Investigating the learning outcomes of adopting active learning strategies that utilize rich resources in order to improve reasoning and analytical skills

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Instructors in university macroeconomics units are continuously reminded that tertiary students are not as capable in higher level reasoning skills as required in business. This has been exacerbated in Australian universities by an increased proportion of students from non English speaking backgrounds. Including more innovative sources and teaching methods into learning have been chosen to revitalise curriculum practices. Students will be exposed to more primary data and related visual news summaries as learning strategies to improve their reasoning and analytical skills and demonstrate the relevance of topics studied. A rationale for this intervention is developed based on research, experience and employers' needs. By guided practise, students gain confidence in interpreting, analysing and critiquing, instead of regurgitating interpretations of a teacher or author. The skills promoted in this intervention require deep and self regulated learning. The paper explains the rationale and methodology of the research.

The evaluation techniques include both qualitative and quantitative measures. The SOLO taxonomy is used to measure reasoning skills as an appropriate measure of student cognitive outcomes that has been applied to ranking tertiary learning skills. The study tests students' skills to summarise and analyse data at entry level, again at mid semester and finally at the end of the semester. A necessary part of the intervention includes 'constructive alignment,' that requires learning objectives to be aligned with appropriate assessment tasks. The qualitative evaluation will be undertaken through focus groups, intending to 'tease out' the student perspective of the intervention and provide richer results than the numbers alone provide.

Keywords: Deep learning, self regulated learning, learning innovation

Introduction

A challenge for tertiary educators is to continue to stimulate our students and motivate them to learn in a context of easier competing pastimes. Many of the alternative activities provide instant gratification through electronic media and easy access to these services, adding to the cost of students living expenses, and hence pressure to work longer hours. Under these circumstances many university colleagues have observed students try to take 'short cuts' in their tertiary studies. These include expecting 'answers' to assessment tasks and tutorial questions, asking for videoed lectures, providing ever more specific guides to tests and examinations. This approach twins with students being less prepared for lectures and tutorials which results in a likely passivity in class. This scenario is called a 'lack of student engagement'. These are the characteristics this innovation is addressing and committed to

reverse.

Students have a diversity of prior experience, motivation and knowledge on arrival into Macroeconomics. This project intends to ensure that student learning outcomes are the focus of improving quality of units offered (rather than entry level which is outside academics' control), thus ensuring lower failure rates and higher retention rates in our units.

Of the 360 students who enrol in Macroeconomics (HBE220/N) each semester, a growing proportion expects to memorise, and regurgitate secondary sources in the form of a text or a lecturer's explanation. These expectations are often satisfied as students continue to rely on set texts, lecture notes and teacher interpretations through a traditional didactic process rather than demonstrating higher levels skills such as critical thinking. In response, students have often treated complex economic questions simplistically, emphasising description and often regurgitating text. Although this has been challenged in a range of ways in Macroeconomics, one well thought through intervention has not previously been applied in a systematic, well documented and well evaluated research study. Changing students' learning would be aided by easy access of information from the media that promotes using economic data and current contexts to enhance understanding the theory (Agarwal and Day, 1998, p108).

This project aims to develop students' independent learning skills through the implementation of innovative teaching and learning practices. It utilises rich and relevant resources to boost student motivation and improve lifelong reasoning and analytical skills which are consistent with a deep learning approach. When student engagement is increased it is reflected in lower failure rates and reduced attrition rates. Student reasoning skills are measured using the SOLO taxonomy developed for application in tertiary learning by Biggs and Tang (2007).

Literature Review

The theory underpinning the intervention in this study draws on pedagogical literature including that relating to increasing 'student engagement' through promoting 'deep learning' by promoting 'active' and 'student centred learning' as well as 'self regulated learning'.

Student engagement is defined as 'students' involvement with activities and conditions likely to generate high-quality learning'. The definition provides a practical guide to improving learning outcomes (ACER, 2010, p3). A focus on student engagement implies a student centred approach and more emphasis on learning outcomes rather than teacher readiness.

Providing more active learning is a way of increasing student engagement. It measures the extent to which students actively construct new knowledge and understanding. It is enhanced by participating in class through questioning, discussion and learning beyond the classroom. It reflects student centred learning which encourages students to find answers, ask their friends or teacher when uncertain and express their own views. The above is quite consistent with a deep learning approach. It is however easier for some students to adopt deep learning practices when they have appropriate background and when a course is well structured and works from first principles in a systematic way (Biggs, 2003, p16-17). These inter-related and consistent themes within educational literature are linked to their learning outcomes in the following summary:

‘In short, measures of student engagement provide information about individuals’ intrinsic involvement with their learning, and the extent to which they are making use of available educational opportunities. Such information …can be a reliable proxy for understanding students’ learning outcomes.’ (ACER, 2010, p4)

Another important body of relevant educational literature relates to ‘self regulated learning’. It is considered synonymous with lifelong learning and involves an active learner who is able to find answers to questions and transfer understanding to new problems (Schloemer and Brenan, 2006). It applies when students set goals for their learning and take responsibility for the learning process and outcomes (Virtanen and Nevgi, 2010). The specific interventions in this study rely more on recent, relevant primary sources and data that students will be trained to explain, analyse and possibly criticise, using higher level skills than needed for reproducing dialogue from lecture slides or a text.

The motivation required for self-regulated learning requires deep learning which was first proposed by Biggs in 1991 and developed further, (Biggs, 2003) in a model of how higher level skills may be achieved in university teaching. Biggs’ model consists of three stages of learning known as ‘presage’, ‘process, and ‘product’stages. ‘Presage’ or prior influences on student and teacher approaches influence the second and third stages of learning after students enrol in university. Discussion of the second stage of Biggs’ model, known as the ‘process’ stage includes both students’ approach to learning and curriculum issues. The third stage of Biggs’ model is the ‘product’ stage. It identifies intended learning outcomes in respect of students’ cognitive development, and achieving a balance between generalist and specialist skills outcomes.

Biggs’ research has its roots in the belief that the best way to understand learning is to study how students learn, rather than focusing on the educational system, the teacher, or learning goals. The focus on student learning originated in Sweden with Marton and Saljo’s study (1976), which distinguished different approaches to learning when a group of students were questioned on the meaning of a text they had read. This study was a landmark and has been a catalyst for the work of Entwistle in the United Kingdom, who worked both independently and jointly with Ramsden, (Entwistle, 1984, 1988; Entwistle and Ramsden, 1983; Ramsden, 1992, 1998) and Biggs in Australia and Hong Kong (Biggs, 1987, 1990, 1993, 1999, 2003). All of the above research has been particularly interested in the implications of learning for student outcomes at tertiary level. Biggs’ research has successfully combined theoretical and practical principles of good teaching into a three-stage model. Although deep learning research was innovative in the 1980’s and 1990’s there have been less developments or new applications of these learning principles since then. ‘There is a clear need for further research to be conducted within specific disciplinary settings’ (Lucas, 2001) and to link the practices of student engagement to active, student centred, self regulated learning, with higher order thinking resulting

Higher order thinking requires students to analyse ideas and data and adapt information to new contexts. Self discovery is more likely to create deep learning and involve higher order thinking and the likelihood of transfer learning to new applications. The literature supports the view that teachers can enhance deep learning by using strategies of linking topics, both within the subject material and to the outside world, ensuring the subject structure reflects the real world, and asking questions that reflect students’ understanding of their learning (Biggs, 1999, 2003; Ramsden, 1998; Entwistle, 1988).

The learning outcomes of the product stage using a deep learning approach are questioning, and analytical students. Students are encouraged to investigate rather than merely accept answers or other's interpretation. When situations diverge from the norm or a previous example they will inquire as to why and how the new situation differs from the previous scenario. These reasoning skills need to be practised and demonstrated in a learning environment.

The presage, process and product stages of Biggs' model for teaching and learning need to be 'constructively aligned' to provide linkage between learning and teaching theory and enable the parts of the learning experience to gel together. This means that when students construct meaning through relevant learning activities, to be effective, they must align closely with those tested in assessment tasks. To be 'constructive' students must use their own activity or reflectivity to maximise the benefit of the learning and its assessment. 'Constructive alignment' is crucial to ensure objectives align with assessment tasks (Biggs and Tang, 2007). When there is alignment between what we want, how we teach and how we assess, teaching is much more effective (Cohen, 1987). A constructively aligned system of instruction means the following three considerations need to be met:

1. Nominated objectives,
2. Consistent, appropriate teaching/learning activities, and
3. Assessment tasks to ensure students' performance are matched with learning objectives. (Biggs, 2003: 30):

The learning objectives and hence the process and learning outcomes are to be 'active', containing verbs to identify the student-centred nature of the learning. In the learning strategies, students gain understanding by 'exploring', 'linking ideas', and speaking or writing to 'explain and defend their views'.

SOLO's taxonomy provides a framework to identify five levels of understanding that may be measured objectively. It starts with the lowest level reflecting an inability to understand the basics, along a spectrum of incremental skill levels including identifying multiple relevant points, and linking, relating or comparing the points identified to making a generalised hypothesis from the data. The assessment tasks can be graded according to the five SOLO categories.

Rationale for the Intervention

The reason for the intervention is to enhance student engagement and encourage deep learning by increasing learner-centred analytical and reasoning skills (higher order thinking), using a range of relevant applications. Increasing active learning requires new and innovative ways to revitalise curriculum practices. Incorporating more primary data provides a source for developing analytical skills. It also provides current data for subject material and allows a sense of immediacy and discovery for students. Practise in analysing data, graphs or tables are all means of developing students' analytical skills. The applications are integrated into the lectures through brief news clips, sources on the internet, discussions or data, promoting students ability to interpret and make theoretical links to current data and commentary related to Macroeconomics. The project is designed to support self regulated learning or life long learning skills for students through the stimulus material, accessible outside class and closely linked to assessment.

> ‘These sources (internet) offer a new medium of interaction that complements classroom instruction and facilitates learning’,
> Agarwal and Day, 1998

A similar study to the current intervention was carried out in a US College and a summary of results include findings of:

> ‘Clear relationships among the use of technology and understanding the lecture material’ and ‘technology increases student’s motivation for learning… brings more ‘real world’ situations into the classroom’

The US study differed from the current intervention by pre-packaging lectures using technology. A multivariate analysis of the data known as MANOVA was used to analyse the survey results. The results showed that students basically agreed with the premise that technology-based lectures were helpful in the learning process (Sousa and Mirmirani, 2005).

The intervention uses rich resources drawn from a variety of sources and makes use of educational technologies. In each week’s lecture there is purposeful news or other web source summary shown as a short video, or transcript combined with a range of learning activities aligned to the unit’s learning objectives, such as ensuring students link concepts covered in the class to a current economy. The arguments or data presented are discussed and evaluated in a range of ways, but active discussion and critique are central. Students use these resources and locate others when responding to an identified issue. This project uses appropriate learning activities for students to develop these skills - to source, explain and critique issues with a view to making recommendations. By guided practise students develop confidence in their own interpretative, analytical and critiquing skills.

Development of higher level analytical and evaluative skills, is essential for business practitioners as identified in an accounting employer survey in the USA, showing analytical/ critical thinking skills was the second highest ranked professional skill, second only to written communications (Burnett, 2003, p131). Ultimately the intervention enhances students’ learning experience particularly related to developing their reasoning and analysis skills. It requires deep learning to develop understanding or higher order analytical skills. Active learning, discussion and deep understanding are indicators of engagement (ACER, 2010). Changes in skills and motivation will be measured, assessed and evaluated. The new learning and teaching approaches are trialled. It is expected that by seeking student feedback on the introduced active learning strategies, improvements, refinements and adjustments to these strategies will be made in response to students’ feedback on the efficacy of particular parts of the intervention and suggested ways of improving their application.

Methodology

A range of possibilities were considered in the planning stage of the intervention and an ethics approval application ensured that the strategy adopted was consistent with students’ interests. It also ensured a full understanding of all the stages of the project were thoroughly thought through.

It was agreed there would be a pre-test to gauge the entry level of students’ analytical skills.

These same skills would be measured again as part of a mid-semester test and again at the end of the semester on parts of all the short answer questions on the final exam. These three tests would be graded using the SOLO taxonomy scales and an analysis of the data using SPSS (renamed PASW). This is software used to simplify data analysis and deploy results.

In order to classify student responses, Biggs and Collis (1982) used the taxonomy to correspond to Piaget's cognitive stages of development. The classification graded from Pre-structural (very weak) to Extended Abstract (highest) based on the understanding demonstrated in students' answers. The SOLO taxonomy was chosen for the purposes of grading students in this project as it has been used before for similar purposes and there are only five categories, which is suitable for measuring learning outcomes (Biggs and Collis, 1982). It was relatively easy to match the SOLO skill levels when grading an answer to explain, summarise or categorise current economic data.

Students were invited to be part of the study. They were briefed on its strategy via Blackboard (internet portal) prior to class, and were briefed in the first lecture with provision for student questions about the study. The invitation to participate in the study was offered, providing assurance that the choice would not be known by teaching staff, or impact participants' academic results. **A pre-test** was provided to all students, and 'participating students' provided their student identification and demographic information on the pre-test.

Student responses were de-identified by an administrator assisting the project. The information was provided by 125 students who recorded their willingness to participate at the beginning of the pre-test. The results of the pre-test assessed the entry level of reasoning and analysis of individual student skills prior to the implementation (learning process) being trialled. Generic feedback on approaches to the question attempted was provided to all students. Similar analysis of data was demonstrated in lectures and practised by students in tutorial questions.

Agreement to participate in a focus group will also not affect individual grades. All students will be invited to participate in a focus group by a non-teaching academic, who will collect the names of those who are prepared to be involved. The non-teaching academic will also facilitate the focus group/s and arrange for all data transcripts to be de-identified prior to being provided to the teaching academics. The focus group session will only be audio recorded with agreement from all student participants. Students will be made aware that they may withdraw from the focus group at any time.

Teaching staff in the unit were briefed and trained for the required new and flexible learning. Teaching staff may also have opportunities to work collaboratively within the faculty across-discipline areas to build a community of practice and to be involved in developing their scholarship around teaching and learning.

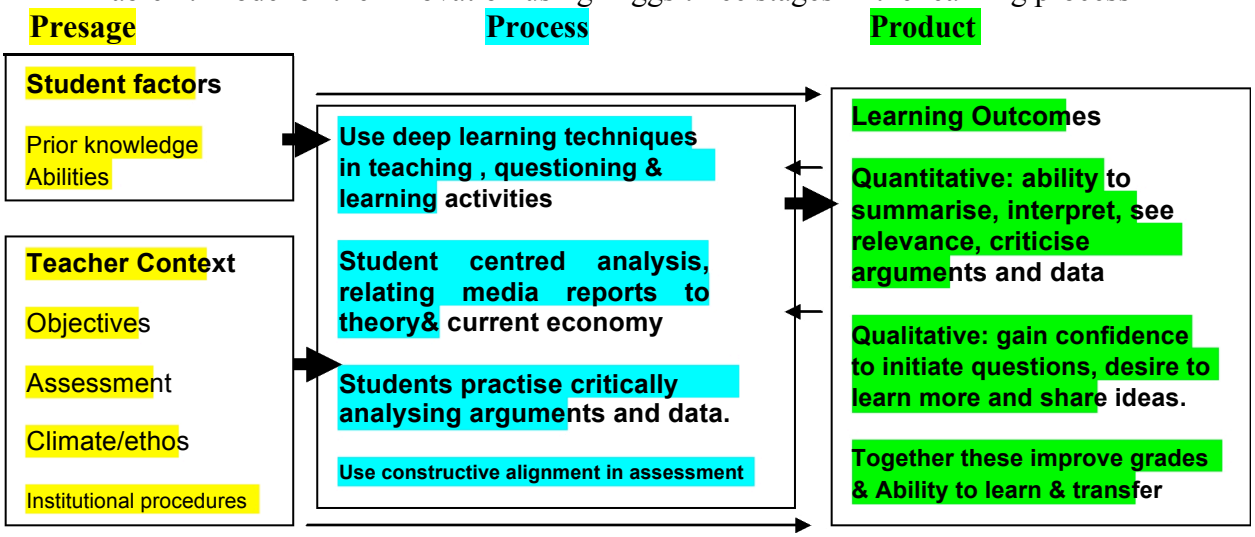
Mid-semester test: All students were re-tested on similar questions included in the mid semester assessment of the unit. This occurred after exposure to the new active learning strategies being trialled and students' skill level were compared to their entry skill level. The results of participating students were again de identified by the non-teaching academic, who recorded their results on the coded spreadsheet to be included in the study. **Final test:** At the end of the semester, the same types of questions were included as part of the final summative assessment, again adopting similar procedures to ensure participating students remain

anonymous. The researcher will compare how the participating students have progressed over the three assessment items. Overall student skill trends will be reviewed and finally correlations with demographic data and result trends will be reviewed.

Summary of the Intervention

The intervention is summarised using an adaptation of Biggs' three stage model. The model identifies three stages of learning. The Presage is prior to the intervention but the diversity of prior student experience and their learning and teaching context is acknowledged as a factor that has changed the tertiary class environment and requires changes in curricula, teaching and learning strategies. It also impacts how readily students are likely to adopt strategies consistent with deep learning. The Process stage summarises the key aspects of the intervention described in the paper relating to the well structured curriculum, the participatory lecture and tutorial program. These include students answering questions in groups, allocated to present answers using current media extracts which ask students to explain and interpret commentary reflecting on how their personal response to, for example, consumption spending or interest rate rises differ from those in the media report. Students are encouraged to find their own media report to provide evidence or an example to illustrate a concept and explain how it links to the relevant topic. Data is integral to all topics in macroeconomics. Analysing simple inflation, unemployment, fiscal and monetary policy data provides a rich medium to develop understanding. Assessment is closely aligned to specified objectives with opportunities for students to provide their own response and reflection on a question. The Product stage is yet to be quantitatively or qualitatively evaluated, but the desired outcomes have been identified and included in Table 1.

Table 1: Model of the innovation using Biggs three stages in the learning process



Adapted from Biggs, 2003: Figure 2:19. The learning outcome results from interaction of many factors but the main direction of effects is shown by the heavy arrows.

Limitation of the study

Although the results from the pre-test, and the mid semester tests are available, the final test data is not yet compiled to provide quantitative data to assess the impact of the intervention for participating students.

The individual data was collected during the semester, coded and will be analysed when the final assessment results are finalised. Feedback from focus groups will provide further insight to the research on questions related to the effectiveness of the intervention and the general trend in results over the semester.

Preliminary results

Quantitative skills

The data cannot be fully analysed until the results of the final examination are completed. However, a random sample of five students whose results have been analysed show all students improved in the mid semester question. Quantitative skills showing students' ability to summarise and interpret data, and their ability to recognise a numbers' sign and its significance and the ability to identify a pattern in the numbers and their meaning and significance showed improvement by all students between the pre test and mid semester tests.

Qualitative skills

Discussion with final semester examiners

'Students have used examples in the videos to illustrate answers in the final exam'.
'The final exam papers show students understand more and have higher marks than last semester'
'The students have shown they are able to use the data provided much better than I thought they would',
'Although they haven't referred to the particular video, they have used illustrations and examples from them'

Anecdotal feedback from students

A sample of students has been questioned on the qualitative aspects of the intervention and responded with the following comments:

'Enjoyed the unit-I particularly liked the videos-they made two hour classes less boring' and 'It's harder now that we have to analyse data' and 'the graphs are difficult to understand' but 'it's a really relevant unit and I understand the news and the news paper more than I did',

'I keep hearing stuff I didn't understand before taking this unit.'

'I definitely think they were worth it'. The data on the budget outcomes was so simple that I was able to answer the question just by explaining the data'

Conclusions

Objectives, implementation and monitoring of the intervention have been disseminated

throughout the accounting, economics and law groups as well as within the whole faculty. The final findings will be used to advise the student learning experience and inform future curriculum development. Data collected will be used to evaluate the effectiveness of the proposed curriculum intervention, so that it might be improved and enhanced within the Faculty. The evaluation of the project will inform the faculty of the efficacy of the approach and will be compared with learning outcomes in future semesters.

Student feedback from the focus group combined with the quantitative analysis will be used to quantify, explain and further unravel the outcomes from the intervention more fully. Preliminary results suggest there has been a strengthening of higher level skills which are transferable to other units, employment possibilities as well as beyond undergraduate studies.

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