
Using Projects to enable Reflective Learning

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Traditionally assignments have been used to both enable and assess students' learning by carrying out formative or summative assessment, typically carrying out tasks which would be impracticable in an examination context (case studies requiring the evaluation and analysis of results, often time and computer intensive). However they can also be used to enhance the students' learning experience by enabling them to carry out **Reflective Learning**.

Here the term **Reflective Learning** is used to describe those situations where the performance and feedback from one assignment is used by the student to improve their performance on a later assignment and on their learning from the module (also improving their study skills and their performance on other modules) by considering and evaluating their performance (reflecting). However to enable this process the assignments have to be designed so that this learning is possible.

The mode of assessment outlined in the following case study (two pieces of work based around a case study) has been developed by the course team to better assess student performance, satisfying learning outcomes. However it has had the additional benefit of allowing the students to reflect on their performances within the first part of the assignment and apply their new knowledge and skills to the second part of the assignment and then to their studies in other modules. A typical assignment is outlined in table 1.

Case Study on Reflective Learning

This process is illustrated by describing its use within the Mathematical Programming Techniques module at the University. This has been a final year Mathematics Scheme module for several years and during this time the type and style of assessments used have been developed to better assess the learning outcomes. The module is concerned with the construction and solution of *Mathematical Models* to analyse manufacturing and business orientated planning problems. The assignments being used to enable the students to develop both

- their analytical problem solving skills, and
- their communication skills.

Table 1

Australian Airlines - Case Study

The objective of the assignment is to evaluate the efficiency of this company. There are two parts:-

Part 1: Investigate packing heuristics

The students were required to develop a new packing heuristic as a replacement for the firm's existing heuristics. As part of this task they had to build a mathematical model to determine optimal solutions to be able to compare heuristics.

Part 2: Investigate 'unit' efficiencies

The students were given "too much" data to carry out this analysis and they were required to select, and justify their selection, of data to be used to enable this analysis, (Data Envelopment Analysis). They then had to build models, obtain solutions and evaluate the solutions to complete the analysis.

Feedback Models

Both parts of the assignment require the students to demonstrate high level skills, production of models and the evaluation of the results, a key element in both being the justification of their methodology and their conclusions.

The feedback from the first assignment is seen by the students as an opportunity to recognise skills deficiencies that they can remedy during the second part of the assignment. The process followed by the students can be modelled by figure 1, with the students following the defined paths as shown.

The awarded grades and feedback were compared by the students with the marking criteria, thus enabling the students to reflect on their work and identify where they can improve their performance.

Typically the first assignment is completed without all the criteria being achieved. The students often might not agree with the awarded grade and the Reflective Process now acts to reconcile the students' perception of their performance with the summary grade awarded to the assignment. This can involve additional verbal feedback from the module staff. This process helps the students accept their deficiencies in their performances, highlights where and how they can improve their performance and also helps them to be more focused with respect to the assessment criteria.

The second part of the assignment, requiring different subject knowledge (see Table 1), now enables the students to put into practice the knowledge gained from their Reflections. It is important that there is this linkage between the "parts of the assignment" because this establishes (to the students) the significance of the feedback in the assessment process, thus enabling the model shown in figure 1 to replace the simpler alternative model of figure 2.

Note: The loops in figure 2 around the feedback sections indicate that, for many students, the use of non linked assignments means that the grade achieved is more important than their learning and that the feedback from the first assignment is not re-examined in light of the feedback from the second assignment.

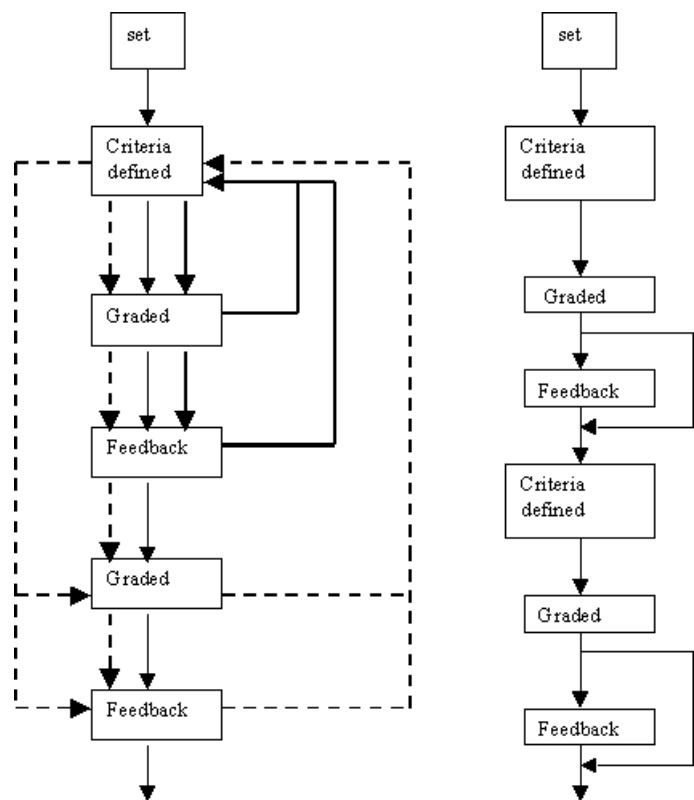
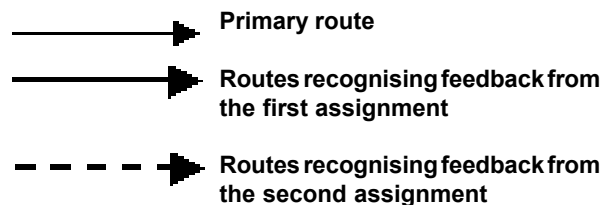


Figure 1

Figure 2



Improved Student performance

The results, measured in terms of grade achieved, showed that the students' performance had improved not only within this module but also within other later stage modules. This improvement was manifested in both the analytical skills displayed in later assignments and in the technical presentation skills used to present the results of their investigations.

Typical improvements were an awareness of the importance of

- "proof" or "evidence" to support conclusions.
- a well constructed report
- a justified model
- good well designed test problems

all of which are high level or professionally required skills.

However in order that this process will work it is essential that

- the assignments have some linkage, so that the students see the need to carry forward the learning from the first part of the assignment
- the module staff are prepared, and available, to give good feedback to the students both in writing and verbally,
- assessment criteria are clear unambiguous and appropriate.
- the students have confidence in the staff and feel comfortable in approaching the staff to ask for explanation or clarification of particular comments.

Conclusion

The use of this integrated approach to assignment work has resulted in a dramatic improvement in student performance as well as in the awareness of their skills development. We have been developing this integrated approach to the use of assignment work within teaching and learning for several years and feel that it can cause students to drastically improve their performances across all their modules, not just in the module which adopts this approach. It also has the added bonus of better preparing the students for their future careers.

MathGate Report

<http://www.mathgate.ac.uk>

Report by Greig Fratus email: g.j.fratus@bham.ac.uk

The LTSN Maths, Stats & OR Network has now created a Math-Net secondary home page which can be viewed at <http://ltsn.mathstore.ac.uk/Math-Net/index.en.htm>. This page was made using the Mathematical Society option on the Math-Net Page Maker tool at <http://elib.zib.de/cgi-bin/mpm-test.pl>. This tool is available for any institution that wishes to make their own Math-Net page and join the Math-Net mathematics network. Math-Net is supported by the International Mathematical Union's Committee for Electronic Information and Communication - further details at <http://www.ceic.math.ca>.

June Website of the Month: Study Skills Online <http://www.brunel.ac.uk/~mastmmg/ssguide/sshome.htm>

The mathematical link here is that this online guide has been produced by Martin Greenhow of Brunel University. It contains tips on time management, making the most of lectures, presentations, revision, reading, examinations, experiments, getting a job and postgraduate research. Examples are provided and links to related sites are also included. Martin welcomes suggestions on ways to improve the guide and as well as being available online users can also freely download the guide as a Word document or plain text.

July Website of the Month: MathML Central <http://www.mathmlcentral.com>

MathML Central is a Wolfram resource that uses Mathematica's built-in capabilities for importing, processing, and exporting MathML in the MathML tools section. The communication between the page and the server is done by the Java-based application webMathematica. Tools available to the user include rendering MathML from text, a URL or a file, validating MathML, converting expressions, plotting and integrating.

Results from rendering can be returned in several ways including GIF, JPEG, TIFF, MathML, and XHTML. The site also contains a history of MathML, information on formatting entries in the tool section, random generators of MathML or expressions, FAQs, and a guestbook. The MathML tools have been tested to work on Microsoft Internet Explorer 5.5, Mozilla 1.0, and Netscape 4.7.

August Website of the Month: Lecture Notes in Mathematics

<http://link.springer.de/link/service/series/0304/>

Springer is offering free online access to the full text of all of the volumes published in this series between 2000 and 2001. This offer is available until 31 December 2002. Papers are in PDF format and the table of contents are free to any user. The series includes research monographs, lectures and seminars. Tables of contents are also available via email through Springer's LINK Alert system.

If you have any favourite sites that you would like to see in the website of the month series please send them to mathgate@bham.ac.uk.