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The Use of an Open Case Study Coursework Assessment and Self-Evaluation Approach to Improve Student Learning

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Abstract: This investigation aims to evaluate the benefits and challenges generated by using an open case study for a coursework summative assessment. This evaluation is conducted from the students' as well as from the tutor's perspective. A selection of mathematical modelling and computer-based simulation techniques are taught in a supply chain modelling module for students studying logistics at undergraduate level in their final year. This is considered a difficult topic due to the level of mathematical modelling required to develop logistics and supply chain models. The summative coursework assessment is designed in the form of an open case study where students can search and develop their individual case studies. This allows students to select the level of difficulty they are most comfortable with in providing a solution for their defined supply chain system. It has been observed that this form of assessment reaches different levels of learning, and allows students to identify links and connections between the use of different techniques studied and their practical application. The discussion provided incorporates findings from tutor's observations, students' self-evaluation reports and observations from an end of year questionnaire.

Keywords: Summative Assessment, Self-evaluation, Open Case Study, Supply Chain Modelling

Introduction

It is shown in the literature that modules incorporating a relatively high level of mathematical modelling are considered hard and challenging not only for students, but also for tutors who need to identify the most appropriate instructions to be incorporated in the delivery of their modules (Tipi 2009). Referring to a statistics course, Chermak and Weiss (1999) relate from their experience that students are intimidated by numbers, as well as this types of course are a challenge to teach as students have limited experience with these concepts. When students are faced with a challenging topic such as mathematical modelling, tutors need to consider a range of teaching and assessment tools that continuously engage and encourage students to take an active role in their learning.

This investigation evaluates how the development of a summative coursework that has a student-centred approach integrating assessment with learning can have a positive effect on student learning. This is considered through the development of a coursework assessment for a supply chain modelling module taught in higher education within a Supply Chain Management degree course. The intention for setting this assignment was to allow for individual research, generation of new ideas, linking ideas from different topics presented in the module, assessing their applicability to a practical scenario and developing critical thinking. The intention here is not to delve into the well-researched topic around the purpose and relevance of summative assessments but to report on the way in which a summative assessment has been designed and used for a group of students studying a module that considers knowledge of mathematical modelling and statistics. The evaluation in this case aims to emphasise that an open case study coursework assessment can create the opportunity to encourage learning that ultimately leads to achievement. The open case study summative assessment is shown together with the self-evaluation provided by students for this assessment.

The paper is structured as follows: A review of the literature has been considered to indicate the relevance of the theory linked to assessment for learning and self-evaluation. The methodology indicates the way in which the open case study has been designed and how data has been collected from a cohort of students during one year of study. The analysis for this work is

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provided in two parts, where the tutor's as well as the students' evaluations are considered, followed by suggestions for future research.

Literature Review

According to Knight (2002, 276) assessments have to meet the following three characteristics: "1. They have to be faithful to the curriculum (charged with developing understandings, skills, self-theories and reflectiveness). 2. They must align with the notion that education is concerned with some degree of abstraction, generalisation or transfer. 3. They should not impede student engagement in communities of practice, but should encourage behaviours associated with good learning."

Therefore, the way in which the assessment is set can form a key ingredient for learning. The assessment should develop understanding of theories and examples by encouraging research and critical thinking and should not be an instrument of direct replication of what has been presented in class. The assessment should also be an instrument that promotes and encourages creativity (Beghetto 2005) and should not be just an instrument for monitoring, reporting and validation. Students are more likely to learn when they engage "with the subject matter for its own sake, not for an extrinsic demand" (Boud 1990, 102).

Torrance (2007, 282) mentioned that "detailed tutor and assessor support, in the form of exam coaching and practice, drafting and redrafting of assignments, asking 'leading questions' during workplace observations…" could lead to achievement. However, he also indicates that this transparency "encourages instrumentalism" and "removes the challenge of learning" by reducing the "quality and validity of the outcomes achieved". Removing the challenge of learning will put students in difficult situations of not being able to set objectives and provide solutions when faced with real, practical problems.

Assessment for Independent Learning

In the literature, assessment has two forms: formative and summative. Formative assessment is regarded as that which improves the quality and process of learning whereas summative assessment aims at grading knowledge (Boud 1990; Harlen and James 1997; Biggs 1998; Bennett 2011).

Formative assessment is intended to improve the quality of teaching and learning due to the encouragement students receive and due to the feedback provided (Boud 1990). Harlen and James (1997) discuss the difference between formative and summative assessment and indicate that "the purpose of assessment has become confused and therefore assessment fails to have a truly formative role in learning". The "role" is seen as the deep learning or learning for understanding. Students achieving this learning have the ability to apply it in many other different situations. Harlen and James challenge the point that summative assessments can be seen as a simple aggregation of formative ones. They indicate that formative and summative assessment "may relate to each other in that they share a set of common criteria which are agreed expectations in terms of desired outcomes, but beyond this they are essentially different phenomena with different assumptions and different methods" (Harlen and James 1997, 337).

An assessment that is free from replication of knowledge, that supports students' own understanding of the knowledge learned and is influenced by their background, experience and perspective (Ellery 2008) can be recognised as a form of assessment that is designed for learning. Assessment for learning (AfL) is a term well used (Klenowski 1995; Wiliam 2011), and there are instances where it is seen as a formative assessment due to the fact that it has the role of providing feedback and offering the opportunity for self-evaluation, factors that support learning.

Students engaging in formative assessment have the opportunity to benefit from the feedback provided. However, from our experience not all students take this opportunity, and not all students submit their formative assessment for evaluation. Ellery (2008) remarks that in

summative assessments such as tests and examinations there is rarely the opportunity for students to act on the feedback provided and therefore this ends up being ignored. For the purpose of this research, the assessment in question is of summative nature administrated half way through the course, where students still have the opportunity to benefit from the feedback provided.

Self-Assessment and Self-Evaluation

Self-assessment has been defined by Andrade and Valtcheva (2009) as the process of collecting information about students' progress or performance and comparing this with specific criteria to be used for revision and improvement. It is also argued here that the self-assessment should only be used for formative assessment and not to provide a final grade. The benefits generated by self-assessment for effective learning have been noted in Boud (1990), yet controversy appears when this is to be used for grading purposes. Andrade and Valtcheva (2009) also distinguish between self-assessment and self-evaluation and indicate that the self-evaluation is the process of involving students in gradinge their work.

    Stallings and Tascione (1996) found that self-assessment is good practice in that it encourages a line of communication between the tutor and student as well as giving students the chance to look at their work in a more critical and honest way. They also indicate that the work produced has more meaning for students and is not just a mark.

    Self-assessment or peer-assessment are rarely used in summative assessments (Taras 2002) where students do not have access to an important form of assessment. Giving the students the opportunity to self-evaluate their work allows them to justify the approach used, to critically reflect if this meets a set criteria, as well as it gives students the opportunity to develop confidence and independence in their learning process.

Methodology

This investigation aims to reflect on the development of a summative assessment that incorporates elements such as the free selection of a case study as well as students' self-evaluation of the work presented. This assessment is of a summative nature and a mark is given by the tutor at the end of the process; it is also designed as an assessment for learning. This approach is taken in the view that allowing independence by involving students in the process of developing their own assignment as well as giving them the opportunity to evaluate their work will play a significant role in the process of learning. It is also relevant to indicate that formative assessments have also been included in the delivery of the module, however it is not within the scope of this paper to evaluate the design and benefits of this form of assessment. Formative assessments are set at the end of each topic, delivered in class in the form of independent or group work with the aim to ensure understanding of the topic introduced in class. These are exercises set by the tutor, where feedback is provided ether individually, or collectively in class with the purpose to develop skills and knowledge to effectively respond to the summative tasks in question. However, the role of this paper is to only focus attention on the development and learning generated by the summative assessment. The summative assessment has been designed to encourage independent learning by asking students to step away from the standard examples set by the tutor. These examples are relevant to aid understanding of a particular task presented in class, however they limit the scope for critical thinking, by the fact that there is a "correct answer" validated by the tutor and given in the form of feedback. The summative assessment as presented in the next section, aims to overcome this issue.

The Open Case Study Assessment

This research is looking at the development of a summative coursework assessment used for a group of students studying the Supply Chain Modelling module in the final year of their

undergraduate degree during 2011-2012. A group of 28 students formed the cohort. Students from four different courses in the field of logistics can take this module. For one course (Supply Chain Management), this module is compulsory, whereas for the other three (Transport and Logistics Management, Air Transport and Logistics Management and European Logistics) this module is optional. Over a five years period the average number of students taking this module was 30, therefore the figure of 28 students in 2011-2012 is considered representative for this investigation.

It was considered relevant to provide students with the opportunity to search and develop their own case study material. For this assessment, students were required to develop their individual case study, where different supply chain issues should be identified, such as stock limitation, high transportation cost, low customer service level and others. The aim here was to encourage students to invest time in searching for an appropriate case study and not simply to rely on a case provided by the tutor. It is appreciated that this could be a time consuming activity, however starting points have been provided for students to be able to design a suitable supply chain. It is not always common to have a supply chain case study readily available in the literature that is fully supported with numerical data. Therefore, the case study to be designed and used for this coursework can be initiated from a real case based on a real supply chain, or can be initiated from a real example presented in a journal or presented in an operations management book, which can then be further developed to form an extended supply chain. A theoretical framework identified for the case study should indicate the main issues faced by the supply chain and the reason for these issues as well as indicate appropriate techniques to solve these issues. A minimum of three operational techniques should be identified and used to solve the issues within the identified supply chain. As part of a supply chain system, numerical data and the results from one operational technique should clearly link with the data or results of another method used within the system. The restriction considered for this case study is that the modelling techniques to be used should only be selected from the list of techniques studied in the particular Supply Chain Modelling module. These include: product allocation, transportation model, assignment models, transhipment model, personnel scheduling, distribution planning, network flow models, vehicle routing and scheduling models as well as simulation models. As part of the evaluation, supply chain performance measures should be identified for the case study used, as well as results for before and after applying this approach should be examined. The last element which is required in this assessment is the verification and validation of the models used in the context of the defined case study. To be able to face challenging situations in industry, it is particularly important to train students to be independent learners, to identify an issue and provide solutions for it. As this is not a pre-defined case, there is no answer available for students to depend on, therefore they cannot rely on a pre-determined solution as a way to validate their understanding. The solution, the final answer for a situation or model requires validation and verification. This is exactly what the assessment sets out to do, to identify ways to validate and verify the proposed solution. Learning to find ways to validate and verify the solutions equips students with skills required in professional practice.

The design for this assessment followed two stages, divergent and convergent stages, as identified by Beghetto (2005), that are seen as requisite for combining novelty and usefulness into the process of creativity. The first part of the assignment follows the divergent stage where ideas are generated for the development of the case study. The second part of the assessment, or the convergent stage, is where students have to narrow their selections and clearly identify only three operational techniques to solve the identified problems in the supply chain, provide solutions for these and finally validate the approach used.

The assessment in question is of a summative nature and provides a mark to indicate achievement. However, detailed feedback for further improvement can still be provided, which can be taken forward to the next stage of examination as well as in practice. The feedback provided to students captures task specific points as well as general points such as report

formatting and presentation, referencing style issues, ability to provide a critical argument to an issue discussed and other points that can be taken to improve other coursework assessments for other modules in the course.

The assessment was structured to identify three main areas: (1) the case study identification, (2) the application of three operational techniques and (3) the models' validation and evaluation, where clear marks were indicated for each area (25, 45 and 30 marks). The marking structure also included details for each section such as: (1) determine an original case study which will support a selection of operational techniques; aim to synthesise logistical concepts and interrelate operational techniques and theories; use appropriate references where necessary; (2) show good theoretical understanding of the modelling techniques; critically discuss the mathematical model and its corresponding solution in each case; evaluate the model limitations and (3) critically analyse the models used in relation to the selected case study; test and validate the models; interrelate logistics theory studied on the course.

Another element included within this assignment is the consideration of a self-evaluation report. Students have the option of providing a self-evaluation report and mark at the end of their work. This is a non-compulsory task and it is also specified that the self-evaluation will not be marked. It is also indicated that any information used from these reports is to remain anonymous and is for the purpose of research only.

Data Collection

The summative assessment considered within this paper forms 50% of the total mark for the module, with the remaining 50% being achieved from an examination carried out at the end of the module. To be able to assess what constitutes a successful setting for the coursework assessment in question, other types of information have been collected. These are divided into: (1) data collected from tutor's observations as well as (2) data collected from students' observations.

Data collected from the tutor is mainly quantitative and comprises aggregated results for the summative assessment. This is supplemented with the tutor's observations recorded during the marking process. The marks from the entire cohort of students were included in this analysis. Based on the marking structure indicated above, the tutor developed an Excel spreadsheet to collect the data for this assessment. The marking spreadsheet captured: the student number, the split mark for each section and the overall coursework mark.

Data collected from students is mainly qualitative, however some quantitative observations have been made. This is based on the analysis of their self-evaluation reports for the summative assessment, as well as the results from their final year evaluation questionnaire for the module. It is considered relevant to include both forms of evaluation in order to further enhance understanding of the assessment, evaluation and feedback issues considered in this paper.

From the self-evaluation report the data was recorded in the same marking spreadsheet as follows: a record in the form of yes or no was made, if a self-evaluation report was received or not together with the coursework. If a self-evaluation report was received, the comments and/or the mark provided by the student were recorded at this stage in the spreadsheet. The data recorded from the self-evaluation reports was then coded, based on three criteria: (1) in line with tutor assessment, (2) mark/evaluation above tutor's and (3) mark/evaluation below tutor's assessment.

The last tool used to collect data is the "end of year module questionnaire" that is a standard University wide on-line questionnaire used for all modules. The answers to 7 quality assurance questions are incorporated with students completing these questionnaires at the end of the year, after all modules have been delivered and after all examinations took place. The tutor can access the results for this questionnaire on-line where only aggregated results from all students are available.

Analysis and Discussion

Tutor Based Evaluation

The aim for this assessment is to influence students' creativity in developing the assignment. By preparing for this assignment, students are faced with the challenge of researching and developing their own ideas. The feedback provided to students is in a numerical form and indicates the level achieved, as well as being commentary based and providing comments on individual steps throughout the coursework. An overall explanation is included as part of the feedback with the purpose to detail the reason for the decision taken as well as to indicate the way in which this work can be further developed. As this assessment accounts for 50% of the total mark, the feedback provided aims to further the development and theories studied and to have a positive effect towards the final mark awarded.

After evaluating the results the following statistics have been considered relevant:

100% - submitted their coursework on time,

100% - followed the coursework requirements,

100% - developed a supply chain case study, and

96% - achieved a pass grade for the summative assessment (29% achieved grade A, 14% achieved grade B, 39% achieved a grade C, 14% achieved a grade D while the remaining 4% achieving a grade E). This analysis does not include results from reassessment.

The case studies developed by students were different in each case. The analysis indicates that 64% of students used the transportation model as one of their selections, however this was combined with various other techniques, such as personnel scheduling, centre of gravity, product allocation, vehicle routing and forecasting.

25% of students used a complex version of the transhipment model. The second most used model in their analysis was the distribution centre location model, followed by vehicle routing models and forecasting models.

54% of students developed a supply chain case study supported by a minimum of one complex model. The complex models considered have been developed for an extended supply chain, and comprised the minimum number of operational techniques required, whilst other students went above this and added one or two other techniques (14% of students used more than three models). This clearly goes to show that students engaged their creative side and explored different cases and opportunities for combining different techniques to form the complex models for extended supply chain systems.

Each report considered a reference list. 46% of students provided a detailed reference list that clearly links to the research required to identify the initial case study. This assignment encouraged students to extend their reading and explore different options, by not being reliant on the simple repetition of the material presented in class.

One other observed benefit from using an open case study is that there is no final answer or final approach for the selected case study. When a mathematical technique is used, students often expect a final "correct" answer. The learning in this case is no longer geared towards learning and evaluating a situation, as it is more linked to finding the final approved answer. When linking this to a real situation in industry, that final "correct" answer does not exist prior to approaching the issue (Tipi 2009). The aim here is to try to find ways to validate that the approach and the solution provided is appropriate by providing clear validation and verification.

Student Based Evaluation

From the self-evaluation report the following have been observed: only 40% of students provided the self-evaluation report. At this stage it can be assumed that this could be linked to the fact that students are not confident to share the evaluation of their assessment (however, no further data was collected within this research to indicate this), or it could be that students are not

yet confident in evaluating their own work (as it was remarked by a student who completed this report and indicated that it was difficult to evaluate his own work). Regarding the self-evaluation for an assignment, Taras (2002, 504) also indicated that students "can also be reluctant to cross the thresh-hold of what has always been forbidden territory", as marking and providing feedback for an assessment was always regarded as the tutor's task.

From the total number of respondents it has been observed that some students evaluated their work below the achieved mark (36%), whilst the rest provided a self-assessment similar (28%) or above (36%) the achieved mark. As an initial observation, this is regarded as a relevant point, where there are confidence issues in evaluating own work. A comment from the self-evaluation report indicates that:

> "It is difficult to give a self-evaluation to my own work. But, I think that this report has some relevant analysis, particularly for the forecast model… this report shows my understanding of the module. And clearly demonstrates that I understand the theory aspect and the importance that the quantitative methods have within the supply chain and for the business decision."

One interesting aspect related by this student is the comment made regarding the difficulty of providing a reflection on his own work. This comment also indicates that although there are some weaknesses regarding the analysis of some of the models conducted, the student portrays confidence in that the work he produced reflects his understanding of the theory used and highlights the importance of models used within the supply chain context.

The following were reported by another student:

> "this report I give myself a 65. The case study was adapted from real figures collected from my work experience and is an actual problem that has only recently been addressed. The personnel scheduling technique felt a little out of my depth at first because I thought I would need to add in every shift time on top of all the routes, but after I adapted and simplified the data it became clear, I could just use total routes rather than a more detailed complex version. I feel that I could have spent a bit more time on the forecasting section, possibly adding in the double exponential smoothing rather than just talking about it. I would also have liked to put in a few more references, as I found these hard to come by for a case study that I created myself."

The reflection provided here not only shows confidence in evaluating his own work but also the link he/she can make with a practical example that tackles a new issue in the logistics industry. The evaluation of the techniques used is relevant, however the development required here is for the student to try to link the practical application with the theory.

The self-evaluation reports include remarks along the following lines:

> "Overall, I have very much enjoyed completing this case study. I originally found it very hard trying to narrow down what I wanted from the case study, however eventually I found the models I needed.…I have referenced a wide range of logistics journals, which have helped provide a wide range of views and angles on the subject area.…if I was to do this again however, I would improve by researching more in-depth models…"

From this self-evaluation report it can be observed that one of the most difficult tasks is to generate the idea for the case study. To find the idea for the individual case study students were required to evaluate a substantial number of research papers, and to develop a complex model for the case selected that can combine the required number of operational techniques. This approach develops deep understanding of the techniques used and of the model developed. Knowledge

learned in other modules within the course could also help to facilitate a complex situation for the supply chain.

Students should self-evaluate and assess their own work for each assignment, regardless of whether the task is indicated or not by the tutor. By self-evaluating one's individual assignment, before submission, not only furthers improvement, but also allows students to gain more confidence and be more independent in their learning.

It is considered relevant to also incorporate the results of the end of year evaluation, as the summative coursework in question represents 50% of the overall assessment. For the Supply Chain Modelling module a 67.9% response rate was registered. The questionnaire comprises 7 quality assurance questions and students are asked to rate their response from 0 to 5, where 5 represent strongly agreed. An average is indicated for the response for each question as well as a percentage of the aggregated values of responses from the 4 and 5 category is also provided. The aggregated value of 100% (average 4.6) was received for the following questions: "*The module has improved my knowledge and understanding of the subject*"; "*There are sufficient opportunities for student participation in lectures/tutorials/seminars*" and "*This module is intellectually stimulating*".

This was followed closely with a 94.7% (average 4.3) agreed that "The assessment criteria specified for the module is clear"; "I am satisfied with the overall quality of the module" followed with a 94.4% (average 4.4) "The module is well structured and the workload, including assessment, is appropriate". 78.9% (average 4.2) was indicated for the "Feedback on my work, in relations to this module, has been useful and prompt". The following were registered as additional comments:

> "Very well delivered module in a highly valuable subject area within the field of Logistics. A hard module, but one where it is possible to do very well if you put the effort in, and where the tutor will support you each step of the way."

> "I am satisfied with the teaching and the package of material provided since year 2 till now. I am pleased and looking forward to apply it in industry. Thanks."

> "the most useful course that I have studied this year".

A level of confidence is shown in using the knowledge learned in this module, as well as the confidence to go out and apply the skills developed into a practical setting.

From the observations made by students and the tutor, together with the results achieved for this summative assessment it can be concluded that the design considered for this assessment, however challenging for students, promotes independent learning and creativity through asking students to design their own case study that can support a selection of appropriate modelling techniques. To analyse different models in the context of one case study demonstrates learning as well as developes deep learning when complex examples are put together.

Conclusions and Further Work

The use of the open case study for the coursework assessment in this area, however challenging, provides the opportunity for students to drive their own learning. By developing their individual case study students are using an assessment free from replication of knowledge (Ellery 2008) and are encouraged to bring and link knowledge from other modules in the course such as Strategic Supply Chain Management as well as Global Logistics and Supply Chain Management. The requirements for the coursework consider the need for wider reading, which ultimately will generate better reports. The challenges are no longer dictated by an imposed case study, where there are situations when students master the knowledge for individual techniques, however, they are not fully able to apply them to a pre-defined case study. Allowing the opportunity of

designing an individual case study for assessment empowers students to define the complexity of their models. This gives the chance for the more able students to engage with more creative options and ideas by increasing the complexity of the approach used as far as they prefer. For students who are less confident in their mathematical skills, this still proved to be a very robust platform to explore different operational techniques and implement them within different models that are selected by them based on their ability. Based on students' achievement and their observations, this assessment encourages students' expression of creativity and empowers them to apply learning to a level they feel most comfortable with.

It is clear that designing and developing the open case study for this assessment is a challenging task for students, however this is the point that encourages originality in their approach and creativity. This, combined with the task of selecting the most appropriate operational techniques to be used and validating them when there is not a pre-defined solution and answer, motivates and empowers students to find ways to justify their own approach and answers and promotes critical thinking. It can be concluded in this case that the summative assessment is an assessment designed to promote deep understanding, creativity, provides feedback and encourages student reflection on the work provided.

The self-evaluation report plays a significant role in designing this assessment that not only encourages reflection, allows students to engage into assessing their work, prepares students for a detailed feedback, but also provides the tutor with students' individual feedback. The self-evaluation reports could also have a role in managing students' expectations as well as providing the opportunity for two way feedback earlier on in the course. The answers obtained from the self-evaluation reports generated key messages for the tutor to take into consideration. Further consideration and further studies should give regard to the self-evaluation reports, to understand the reason for the low response rate (40%) as well as to further incorporate the outcomes from this analysis into the design of the module, coursework material as well as the feedback process.

An end of coursework evaluation questionnaire should be considered in the future to capture students' opinions on the feedback received. Further qualitative data should be collected from self-evaluation reports as well as questionnaires to enhance understanding on assessment and student reflection.

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