of Pellegrino, Chudowsky, and Glaser, (2001) (There were other items which enabled students to check values. For brevity, these are not shown here). The answers are presented in a way that also helped students assess their progress, both in relation to their acquired knowledge in specific areas of study and their ability to exercise relevant skills. Achievements were expected to have a positive impact on the student's confidence, level of interest and motivation, thus enhancing their learning experience. Security features prevented students from locating the method of obtaining correct answers stored in an adjacent area.

Student Number	**15922957**
Trial Balance Total @ Year End	25,081,262
Revenue	15,972,957
Net Profit for the Period	**3,507,950**
Income Tax Expense	1,548,407
Current Tax Liability	2,035,792
Deferred Tax Asset	560,885
Total Assets	**11,125,146**
Total Liabilities	**5,437,190**
Total Shareholders' Equity	**5,687,956**
Operating Cash Flows	6,865,888
Basic EPS	**$1.48**

Figure 1: Key Figures Spreadsheet

After manually completing their paper-based assignment solution, the student entered specific values drawn from their work into a locked range in the 'Submission Schedule' spreadsheet and submitted their solution using the WebCE facility.

The marking package automatically extracted data from the file containing a student's submitted answer and compared each assessment item against the computer generated solution, awarding marks according to the pre-set marking scheme. The marking package generated a print out of the 'Assessment Result and Feedback' document, an extract of this

print out is shown below (Figure 2). (Again, there were other items which were marked and scored, however for brevity, these are not shown here.). This document provided important summative feedback to students enabling them to clearly identify specific problem areas and take appropriate corrective learning activities.

Assessment Result and Feedback						
Szanto						
Frank		**The Values You Provided**		**The Values Should Be**		**Score if Value Correct**
Wed 6-9pm EA205	**4**					
Student Number		16177169				
Diluted EPS		0.77		0.77		1
Dividends Per Share		0.09		0.09		1
Cash assets		3,969,956		4,235,534	X	
Receivables		1,095,627		1,170,653	X	
Inventories		1,294,174		1,385,634	X	
Other financial assets		150,000		6,791,820	X	
Goodwill		50,000		50,000		1
Value for Correct Answers / 50						**19**

Figure 2: Assessment Result and Feedback

Providing feedback to the teacher

In order to make appropriate instructional decisions and improve student learning it is also important that the teacher obtain feedback on the effectiveness of their teaching, the validity of the questions set in the task, and the extent and accuracy of student learning. To some extent traditional marking provides this feedback because, when reading the students' answers, if a significant number of students make the same mistake, the teacher quickly becomes aware of the problem. With automated marking it is harder to get a clear idea of these matters. The output of a listing of final marks does not tell the teacher much about where specific problems might lie. The package provides a comprehensive analysis of the student cohort's submissions identifying relative performance of each item in the assessment. This data enables teachers to very quickly pinpoint topics or aspects in which further attention is needed to overcome areas of apparent learning deficiency.

Student reaction

A common theme in the assessment literature is the design of appropriate assessment activities should be thorough and comprehensive because there is no one factor more likely to undermine the achievement of learning objectives than inappropriate assessment. Hinett and Knight (1996) reported 'Students spoke in terms of "us" and "them" and perceived [teaching] staff to be part of an assessment system which makes success difficult'. They further reported that 'Students complained they did not know what was expected of them, nor were they offered guidelines: You don't know what they [teachers] want, you just hope you have done the right thing' (p. 6).

As this was an evaluative project (to see whether it was feasible to develop an individualised automated assignment) ethics approval to conduct a survey of students had not been sought.

Consequently, the 'Student Feedback on Unit' (SFU) survey was used to gauge student's opinions on the assignment. The SFU is a generic survey document administered to all students of the University to assess the overall quality of learning experiences in units of study. Students are required to complete 13 questions on a traditional five point Likert-type scale, ranging from one ('strongly disagree') to five ('strongly agree'). The students also have the opportunity to provide unfettered qualitative responses. 86 usable surveys were completed, representing a 58% response rate.

From the three questions associated with the assessment process, it was clear that the responding students overwhelmingly appreciated the forms of assessment. In response to the statements: 'The assessments in this unit have helped me to learn'; and 'There were clear guidelines for all assessment tasks in this unit', only 8% of students 'disagreed' or 'strongly disagreed.' In response to the third statement: 'I have received adequate feedback on my work in this unit', only 15% of students 'disagreed' or 'strongly disagreed'. These encouraging responses indicated that a significant proportion of students did not feel negatively towards the assignment. Many of the qualitative comments were encouraging too: 'Assessment was very helpful and relevant to help students understand the topic'; 'lots of good support and feedback through providing solutions', 'quick feedback on assignments'.

In ad hoc discussions with various groups of students, the consensus was that whilst the assignment was challenging, students found their confidence increased. This was evident in comments similar to 'I know I am on the right track because I got the result I was supposed to'. Further, students were determined to get the correct answer evidenced by comments similar to 'At first I didn't get the right answer, but then I went back and found where I had made my mistake and got the right answer'. This supports the rationale of providing effective immediate feedback.

Conclusion

This paper describes a study that explored the rationale behind developing and using a unique 'package'; a paper-based individualised accounting assignment supported by an immediate feedback facility. This feedback facility provided students with immediate, directive, task-level feedback on the accuracy of their solutions. The package was positively received by the majority of students with many of the anecdotal student comments indicating a higher degree of engagement was evident and, despite the level of difficulty, the students claimed the assignment supported their learning by providing a focus and context for learning, enabling them to put theory into practice, reinforcing the theoretical elements through practical activities. Consequently, the research provided evidence that paper-based individualised accounting assignments supported by an immediate feedback facility do in fact engage students.

Because of the overwhelming positive response from this exploratory research, development of this research is now continuing with ethics approval currently being sought with the view to quantifying the extent to which students engage with the unit material, whether the assignment encourages students to learn the material with a deeper level of understanding, and ultimately improving their scores in subsequent assessment events for example their final examinations.

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