

NON-STATISTICIANS LEARNING STATISTICS

Dr Ayse Bilgin

Department of Statistics, Macquarie University, Australia
ayse.bilgin@mq.edu.au

Learning approaches of students could be either deep, surface or achievement oriented. If students choose to study a unit (elective unit instead of a core unit) then we might expect them to use a deep approach to their learning since they have chosen the unit themselves, probably anticipating the benefits of the unit to their careers. If they choose two elective units that are related to each other, and one of them is prerequisite to the second one, then we might expect students to utilize the deep or achieving approaches to their learning at least for the lower level unit to maximize their grades (achievements) for these units. The main results of this study is show that the learning approaches of students do not change from second to third year in two large statistics units. The student characteristics such as country of gender, the degree enrolled and intention to enroll to higher degree are not significant factors for learning approaches.

INTRODUCTION

This project builds on the earlier work undertaken by the author (Bilgin & Crowe, 2008). The earlier study was a cross sectional study which a significantly higher Deep Strategy scores were observed for postgraduate students compared to undergraduate students, but no other significant difference. Previous studies reported that learning approaches of students change over the course of a university degree from a deeper approach to a surface approach (e.g., Kember, 2000; Biggs, Kember & Leung, 2001; Rodriguez & Cano, 2007). In addition, it was speculated that students whose first language was not English would have a narrower approach in general to learning. This speculation was not found to be true for cross sectional studies where the Australian and Asian learners are compared (Kember & Gow, 1991; Green 2007). Other researchers reported that students might have mixed learning approaches and change their learning approaches from unit to unit (Marton & Saljo, 1984), therefore it is important to investigate how in two similar units, students might change their learning approaches to their studies. This project aimed to investigate whether learning approaches of students changed over time and, if so, to propose curriculum strategies to broaden learning approaches.

STUDY BACKGROUND

The first step for this project was preparing a project plan and applying for a Learning Excellence and Development (LEAD) Grant from the Faculty of Business (then the Division of Economics and Financial Studies) at Macquarie University. This grant scheme was set up in 2007 to assist the development of the learning and teaching process under the guidance of the Director of Learning and Teaching Studies and the Associate Dean of Learning and Teaching (Wood & Petocz, 2008).

The largest second and third year units offered by the Department of Statistics were chosen as the units which students were given the opportunity to participate to this study. These units were Operations Research I (OR I) and Operations Research II (OR II). While OR I provides a broad introduction to quantitative decision-making methods in a business context and covers the topics such as linear programming, project planning, transportation, queueing and inventory management, OR II builds on the knowledge gained in OR I and adds more by providing the background for making informed decisions about complex problems based on the principle of optimization; and teaching students how to deal with uncertainty, using indicator variables in problems, solving and analysis of integer based problems and understanding the use of probabilistic models which are integral parts of business decision making.

The research questions answered as a result of this study are:

- Do learning approaches of students significantly change from second year to third year?

- Is there a significant difference in the students' approaches to learning for different subgroups (i.e., local and international students, male and female students, students who work and students who do not work)?
- Do learning approaches associated with the degree enrolled or intention to enroll to a higher degree?
- Is there a relationship between the students' achievements (Standard Numerical Grades - SNG) and their approaches to learning in statistics?

METHODOLOGY

The project is carried out during the offerings of OR I (second year unit) in semester 2 of 2008 and OR II (third year unit) in semester 1 of 2009. Ethics Application was approved by the Macquarie University Ethics Review Committee (HE26SEP2008-R06099). All the students who attended the practical classes (OR I) or tutorials (OR II) were invited to participate to the study. A demographic survey and the Study Process Questionnaire (SPQ) (Biggs, 1987a & 1987b) were used as data gathering instruments. The demographic survey is used to describe the backgrounds of the students while SPQ is used to identify the students' approaches to learning. The SPQ is a self-reporting survey consisting of 42 items on six subscales. There are seven items on each subscale. The six subscales are *surface strategy* (SS), *surface motive* (SM), *deep strategy* (DS), *deep motive* (DM), *achieving strategy* (AS) and *achieving motive* (AM). Three different learning approaches of students are calculated by summing up the strategy and motive of a certain approach, for example *Surface Approach score* is calculated by adding up surface strategy and surface motive scores. Each item on the SPQ has a five point scale ranging from (1) "this item is *never* or *only rarely* true of me" to (5) "this item is *always* or *almost always* true of me".

To eliminate any bias due to the researcher being in the class during the survey, a research assistant (RA) was employed to oversee the process. After a short introduction by the researcher about the study and inviting students to participate, the researcher left the classroom and the RA administered the surveys.

The same questionnaires were given to students in 2008 and in 2009. Although, there were 490 students enrolled in the second year statistics unit (OR I), where 323 of them participated in the study (66% response rate); and 136 out of 196 students enrolled in the third year unit (OR II), participated in the study (69% response rate), when we matched the students in the second and third years, the sample size was 35. In other words only 35 of 490 students who enrolled to both units in consecutive semesters had participated to the study.

The participating students' academic achievements (SNGs) for OR I and OR II were matched to their surveys. These matches enabled us to test the hypothesis that students' approaches to learning in statistics do not affect their academic achievements against the hypothesis that students' approaches to learning in statistics affect their academic achievements.

The data was analysed by calculating mean scores for different groups defined by the demographic variables collected (i.e. gender, students who worked versus students who did not work). Paired t-tests and two sample t-tests (for the differences of scores in two units) were used to test various hypothesis identified above.

RESULTS

The sample was reasonably split between male (54.3%) and female (45.7%) participants. The average age of students at the time of first survey was approximately 22 (std=2.1) years, with females having a slightly lower average age (less than a year younger than their male peers). Most students were under 25 years of age, apart from 2 males who were 26 and 30 years old. The sample consisted of students who identified themselves as an international student from an Asian country (91%) and very small number who were Australians (2 students) or from another country (1 student). Although all international students were fulltime students (33), 43% of the students had a job during their studies of OR I where they worked from 8 hours per week to 30 hours per week and 34% of the students had a job during their studies of OR II where they worked from 3 hours per week to 24 hours per week. Only nine students worked both in second and third years. On average, third year students reported working one and a half hours shorter in employment than the second year students.

More than half of the students (60%) were studying towards a BCom, Accounting degree, while 17% were studying towards a BCom or BA, Statistics degree and the remaining other degrees in 2008. In 2009, these proportions changed to 71.4%, 14.3% and 14.3% respectively. In 2008, three-quarters of students liked studying and considered statistics to be useful for their future work while 80% said that they also liked studying Mathematics. While the percentage of students who like studying (69%) and studying Mathematics (71%) slightly decreased in 2009, the percentage of students who considered statistics to be useful for their future work (83%) slightly increased. The majority of the students intended to enroll to a higher degree after completing their Bachelor degree (83%).

Except six students, all the students answered the open ended question “*Why have you chosen this unit to study?*”. Accounting students who chose these units as electives provided very interesting answers: “*Useful for my future work*”, “*I think that the content of unit is useful for company operations*” and “*Prepare a stronger foundation for my accounting degree*”. There were also some unexpected answers considering the literature about students’ dislike of statistics: “*It’s fun!*”, “*I like it very much*”, “*my friend told me that this subject is good*” and “*Because it is interesting*”.

The comparative boxplot in Figure 1 (left) shows the distribution of the differences for Motive and Strategy scores in the two units (OR I – OR II) for the three dimensions of the SPQ. The second and third year units do not show any large differences on either of the surface, deep or achieving motive and strategy scores. Paired samples t-tests were used to test for any significant differences between the second and third year units on all of the motive and strategy scores. Only the comparison of the Deep Strategy score in the two groups was significant ($p=0.037$). It is interesting to note that there is more variability in the differences of Achieving Motive and Strategy scores, compared with both Surface and Deep scores.

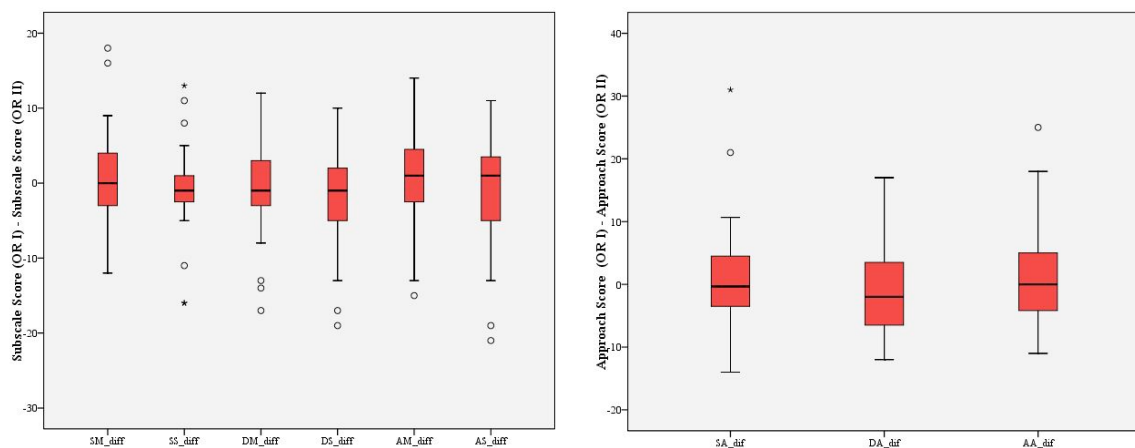


Figure 1. Distribution of the differences for Motive, Strategy and Approaches scores

The distribution of the differences for the Approaches scores is also shown in Figure 1 (right). Although on average, the Surface and Achieving Approaches scores are higher for OR I compared to OR II and Deep Approach scores are lower for OR I compared to OR II, these differences are not statistically significant (all three p values are greater than 0.05).

Due to the very small number of local students in this data set, we are unable to test the hypothesis whether local and international students differ from each other. No significant differences of the differences in Motive, Strategy and Approach scores were found between male and female students; students who worked or did not work. Although all the differences between the Motives and Strategy scores between OR I and OR II were lower for the students who liked studying, the differences were not significant. There were no significant differences between the differences of Approaches scores of students who enrolled to accounting, statistics or other degrees.

Students who considered statistics useful for their future work had higher Surface, Deep and Achieving Approach Scores in the OR I (and lower in OR II) compared to the students who did not, however there were no significant differences between the groups.

Standard numerical grades (SNGs) were significantly positively correlated only with Achieving Approach scores for OR I ($p=0.01$), but not for OR II.

CONCLUSION

Based on the analysis we can conclude that the learning approaches of the students did not significantly change from second year to third year; females and males were not significantly different from each other and whether the students worked or not worked during the semester did not affect their learning approaches. The only significant difference is observed for Deep Strategy scores. While studying OR I, students had lower Deep Strategy (mean=21.5, std=5.9) scores than when they were studying OR II (mean=24.1, std=3.2). Interestingly, all Motives and Strategies scores were higher in third year unit for students who liked studying compared to the students who did not like studying however these were not significantly different from each other. The degree enrolled and the intention to enroll to a higher degree were not significant factors for learning approaches scores.

We recognize that this is not a random sample but a convenient sample from one institution. However due to the nature of the study (longitudinal instead of cross sectional), the sample size is large enough to provide answers to hypotheses raised in this paper.

Further research is needed to clarify why and when students use one or other learning approaches to their learning. Better understanding of why the students chose to use a certain approach or a mixed approach to their learning could be achieved by a series of studies where both qualitative and quantitative methods are utilised.

ACKNOWLEDGEMENTS

The author wishes to thank Dr David Bulger, Dr Tania Prvan, Ms Sigurbjorg Gudlaugsdottir for providing the time to survey their students; Ms Balamehala Pasupathy, Dr Paul Taylor, Ms Anna Rowe, Ms Natasha Almeida and Mr Simon Bartlett for their assistance with the survey administration and data entry; and of course for the students who took part in the study.

REFERENCES

- Biggs, J. B. (1987a). *Study Process Questionnaire Manual*. Melbourne: Australian Council for Educational Research.
- Biggs, J. B. (1987b). *Student Approaches to Learning and Studying*. Melbourne: Australian Council for Educational Research.
- Biggs, J., Kember, D., & Leung, D.Y.P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, 71, 133-149.
- Bilgin A.A.B., & Crowe S. (2008). Approaches to Learning in Statistics. *Asian Social Science*, 4(3), 37-43.
- Green, W. (2007). Write on or write off? An exploration of Asian international students' approaches to essay writing at an Australian University. *Higher Education Research & Development*, 26(3), 329-344.
- Kember, D., & Gow, L. (1991). A challenge to the anecdotal stereotype of the Asian student. *Studies in Higher Education*, 16(2), 117-28.
- Kember, D. (2000). Misconceptions about the learning approaches, motivation and study practices of Asian students. *Higher Education*, 40, 99-121.
- Marton F., & Saljo R. (1984). Approaches to learning. In F. Marton, D. Hounsell & N. Entwistle (Eds.), *The experience of learning* (Chapter 3: pp. 39-58). Edinburgh, United Kingdom: Scottish Academic Press.
- Rodriguez, L., & Cano, F. (2007). The learning approaches and epistemological beliefs of university students: a cross-sectional and longitudinal study. *Studies in Higher Education*, 32(5), 347-667.
- Wood, L., & Petocz, P. (2008). Learning Excellence and Development Team: LEADing Change in Learning and Teaching. *Asian Social Science*, 4(3), 2-9.