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Multiple Methods: How to Help Students Succeed in Quantitative Methods for Business Unit

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Abstract

Helping students succeed in a quantitative analysis courses is often difficult especially when students have little or no prior mathematical training. Without denying the significance of traditional lectures and tutorials in undergraduate education, an increasing number of academics are recognising the value of practical sessions, informal small-group learning and online learning facilities. By recognising that each person processes information differently, by reducing student's anxiety towards the unit and by making teaching accessible to students of multiple learning styles, the lecturer can give all students a better chance of successfully completing the unit. This paper looks at the links between the multiple learning activities adapted in Quantitative Methods for Business unit to the students' academic performance and their attitude towards the unit.

Keywords: *learning activities, education, quantitative units, mathematics anxiety, mathematical self-efficacy*

1.0 Introduction

Governments and employers have highlighted the importance of numeracy skills in one's ability to find employment, attain job satisfaction, level of remuneration, community participation and well being (Capellari *et al* 2009). Further, several studies (Bishop 1989, Murnane 1998, Ma 2001) have observed that proficiency in quantitative skills improve job performance not only due to the array of the computational jobs performed in most jobs but also because of the greater general productivity associated with quantitative literacy. Previous studies also suggest that adult numeracy is associated with educational achievements (Kirsch et al 1993, Boudard 2001, Desjardins 2004). In particular, Mc Nabb *et al* (2002) and Smith and Naylor (2001) have found that grades obtained in first year mathematics exam can be a good predictor of the subsequent academic performance of students in Economics. Likewise, research results (Campbell and Hackett 1986; Hackett, Betz, O'Halloran and Romac 1990) reveal that previous mathematics performance and perceived ability are both key elements for success in higher level mathematics in universities.

The mathematical ability of students entering Australian Universities has been a matter of some concern and debate for a number of years and this concern has been felt strongly on courses for which mathematics is a primary requirement. Recent research (Mallik and Varua 2008) have highlighted the increasing variability in the mathematical background of business students entering university and the abolishment of the 2 unit maths requirement for the Bachelor of Business in most universities.

During the late 1990s to present, possibly due to lower government funding and support, universities were forced to employ various measures to increase the number of enrolments (i.e. student population). Consequently, the required pre-requisites for a business degree went from specific units such as mathematics (advance, two units) to assumed background. This indirectly lowering of standards created a gap between lecturers' expectation and students' ability. Although the traditional lecture-tutorial format can still be utilised, knowing the level of mathematical capabilities of the students are crucial in determining the failure rate. This means that the content of the unit is watered down. The full unit material cannot be covered in 12 weeks

when students do not know how to handle fractions and percentages even with the aid of calculators.

It is apparent that the minimum mathematics required for all students in Year 10 and the absence of a required level of mathematics in Year 12 severely affects students' academic performance and attitude towards a quantitative subject at university level.

Hence, in this paper, the different teaching and assessment methods used to assist as many students in passing quantitative methods for business is discussed. In addition, the importance of attitude towards quantitative subjects especially mathematics and the dismal level of mathematical ability in most of the business students are highlighted.

The outline for the remainder of the paper is as follows. The related literature is presented in Section 2. Section 3 describes the students' profile, prior mathematical ability, existing teaching and assessment activities employed in the course. Section 4 presents the revised teaching and assessment activities of the course after the poor performance from the students while Section 5 gives the conclusion.

2.0 Related Literature

Several variables influence student academic performance of which intelligence (*i.e*. ability) seems the most obvious. However, there is a body of knowledge that suggests that factors other than ability explain a substantial portion of the variability in student performances (Nonis*, et. al* 2003). Moreover, educational psychologists have long known that different students learn differently. There are several schools of thought on how students learn, including the popular Kolb Learning preference Model (1985) and Gardner's Theory of Multiple Intelligence (1983). Dr. Gardner of Harvard University has been challenging the basic beliefs about intelligence. He believes that intelligence is much more multi-faceted than what is measured using *IQ* tests, university admission tests, and many other similar tests. He also believes that intelligence is not fixed. He defines intelligence as: a measurable aptitude; an aptitude one uses to solve problems; and an aptitude to create.

He also identified the different types of intelligence and his initial list includes the following:

- Interpersonal aptitude for working with others
- Logical/mathematical aptitude for math, logic, deduction
- Spatial/visual aptitude for picturing, seeing
- Musical aptitude for musical expression
- Linguistic/verbal aptitude for the written/spoken word
- Intrapersonal aptitude for working alone
- Bodily/kinesthetic aptitude for using your physical self

One might ask how these findings impact upon a student's learning? Gardner believes that most students are comfortable in 3 to 4 of these intelligences, and may avoid the others. While the intake styles reflect how student prefer to receive information, the intelligences reflect how each student prefers to process information. For example, if the student is not comfortable working with others, doing group case studies may interfere with the student's ability to process new learning. Further, video-based instruction will not be good for a student with lower spatial/visual aptitudes.

Disappointingly, traditional lecture format reaches very few students effectively. Russel Martin and associates for instance have indicated that fewer than 12%-18% of the population learn aurally, which implies that more than 80% of students in the classroom have difficulty learning the materials because it is spoken rather than taught in a hands-on manner or written down. Also, less than 20% of the population have logical-mathematical intelligence to succeed in a traditional lecture-style methods course (Hibbison 1999). Thus in a traditional quantitative course such as Quantitative Methods for Business (QMB), the only students favoured to succeed must be in the 12%-18% of the population that learns aurally and part of the less than 20% of the population that has logical-mathematical intelligence. As such, the majority of the class is at a disadvantage even before the course outline has been handed out in the first lecture.

But by recognising that each person processes information differently, by reducing student's anxiety towards the course and by making teaching accessible to students of multiple learning

styles, the lecturer can give all the students a better chance of successfully completing the course.

This paper looks at the link between the multiple teaching activities adapted in QMB to the students' differing learning styles, academic performance and their attitude towards the course.

3.0 Students' Profile, Assessments and Learning Methods Used

3.1 Student Profile

The University of Notre Dame Australia is a private Catholic university with campuses located in Fremantle, Broome and Sydney. In the Sydney campus, most of the students are from Catholic schools although a great number comes from non-catholic and even public schools. The student population seems to be predominantly female. In particular, for the cohort of students included in this study, 55% and 54% are female for semesters 1 and 2, respectively. The students are from the School of Business undertaking accounting, management, marketing and public relations courses.

This research draws on experiences from two separate cohorts of students studying one of the core units for a business degree, that is, Quantitative Methods for Business (QMB).

QMB is one of the units majority of the students find with most difficulty. In 2009, semesters 1 and 2, there were around 200 students and the failure rate was around 30% for both semesters. This was lower compared to previous years, i.e. 2007 and 2008, where the failure rates were around 40 per cent and 70 per cent respectively. We attribute the lower failure rate in 2009 to the revised teaching and assessment activities plus the students change in attitude.

3.2 Prior Mathematical Ability

In this paper, a survey was conducted to establish the level of mathematical ability amongst students. Of the total 200 students, only 25 per cent participated in the survey. Students were asked to indicate the level of mathematics, if any, they have completed in Years 10, 11 and 12. The surveyed data is then added to the student data available in the University and the

assessment marks. Students' attitude is gauged by the lecturer and tutor where 1 is positive and 0 is negative. Each student was given an attitude score of either 1 or 0.

Since mathematics in Year 11 and 12 is not compulsory, around 20% of respondents have not studied mathematics 12 months before commencing at university. Moreover, some students would have taken a gap year or longer. Hence, these students would need some refresher course to pass the QMB. There is no bridging course offered in Notre Dame for students who do not have the appropriate mathematics background.

Around 9% of the students decided not to study mathematics in Year 11 and around 43% and 46% of students opted to study general mathematics in Years 11 and 12, respectively. There are four levels of mathematics a student can attempt in Year 12.

They are General and Advance, both are two units, Extension 1, which is three units and Extension 2, which is four units. Only 2% and 7% of the students studied Extension 2 and Extension 1, respectively. The other 25% of the students in Year 12 studied Advance Mathematics. Hence, 66% of the students in Year 12 either had not studied mathematics at all or only opted for the minimum mathematics subject which is General Mathematics. This scenario is not so different in Year 11, which stood at 52%. It is not a surprise that failure rates could be as high as 70% in 2008.

A majority of students opt for general mathematics to complete in Year 11. The experience from the two cohorts included in this study suggests that a higher level of competency in mathematics is required to successfully pass QMB. Despite this, a few students that have the right attitude towards the course having only just completed general mathematics in Year 12 showed that they could pass the course albeit not easily but with a decent amount of effort.

3.3 Learning Activities

QMB is delivered via a lecture-tutorial format. That is, two-hour lectures and one-hour tutorials. Students with varying capabilities and background in maths were placed in the same weekly 2-hour lecture and then split into smaller tutorial groups. Students were expected to read before the

lectures and complete their assigned tutorial exercises each week before class. At the tutorial groups, students with no maths background since Year 10 or students who have left school for a considerable length of time, were placed with students who have completed 3 or 4 units of Maths at Year 12.

Because of the differing competencies and learning styles, a large portion of the students felt disengaged and were not able to keep up with the students who have obviously done extension maths at Year 12. Slowing the pace at tutorials was not a solution as the more competent students would then feel 'bored'.

3.4 Assessments

The performances of the students were assessed using assignments, mid-semester test and final exam averages. Assessment tasks ranged from weekly tutorial exercises, fortnightly quizzes, a mid-semester test and a final exam. The weekly tutorial questions are known beforehand to give students plenty of time to prepare. Weekly tutorials are designed to encourage participation based on the exercises provided. Fortnightly quizzes were given to boost confidence by setting questions that were relatively easier and highlighting basic mathematical concepts. The mid-semester test and final exam are typical mathematical exam questions where solutions have to be shown in full.

3.5 Initial results

After recovering from the initial shock that majority of the students in business did not have the adequate mathematical ability, lecturers and tutors have to simplify course content/assessment and utilised varied teaching and assessment tasks. This inadvertently resulted in a dumping down of the curricula and its assessment.

Lecturers adapted their teaching and assessment strategies to suit the students so that constant testing of their mathematical knowledge is done to reinforce the learning. Several learning enhancement activities were introduced in the unit to reduce anxiety and to engage students in learning. Four key teaching activities were either revised or introduced in QMB.

4.0 Revised teaching activities

4.1 Access to the course web site

Although the majority of students graduated in Australia, many are still not very familiar with online learning. ***Blackboard*** was used in QMB in the past and we found that students have difficulty navigating the various resources contained in the course. In semesters 1 and 2 some strategies have been adapted to improve the student's understanding of accessing the course website. The most important of these steps were:

- Providing a tutorial in the first week of the course to give an introduction to the web site and some written notes as a guide to the use and contents of the ***Blackboard*** support materials; and
- Design and introduction of a web assignment, which could only be answered by accessing material placed on the site or using links provided there.

4.2 Prac Sessions (Tutorial Sessions)

The preliminary survey reveals that in most of the undergraduate quantitative courses the students have completed, they were given limited exposure to the empirical applications of the theory.

In QMB, the exercises were designed that the theory discussed in lectures are applied to practical problems in tutorials. The selected questions enabled students to relate real world examples to theory.

Students with no Year 11/ 12 mathematical background or no mathematical background since leaving school for over 2 years, were put into a special tutorial group. This group was placed in a special 2-hour tutorial group with extra homework questions. They were told to prepare for the answers and discuss them in class. Rather than undermining their confidence, students found that

learning among students with similar mathematical capabilities gave them confidence and encouragement to improve their capabilities.

In the other tutorial groups, students with higher level of maths background were very often asked to complete the assigned problem on the whiteboard. This bolstered their confidence but it also gave some of others a positive attitude towards maths.

4.4 Small group discussion

In the second week of lectures, students formed small groups known as consult groups. The students were allowed to choose their own group and were advised not to have more than 50% members of the group coming from the same secondary school. The groups consulted with each other before each exam and prac session, suggesting various ideas from course material to provide solution to the tutorial exercises or to an instructor generated problem.

Consult groups were known to approach their tutors on problems that they could not resolve within the group. Students who studied well in groups gained greater confidence in their approach to problem solving questions.

4.4 Assessments

Assessment tasks were re-designed to encourage weekly revision, build confidence and ensure students have a basic idea of computational methods used in business (albeit not economics). The tasks ranged from weekly tutorial questions, fortnightly quizzes, a mid-semester test and a final exam. In 2009 for semesters 1 and 2, although almost half of the students took General Mathematics in Year 12, the failure rate could be as high as 40%. Frequent quizzes re-affirmed their knowledge on the subject and allowed them to practice the theory on problem solving questions.

Tutorial participation and the marks from quizzes plus frequent consultation with tutors and lecturers assisted most students in passing the unit. A number of students had to repeat a few times and required private tutors. Students' attitude also played an important role. Frequent

consultation with their tutors helped to change their attitude towards the course. The continuous assessment during the semester provided frequent and updated progress for students and tutors. Students who were willing to learn and improve, managed to pass the course.

Amongst the respondents in the survey, 68% had a positive attitude towards mathematics. This is in contrast to the combined average between the two semesters at 41%. It is expected that students with a positive attitude would participate more in the survey. With the actual failure rate in both semesters at 30%, the attitude of students seem to have a significant effect on students' performance in this particular unit.

5.0 Conclusion

The paper findings suggest that students' mathematical ability and attitude played an important role in determining the failure rate in quantitative methods for business at university level. Various assessment methods have to be employed to lower failure rates closer to an acceptable level.

However, standards in secondary school would have to be reviewed and looked at. Students who choose to attend universities in similar courses have to have similar capabilities, say, business students. Teaching and assessment procedures would be difficult to administer when you have students with a high and/or adequate knowledge of a subject attempting the same unit with students having either no mathematics background in Year 12 or very little.

Universities would also have to consider introducing refresher course on basic mathematical concepts for students who have a negative attitude towards maths or who have been advised to drop maths in Year 11 and 12 after attaining a 'less than satisfactory' score in Year 10 or 11 to proceed to their HSC level. Students who have left high school for more than 2 years will also need to attend the refresher course.

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