

Magnitude of Interaction between Language of Instruction of Prior Education and Learning Traits on Academic Achievement Scores of International Students

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Abstract

This paper investigates the magnitude of difference of academic achievement scores by language of instruction of prior education and the magnitude of interaction between language of instruction of prior education and students' preferred learning trait on academic performance of a group of international students in two teaching and learning practices. The magnitude of difference and magnitude of interaction were determined by using Cohen's *d* with Hedges *g* correction. Coe's spread sheet was used for the analysis. The study showed that the magnitude of difference of academic achievement score was found to be *very small* on Traditional method of Teaching and Learning (TTL) and *small* on Problem-Based method of Learning (PBL). However, the magnitude of interaction between language of instruction of prior education and learning traits varied from *very small* to *large*. It is a challenging task to accommodate international students from different language background and optimize the whole learning process in an English speaking teaching and learning environment.

Keywords: International Students, Learning Traits, Effect Size, Magnitude of Differences, Teaching & Learning Practices.

Introduction

The study investigated the magnitude of difference of academic achievement by language of instruction of prior education and the magnitude of interaction between the language of instruction of prior education and students' learning trait on academic achievement under two methods of teaching and learning practices. The participants of this study were international Biology students in Foundation Studies (FS) at the Royal Melbourne Institute of Technology (RMIT) University, Australia. These students were from different cultural, social, educational and linguistic backgrounds. Researches have supported the fact that students from different cultures tend to exhibit greater diversity in their approaches to learning than students from relatively same or similar cultures (Bennett, 1999). The purpose of this study was two fold. Firstly, to find whether there was any effect of language of instruction of prior education on their academic performance under two different methods of teaching and learning and secondly, what was the magnitude of interaction between language of instruction of prior education and learning traits on academic achievement scores. It is a challenging task to accommodate all individual differences, optimise the learning environment and engage and support students together effectively (Felder, 1993). The two methods used in this study were the Traditional Teaching and Learning (TTL) and Problem-Based learning (PBL). It is well established that students' individual differences influence both their learning and their academic achievement (Riding, 2005). A study conducted at the RMIT University showed that the magnitude of differences in performance by students' approaches to learning in two pedagogical environments varied from small to medium (Varughese & Fehring, 2009). However, no study has measured the magnitude of interaction between language of instruction of prior education and students' learning trait on academic achievement scores under TTL and PBL. It is on this count that this study is unique and differs from other educational research in this field.

Science education is concerned with imparting scientific knowledge and skills to individuals who are not part of the scientific community. These individuals may be school children, college students or adults within the general public. The field of science education comprises science content, some sociology and some teaching pedagogy (Fraser & Tobin, 2001). Research in science education emphasises the metalearning of the learning community. This piece of research throws some light on the metalearning of students with diverse language background. The FS at RMIT is a pathway for international students to their higher education at RMIT or any other higher institution in Australia (RMIT, 2006). The program extends over two semesters and students who are doing biology have various options in their future education include medicine, nursing, physiotherapy, chiropractic, pharmacy, food technology, environmental sciences and biological sciences. Health education in Australian universities is increasingly using the Problem-Based method of teaching and learning. It is in this context that this study seeks to examine whether International students from vastly different educational, cultural and linguistic backgrounds are able to learn successfully under the PBL method. An important feature of PBL is that it is a student-centred approach of learning. In this method students learn to determine what they need to know. PBL is an instructional method that challenges students to learn how to learn, work cooperatively in groups to seek solutions to real world problems (Duch & Norton, 1992). Students in FS are encouraged to develop both a deep and achieving approach in their learning. In order to pursue their further studies in tertiary education, they have to develop deep understanding in their learning areas and at the same time they have to get the required study scores to get admission in their field of interest after FS.

Research Participants

The participants of this research were all international students from FS at RMIT over a period of four academic years. All the participants were offered Biology along with four other courses of which English was compulsory. There were two intakes in each year with an average of 14 Biology students in each intake. The first intake designated as Group 1 runs from January to November consisting of two 18-week semesters with five contact hours per week for Biology. The first semester for this intake runs from February to June and the second semester from July to November each year. The second intake designated as Group 2 runs from June to January and consists of two 14-week semesters with six contact hours per week. The first semester for the second intake runs from June to September and the second semester from October to January of the following year.

Data collection

The data collection commenced after obtaining the ethics approval from Human Research Ethics Sub Committee (HRESC) of RMIT. It was conducted in the second semester for both Groups 1 and 2 of each academic year. Students' name, student number and nationality were collected by using a simple questionnaire. Name and student number were included in the questionnaire to identify each student at any time during the course of the research. The nationality was included to determine students' heterogeneity in terms of their cultural background.

Of the ten topics in semester 2, one topic (Topic 1) was taught under the TTL method and the second topic (Topic 2) was taught under PBL method for the intake one (Group 1) of each year. For the intake two (Group 2) of each year, Topic 1 was taught under PBL method and Topic 2 was taught under TTL method. At the end of each topic a test was conducted to assess students' understanding in these particular areas. The test that was given after TTL method of teaching was named TTL test and the test after the PBL method of teaching was called the PBL test for the analysis purpose. Thus each participant took both TTL and PBL tests. Each test consisted of two sections, Section A and Section B. Section A of each test consisted of 20 multiple-choice questions worth 20 marks. Section B of both tests consisted of four short questions worth 10 marks each. Hence the total mark for each test was 60.

The Paragon Learning Style Inventory (PLSI), was used to assess students' preferred learning traits (Shindler, 2002). The permission for using this inventory was obtained from the director of Paragon Educational Consulting. The PLSI is a self-administered inventory based on the personality test called MBTI, which in turn is based on Jung's theory of personality (Yeung, Read, & Schmid, 2005). It was developed specifically for use in educational settings in determining the learning styles (Yeung & Read, 2006). Most of the FS students have difficulties in the usage of English language. Hence it was decided to use PLSI because of its simple language and structure of questions in determining students learning traits. The PLSI uses Jungian/Myers-Briggs dimensions, *Extroversion/Introversion*, *Sensing/Intuiting*, *Thinking/Feeling* and *Judging/Perceiving*. Sixteen Learning Style categories are formed from these dimensions. However, because of the fewer participants in this research, it may not be possible to derive conclusive results when there are very few students in some of the learning style categories. Hence the learning style category has been considered as the variable defined by the

four dimensions for all analysis purposes. Each dimension has two traits and each student has one or the other as a preferred trait. It provides a much better distribution of the participants over four learning traits, lending greater credibility to any result analysis.

Data Analysis

The analyses were mainly carried out using the statistical package SPSS 13.0 and an Excel spreadsheet. The study investigated the magnitude of difference of academic achievement by the language of instruction of prior education and the magnitude of interaction between language of instruction of prior education and students' learning trait on academic achievement under two methods of teaching and learning practices. A format was set up for data entry and it captured the information such as number of students who had English and languages other than English as the language of instruction for their prior qualifications, TTL test marks, PBL test marks and number of students in each learning trait. Various functions of SPSS and Excel were used to ensure that all data had been correctly entered and then preliminary analysis of data was carried out. Frequency tables for the variables were used to check for any missing values or errors as well as to obtain appropriate frequency distributions of the data. Having completed the preliminary analysis of comparisons the data were then analysed to investigate variations and effects of these variations. This was carried out using effect size analysis. The appropriate statistics for educational research are point estimates of sizes and confidence intervals around these point estimates. Substantive significance is more useful than statistical significance. When a teaching method is compared with another method, the magnitude of the difference between the methods may not be large enough to be worth the expense of changing methods. Effect sizes were calculated by using Cohen's *d* (Cohen, 1988) with Hedges *g* correction (Hedges & Olkin, 1985). Coe's spreadsheet (Coe, 2006) was used for the purpose. Hedges's *g* is an inferential measure and is calculated by using the square root of the mean square error from the analysis of variance testing for differences between the two groups (Hedges & Olkin, 1985). Effect size measures the treatment effect (Glass, McGaw, & Smith, 1981). Descriptors for magnitudes of effect sizes include small, medium, large (Cohen, 1969) and very small (Izard, 2004). An effect size of ≥ 0.8 has been classified as large, any value ≥ 0.5 and < 0.8 as medium, a value ≥ 0.2 and < 0.5 as small, and anything < 0.2 as very small or negligible. In effect this provides an assigned range on either side of the endpoints for decimal rounding. For example any effect size from 0.45 to 0.74 is the assigned range for medium effect size.

Results and Discussion

The total participants were 116 FS Biology students over four academic years. All Foundation students were international students and were from 27 countries. Of the participants, 53 had completed their prior education with English as the language of instruction while the remaining 63 had other languages as the language of instruction. The effect of the language of instruction of prior education on academic achievement scores on TTL and PBL was measured by the effect size calculation. The results are given in Table 1.

Students who had completed their prior education in English seemed to score higher than students who had other languages as the medium of prior education, showing that language difficulties might have affected the academic performance in Biology in both TTL and PBL. The difference in mean scores was greater on PBL than on TTL. The magnitude of difference was *very small* on both TTL (0.10) and *small* on PBL (0.20). This showed that students who had completed their prior education in non English speaking learning environment need more support in PBL. In TTL they might have got more support from the teachers in their learning process.

The magnitude of interaction between language of instruction used of prior education and learning traits was also measured by effect size calculation. The results are given in Table 2.

The magnitude of interaction with the *introvert/extrovert* traits was *small* (0.15) on TTL due to the *very small* (0.05) effect size of the difference in means between *introverts* with English and other languages of instruction and the *small* (0.20) effect size of the *extroverts* with English and other languages of instruction. On PBL there was a *medium* (0.65) interaction between language of instruction and the *introvert/extrovert* learning traits obtained from a *very small* (0.05) but reversed effect size of the difference in means between *introverts* with English and other languages of instruction and a *medium* (0.60) effect size of the corresponding difference among the *extroverts*. Thus the analysis of interaction between language of instruction of prior education and learning traits indicated that the *introvert/extrovert* traits clearly had some interaction with the language of instruction. The difference in performance between the two groups was more pronounced among the *extrovert* students, the *introverts* seeming to cope better.

A *small* (0.38) interaction was observed between language of instruction and *intuitive/sensing* traits on TTL, owing to the *very small* (0.12) but reversed effect size of the difference in means between the *intuitive* students

with English and other languages of instruction compared to the *small* (0.26) effect size of the difference in means between the *sensing* students with English and other languages of instruction. On PBL, the magnitude of interaction was *small* (0.18) obtained from a *very small* (0.09) effect size and a *small* (0.27) effect size of the difference in means between the two groups. Hence in the case of the *intuitive/sensing* traits it was seen that the *intuitive* students with other languages of instruction of their prior education seemed to cope better on TTL where as it was the *sensing* students with English as the language of instruction performed better on PBL. Hence *intuitive/sensing* traits had very clear interaction with language of instruction of prior education.

A *very small* (0.12) interaction was observed between language of instruction and *thinking/feeling* traits on TTL, owing to the *small* (0.16) effect size of the difference in means between the *thinking* students with English and other languages of instruction and the *very small* (0.04) effect size of the difference in means between the *feeling* students with English and other languages of instruction. On PBL, the magnitude of interaction was *very small* (0.07) obtained from a *small* (0.16) effect size and a *small* (0.23) effect size of the difference in means between the two groups. Thus the *thinking/feeling* traits did not seem to interact much with language of instruction. However, the very slight difference was in favour of *thinkers* who appeared better able to overcome any difficulties in language proficiency.

The *perceiving/judging* trait on the other hand had a very definite interaction with language of instruction of prior education. The magnitude of interaction between language of instruction and the *perceiving/judging* traits on TTL was *large* (0.78) owing to the *small* (0.42) but reversed effect size of the difference in means between the *perceiving* students with English and other languages of instruction and the *small* (0.36) effect size of the difference in means between the *judging* students with English and other languages of instruction. On PBL the magnitude of interaction was *large* (1.18) due to the *medium* (0.66) but reversed and the *medium* (0.52) effect sizes of the difference in means between *perceiving* students with English and other languages of instruction and *judging* students with English and other languages of instruction. Thus the general trend was reversed in the case of *perceivers* on both assessments in that among the *perceivers*, students with other languages of instruction scored higher than students with English as language of instruction. On the other hand among *judgers*, the reverse was the case on both assessments. This showed that the *perceivers* seemed to cope better with any language related difficulties.

Summary

This research study investigated international students' magnitude of difference in academic achievement scores and the magnitude of interaction between language of instruction of prior education and learning traits under two different methods of teaching and learning. The effects were measured by effect size calculations. The magnitude of difference in academic achievement scores was found to be *very small* on TTL and *small* PBL. The interaction between language of instruction of prior education and learning traits was found to be varied from *very small* to *large* in two different teaching and learning practices. International students often have languages other than English as language of instruction in their prior education. Comparisons between the performance of students with English as the language of instruction of their prior qualification and their counterparts with other languages of instruction, have shown that the difference in performance between the two groups was greater in PBL, although the difference was *small*. Hence it is recommended that students from other language backgrounds who have completed their education in other languages might need more facilitation to overcome their language difficulties in self-directed, student-centred PBL activities. Further interaction analysis showed that *extroverts* with other languages of instruction need more support under both methods of learning. *Sensing* students with other languages of instruction seemed to need more support on both TTL and PBL. Another interesting observation was that *perceiving* students with other languages of instruction actually scored higher than their counterparts with English as language of instruction reversing the general trend on both assessments. This suggests that *judging* students with other languages of instruction need more support on language issues. Hence it is recommended that teachers should encourage *extrovert*, *intuitive*, *sensing* and *judging* students from other language backgrounds to use support facilities provided by most universities to improve their language, writing, presentation and communication skills.

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Table 1. Magnitude of difference of academic achievement scores under TTL and PBL by the language of instruction of prior education

Teaching & Learning practice	Language of instruction	n	Mean	Diff in Means	Effect size of difference	Magnitude of interaction
TTL	English	53	35.86	1.19	0.10	<i>very small</i>
	Other	63	34.67			
PBL	English	53	36.08	2.55	0.20	<i>small</i>
	Other	63	33.53			

Table 2. Magnitude of interaction between language of instruction of prior education and learning traits on students' academic achievement scores under TTL and PBL

Teaching & Learning	Group 1	Group 2	Effect size	Difference in effect size	Magnitude of interaction
TTL	Eng Intro	Other Intro	0.05	0.15 in favour of Extro	<i>Small</i>
	Eng Extro	Other Extro	0.20		
PBL	Other Intro	Eng Intro	0.05	0.65 by reverse trends	<i>Medium</i>
	Eng Extro	Other Extro	0.60		
TTL	Other Inuit	Eng Intuit	0.12	0.38 by reversed trends	<i>Small</i>
PBL	Eng Sens Eng Inuit	Other Sens Other Intuit	0.26 0.09		
		Eng Sens	Other Sens	0.27	0.18 in favour of Sens
TTL	Eng Think	Other Think	0.16	0.12 in favour of Think	<i>Very Small</i>
PBL	Eng Feel Eng Think	Other Feel Other Think	0.04 0.16		
		Eng Feel	other Feel	0.23	0.07 in favour of Feel
TTL	Other Perc	Eng Perc	0.42	0.78 by reverse trends	<i>Medium</i>
PBL	Eng Judg Other Perc	Other Judg Eng Perc	0.36 0.66		
		Eng Judg	Other Judg	0.52	1.18 by reverse trends