USING TWO-WAY MANOVA TO STUDY THE INFLUENCE OF TAIWAN'S TECHNOLOGICAL UNIVERSITY STUDENTS' SPECIALTIES AND GENDERS ON ACADEMIC ACHIEVEMENTS – A CASE OF T UNIVERSITY OF SCIENCE AND TECHNOLOGY

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ABSTRACT

This paper tries to study the relationship between Taiwan's technological university students' specialties, genders and academic performances. We consider four constructs: study involving motivation, understanding capability, concentration and attitude toward learning, and study strategies. The empirical results showed that technological university students with different specialties (mathematics specialty; language specialty) and different genders have significant differences in "study involving motivation" and "understanding capability." Language-specialty students have stronger "study involving motivation" than mathematics-specialty students. However, in terms of the "understanding capability" construct, mathematics-specialty students are stronger than language-specialty students. Additionally, the gender factor also has significantly different impacts on the two constructs of "study involving motivation" and "understanding capability." Female students are superior to male students in "study involving motivation," while male students are superior to female students in "understanding capability."

Keywords: Two-Way MANOVA, students' specialties, genders, academic achievements

JEL Classification: I20

1. INTRODUCTION

Since technological university students have different natural talents and specialties, does the academic performances of students differ when the university provides uniformity in terms of teachers and field of study? In Taiwan, higher education has two different pathways: 1) the generalized university, focused on studying theory and thesis; and 2) the technological university,

focused on studying specialized technology and practice that helps students rapidly connect with industry and companies after graduation.

In the learning process of the technological university, students' motivation to study is an important element that affects students' attitude, as well as their academic performance and achievements. Afzal, Ali, Khan and Hamid (2010) noted that, in higher education, students' motivation is an important issue that probably influences students' academic performance as well as their professional life after graduation. In this paper, we try to explore the impact of technological university students' motivation to study on their academic achievement, and use a questionnaire to identify numerous factors to understand these students' attitude toward learning, which is effective for strengthening courses planning, reducing factors that hinder, and helping governmental higher education policy-makers better understand the learning process of technological university students and promote appropriate policies. Lumsden (1994) pointed out that students' study involvement and motivation are two important elements in the educational realm. Ames (1990) also noted that motivation to study is a long-term, quality-dependent role in students' learning. Therefore, this paper tries to study the relationship between Taiwan's technological university students' specialties, genders and academic performances. In this paper, we consider four constructs: study involving motivation, understanding capability, attitudes toward learning, and study strategies.

This paper involves Taiwanese technological university students as samples to study the correlation between their specialties, genders, and academic achievements. At the time of entering the technological university, freshmen students are classified into Class A and Class B, based on their Mathematics and English scores in the entry examination. Most Class A students have a superior Mathematics specialty, and most Class B students have a superior language specialty. However, during the period of study, university professors usually observed that Class A- mathematics-specialty students express higher study achievements than Class B- language-specialty students. Therefore, this paper tries to employ the Two-Way multivariate analysis of variance (MANOVA) to empirically study the relationship between the specialty-based classification, different genders (male and female), and students' academic achievements. The main objective is to understand whether the two factors – specialty and gender - influence students' performance. In the empirical method, we perform two-way MANOVA analysis. The independent variables are students' specialties and genders. Meanwhile, we also consider the effects of the interactions between two factors - specialty and gender. The dependent variable is academic achievements, which includes four constructs, depicted as follows: study involving motivation, attitudes toward learning, study strategies and understanding capability.

We use Taiwan's technological university students as samples, and divided them in two groups –

mathematics-specialty and language-specialty students, to examine the correlation of their specialties on their academic achievements. The objective is to understand whether the university should continue the policy of dividing students into different classes based on their specialty, or adopt the policy of random (undiversified) students in a class, for better academic development. The major findings are depicted as follows. First, technological university students with different specialties (mathematics specialty; language specialty) and different genders have significant differences in "study involving motivation" and "understanding capability." Furthermore, Class B– language-specialty students have stronger "study involving motivation" than Class A– mathematics-specialty students. However, in terms of the "understanding capability" construct, Class A –mathematics-specialty students are stronger than Class B –language-specialty students.

Additionally, the gender factor also has significantly different impacts on the two constructs of "study involving motivation" and "understanding capability". Female students are superior to male students in "study involving motivation," while male students are superior to female students in "understanding capability". Regarding the interaction of the factors of specialty and gender among the four constructs, only the "study involving motivation" construct showed significant differences. Additionally, in both classes – mathematics specialty and –language specialty - female students were superior to male students in "study involving motivation." This phenomenon indicates that in Taiwan's technological universities, when students with mathematics-specialty are assigned to one class, they seem to have more confidence and exhibit superior academic performance and achievements than students from the language-specialty class. Furthermore, female students exhibit stronger "study involving motivation" than male students. Thus, when entering school, random (undiversified) placement of both mathematics- and language-specialty students in one class seems more suitable for the academic development of technological students, because they all have superior student role models to follow and learn from, eventually attaining better academic performance. These empirical results may provide a reference point for policy makers for technological university management, as well as the governmental educational department to draft policies in the future.

The remainder of this paper is organized as follows. Section II discusses the research hypothesis. Section III discusses the empirical method and results. Section IV concludes.

2. RESEARCH HYPOTHESIS

This paper designs a questionnaire based on four research hypotheses depicted as follows.

(1)   Technological university students of different specialties and genders have significant differences in "study involving motivation."
(2)   Technological university students of different specialties and genders have significant

differences in "concentration and attitude toward study."

(3)   Technological university students of different specialties and genders have significant differences in "study strategies."

(4)   Technological university students of different specialties and genders have significant differences in "understanding capability."

3. EMPIRICAL METHOD AND RESULTS

3.1 Factor Analysis (Analysis of Effectiveness):

In examining the original attitude toward study, we employed a questionnaire and used a five-point Likert-type scale to find the scores. Initially, we designed 29 questions (see Appendix - Questionnaire). An estimation method involving factoring analysis was used to estimate the effectiveness of the questionnaire. The testing results indicated that the KMO (Kaiser-Meyer-Olkin) value was too low (KMO=0.203<0.5). Therefore, we re-modified the questionnaire's question items and contents by way of item analysis of each question. Then, we decided to delete 13 insignificant questions without significance and identification; subsequently, 16 questions remained to be formalized in the modified questionnaire. By way of factor analysis, the KMO value was raised to 0.619 (>0.5), which indicates that the new modified questionnaire was effective enough to be adopted for this study. Then, we extracted four common factors and set up four constructs – "study involving motivation," "concentration and attitude toward study," "study strategies," and "understanding capability." We sent out 102 questionnaires, and received 80 answered questionnaires. The effective questionnaires were 64 sets.

The four constructs included in the questionnaire were depicted as follows:

- Construct of "study involving motivation": a3, a4, a5, a6, a7, a8 and a16, 7 questions. (Coefficient of Confidence αvalue is 0.8580)
- Construct of "concentration and attitude toward study": a2, a9, a11 and a15, 4 questions. (Coefficient of Confidence α value is 0.7457)
- Construct of "study strategies": a1 and a12, 2 questions. (Coefficient of Confidence α value is 0.5308
- Construct of "understanding capability": a10, a13 and a14, 3 questions. (Coefficient of Confidence α value is 0.7976)

3.2 Confidence Analysis:

Using the confidence analysis, the estimation results were obtained, and Cronbach α value was 0.88 (>0.7). Also, the α value obtained for each of the four constructs was 0.8580, 0.7457, 0.5308

and 0.7976 respectively. We could observe that the third construct, "study strategies" had the lowest confidence, and the other three constructs' coefficient of confidence all exceeded the 0.7 mark. The coefficient of the questionnaire as a whole was over 0.8. These estimation results indicate that the questionnaire we designed had a high confidence score, which demonstrates creditability and stability.

3.3 Two-Way MANOVA Analysis:

The estimation results of the Multivariate Tests are as follows.

- A Factor (specialty): the main effect of the Multivariate Tests of the specialty factor exhibited Wilk's ^ value of 0.510 (p value < 0.05), which is significant.
- B Factor (gender): main effect of Multivariate Tests of the gender factor exhibited Wilk's ^ value of 0.388 (p value < 0.05), which is significant.
- The interaction of A x B (Specialty * Gender): the effect of the Multivariate Tests of Specialty*Gender factors exhibited Wilk's ^ value of 0.514 (p value < 0.05), which is significant.

3.4 Tests of Between-Subjects Effects:

The aim of the estimation of between-subjects effects is to separately test the single independent variable's significance. When we performed the tests of between-subjects effects, we found that the single A factor (specialty) has significant differences between "study involving motivation" (F value was 7.439, p value=0.011) and "understanding capability" (F value is 4.455, p value=0.044). However, there did not exist significant differences between "concentration and attitude toward study" (F value is 1.082, p value=0.101) and "study strategies" (F value is 0.067, p value=0.797). These results express that the specialty factor shows significant differences between "study involving motivation" and "understanding capability."
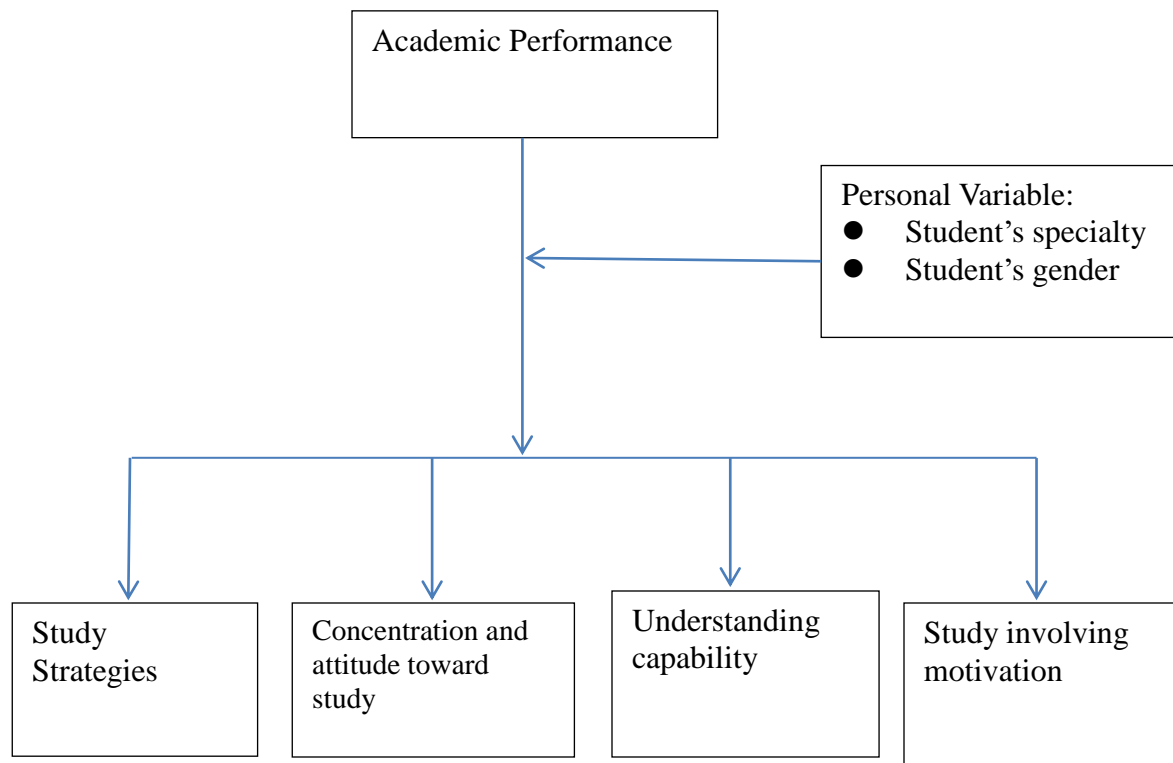
With respect to factor B (gender), the estimation result shows that the gender of technological university students also has significant differences between "study involving motivation" (F value is 18.043, p value=0.000) and "understanding capability" (F value is 6.570, p value=0.016). However, the difference between "study strategies" (F value is 0.422, p value=0.521) and "concentration and attitude toward study" (F value is 0.430, p value=0.836) was still insignificant. We can observe from the above results that gender also showed significant difference between "study involving motivation" and "understanding capability."

When we compare the average score of each factor, in "study involving motivation" of different classes (Class A –mathematics specialty and Class B –language specialty), we found that Class B

(M= -0.198) has a higher average than Class A (M= -1.544). This means that Class B –language-specialty students had stronger "study involving motivation" than Class A –mathematics-specialty students. However, with respect to "understanding capability," Class A– mathematics-specialty students (M=1.2) had a higher score than Class B language-specialty students (M= -0.00613). This means that Class A –mathematics-specialty students have a stronger "understand capability" than Class B –language-specialty students. In terms of gender, female students (M=0.177) were superior to male students (M= -1.919) in "study involving motivation." However, in terms of the aspect of "understanding capability," male students (M= 1.328) were superior to female students (M= -0.122).

Regarding the aspect of interaction of factor A (specialty) and factor B (gender), only the construct "study involving motivation" (F value is 7.616, p value=0.01) showed a significant difference. Also, in the context of both Class A –mathematics-specialty and Class B –language-specialty students, female students were superior to male students in "study involving motivation." This phenomenon indicates that female students seem to have higher motivation to study and make greater efforts on school papers than male students.

4. CONSTRUCTION

5. CONCLUSION

This paper employs a questionnaire to research technological university students' academic performance and study achievements by way of an estimation using factor analysis, confidence analysis, and two-way MANOVA analysis. Wu (2011) used a questionnaire to study the influence of motivation to study on academic performance of Taiwan's junior-high students, and concluded that there is a significant positive correlation between motivation to study and academic achievements. In this paper, we also obtain estimation results consistent with Wu's study, and found that in Taiwan's technological university students, different specialties and genders both have significant differences in "study involving motivation" and "understanding capability." In addition, in Cheng (2011) investigation of primary school students' attitude toward learning in Taiwan and Mainland China, the students were also surveyed using questionnaires and it was found that both Taiwanese and Chinese students showed no significant differences in attitudes toward learning. In our study, we also obtained results consistent with Cheng's study, and found that there is no significant difference between students' attitude.

In the aspect of "study involving motivation," – as seen in question item (4),– "I feel perturbed while studying the school syllabus," and question item (5),– "When I come across tough exercises, I give up easily, and do not discuss with or take the help of my classmates." – language-specialty students and female students showed significant inconformity. That is, in "study involving motivation," we found that Class B –language-specialty students were stronger than Class A –mathematics-specialty students. Also, female students were stronger than male students in this construct.

However, in terms of the aspect of "understanding capability" the results were the opposite; Class A –mathematics-specialty students had stronger "understanding capability" than Class B – language specialty students. For example, in question item (10) – "When preparing for the school examination, I am able to read through and recite, but not necessary understand the material completely", the results indicated that mathematics-specialty students exhibit insignificant differences than language-specialty students. This indicates that mathematics-specialty students' "understanding capability" is stronger than that of language-specialty students, and also, male students are stronger in "understand capability" than female students. This estimation expresses that in Taiwan's technological university, when the students with mathematics-specialty are all assigned to one class, they have more confidence, and exhibit a stronger academic performance and achievement than that of students of the language-specialty class. Additionally, female students exhibit stronger "study involving motivation" than male students. Thus, at the time of entering school, random (undiversified) placement of both mathematics- and language-specialty students in one class, seems more suitable for the academic development of technological

students, because they all have superior student role models to follow and learn from, and eventually attain better academic performance. These empirical results may provide important information for Taiwan's governmental education department, as well as those involved in the management of technological universities, by acting as a reference base for policy-making and decision-making.

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APPENDIX

<u>QUESTIONNAIRE</u>

■In the following questions, please circle the appropriate option from 1~5 based upon your personal consciousness and real experience. To prevent incomplete and biased conclusions, you must answer each question. 1- extremely inconsistent, 2 – most inconsistent, 3 – neutral, 4 – mostly consistent, 5 – extremely consistent

1	In the class, I am usually involved in things other than academics, for example daydreaming.	1	2	3	4	5
2	I am used to listening to music while studying.	1	2	3	4	5
3	I don't want to pursue higher scores; simply passing the course is enough.	1	2	3	4	5
4	I feel perturbed while studying the school syllabus.	1	2	3	4	5
5	When I come across tough exercises, I give up easily, and do not discuss with or take the help of my classmates	1	2	3	4	5
6	For the papers that I dislike, I usually give up at once.	1	2	3	4	5
7	If I don't like a specific teacher, I do not spend time on that paper.	1	2	3	4	5
8	I usually neglect homework, as well as quizzes.	1	2	3	4	5
9	When my final exam is approaching, I am often unwilling to prepare beforehand.	1	2	3	4	5
10	When preparing for the school examination, I am able to read through and recite, but not necessary understand the material completely.	1	2	3	4	5
11	I often feel sluggish when I study until late at night.	1	2	3	4	5
12	I use the same methods to study each subject.	1	2	3	4	5
13	I am unwilling to go to school.	1	2	3	4	5
14	I study with the single aim of passing the exams.	1	2	3	4	5
15	I spend more time on the internet than on study.	1	2	3	4	5
16	I feel that other activities are much more important than studying.	1	2	3	4	5

■Personal basic information

Gender	☐Male	☐Female		
Class	☐ A	☐ B		
Average Study Grade	☐Grade A	☐Grade B	☐Grade C	☐Grade D

SOURCE: THIS STUDY