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IT EDUCATION IN TAIWAN: RELATIONSHIP BETWEEN SELF-EFFICACY AND ACADEMIC INTEGRATION AMONG STUDENTS

Abstract

This study examined the relationship between academic integration and self-efficacy with regard to institution types and students' majors among IM (Information Management) and CS (Computer Science) students. A Taiwanese National survey database was used to achieve the research objective. MANOVA was used to analyze the interaction effects between academic integration and self-efficacy. The independent variables were institution types and students' majors. The results showed that students of public institutions have higher levels of self-efficacy than students of private ones. Another finding is that IM students seem to have better study strategies and habits than CS students while CS students were found to have better collaboration and satisfaction with their institutions than IM students. Counselling services and team projects are suggested to enhance students levels of academic integration and self-efficacy.

Keywords: self-efficacy, academic integration, IT education, student retention

1 INTRODUCTION

Student retention in higher education is an important research topic because of high student attrition rates (Titus 2006, p. 626). Despite the efforts provided by the federal government and some states of the United States for improving student retention, graduation rates still declined from 58% to 52% in the 1980s and 1990s (Scott, Bailey & Kienzl 2006). Research on student retention has investigated the factors affecting student retention as well as validated the effect of these factors on various student populations. The factors affecting student retention include: academic integration, social integration (Beil, Reisen & Zea 1999), psychology variables (Gore 2006). Student populations have been investigated at various types of institutions such as: public universities, private universities (Scott, Bailey & Kienzl 2006), universities with 4-year undergraduate programs (St. John et al. 1994), colleges with 2-year programs (Hyers & Zimmerman 2002), and community colleges which have more non-residential, part time, and aged students (Ashar & Skenes 1993). Although the research topic has been studied for decades, it is still very difficult to sort out the influence of different variables whose movements are correlated over time (Aksenova, Zhang & Lu 2006).

Although student retention has been studied for decades for various student populations, most of these studies have been performed in western countries. Hence, the findings of these studies may not necessarily be applicable to countries with different cultures and educational systems such as Taiwan. Identifying the factors affecting student retention for various types of Taiwanese institutions is becoming an important concern for the administrators of these institutions.

Computer Science (CS) and Information Management (IM) are two popular majors for Taiwanese undergraduate students. As the IT workforce is highly demanded, students entering the IM major come from widely varying backgrounds and are more likely to dropout or transfer to other majors because of difficulties learning computer programming courses. On the other hand, students taking CS majors are more technically-oriented and in theory they are better prepared to learn programming courses than IM students. However, an investigation of CS schools found that students' characteristics and the practices of CS schools affect student retention (Cohoon 2001). Satisfaction with the CS major was the most important factor on CS major (Lewis et al. 2008). Thus, both IM and CS schools face various student retention factors.

The most famous model (Tinto 1975) of student retention proposed that integration is a central feature. The level of integration of a student into the social and academic systems of the educational institution, determines whether the student will persist in her studies or dropout from the course. Academic integration, in particular, has been found to be an important factor of student retention (Lee 1999; Titus 2004). As a response to the wide diversity in the student population present in higher education institutions today, the construct of self-efficacy was introduced in the research on student retention. Self-efficacy has been explored as a possible predictor of students' academic success and persistence in their studies (Gore 2006). Self-efficacy has also been found to account for 14% of the variance in academic performance and 12% of the variance in academic persistence (Multon, Brown & Lent 1991). Research on student retention has not explored the relationship between academic integration and self-efficacy. In the application of Tinto's model, research has not yet included the construct of self-efficacy as a predictor of student retention.

For research to be more policy relevant, the development of models or methods specific to types of educational institutes is required (Tinto 1982). Organizational characteristics have been used to investigate student outcomes and retention. Public institutions were found to graduate a slightly larger percentage of students than private ones (Scott, Bailey & Kienzl 2006). In Taiwan, there are four types of higher education institutions, namely: public and private universities and public and private institutes of technology. Academic integration plays an important role on student retention, while self-efficacy has been proved to be an important predictor of student persistence. Since type of institutions has been found to affect student retention and students studying IT majors experience high attrition

rates, the focus of this study is on the relationship between self-efficacy and academic integration with regard to type of institutions for various IT-related majors in the Taiwanese higher education sector.

2 LITERATURE REVIEW

A number of factors have been investigated and found to affect student retention significantly in higher education. The best-known conceptualization of student retention is Tinto's (1993) theory of university departure. In his model, academic and social integration are the two most important factors in the retention of higher education students. Academic integration includes such variables as: grade point average (GPA), perceived intellectual development, student perceptions of satisfaction with elements in the classroom environment, and perceived concern of faculty (lecturer) for teaching students. Several studies investigated the effect of academic integration on student retention. Contrary to traditional institutions, commuter institutions and community institutions have more non-residential, part time, and aged students. In these non-traditional institutions, academic integration was found to be more important than social integration for 2- and 4-year undergraduate programs (Pascarella & Chapman 1983). Academic integration directly affected attrition decisions even more than social integration (Fox 1985). In a study of higher education completion by students who began at community colleges, results showed that of all the variables studied, academic and social integration had the most consistently positive effects on long-term persistence (Pascarella, Smart & Ethington 1986).

Poor academic performance is often indicative of difficulties in adjusting to university environment and makes dropout more likely (Murtaugh, Burns & Schuster 1999). Since adjusting to a new environment would be affected by individual psychology, retention at school was predicted by a combination of achievement and the absence of physical/psychological distress (Close & Solberg 2008).

The search for predictors of academic success has long been a research theme in the educational psychology literature (Pascarella & Terenzine 1991). Central to the social learning theory (Bandura 1997), is the concept of self-efficacy which helps to determine what activities individuals will pursue, the effort they expend in pursuing those activities, and how long they will persist in the face of obstacles. Self-efficacy predicts academic performance, persistence, and the range of career options considered after controlling for other variables such as ability and vocational interests (Lent, Brown & Larkin 1986).

After the introduction of social learning theory (Bandura 1997), self-efficacy received widespread attention from vocational and counselling psychologists. Even in studies of student retention behaviour, self-efficacy has been explored as a factor affecting student retention. Using structural equation models to assess the relative importance of self-efficacy and stress in predicting academic performance outcomes, results identified self-efficacy to be a more robust and consistent predictor than academic stress (Zajacova, Lynch & Espenshade 2005). Students with science and engineering majors are more confident in their ability to successfully complete academic requirements to earn higher grades and are more persistent in their majors (Lent, Brown & Larkin 1984). Moreover, there is a positive association between self-efficacy and the number of hours students spent studying which is related to academic integration (Torres & Solberg 2001). Self-efficacy is related with study habits in terms of academic integration.

Students with higher levels of autonomous motivation for attending school reported more confidence (i.e. self-efficacy) in their academic abilities and performed better academically. In addition, students with higher self-efficacy beliefs reported less physical and psychological distress and higher levels of achievement (Close & Solberg 2008). Stronger self-efficacy expectations result in better higher education outcomes because students with high self-efficacy perceive failure experiences as challenges rather than threats. Students with higher academic self-efficacy reported higher persistence

intentions. The aim of our present study is to investigate the relationship between the two important factors which are academic integration and self-efficacy, on student retention.

A number of studies investigated the effect of study majors on student retention. One study (St. John et al. 2004) showed that African-American students re-enrolled in second year of higher education institutions studying high-demand major fields such as business, health, engineering and computer science are more likely to persist than those in other major fields. Another study (Scott, Burns & Cooney 1996) investigated the differences of dissatisfaction as a reason of dropout between science/technology, art/humanities or business/law students and found a higher level of dropouts among students enrolled in non-traditional subjects (e.g. economics, business and law). Another study using GPA and learning experience to measure academic integration found that dropout students from arts and education to have higher GPA than science students (Johnson 1996). Thus, there is sufficient evidence that majors of study have significant effects on student retention.

IT major of studies are popular in Taiwan (and in other countries as well) as the IT workforce is in high demand. Since previous studies (St. John et al. 2004) have found that students in high-demand major fields are more likely to persist than those in other major fields. Our objective in this study is to assess the effect of IT-related majors in various types of higher education institutions. In Taiwan, both the IM and CS departments use IT as main courses to educate students. While there are common IT courses for both groups of students, CS students study more courses on the technical aspects of the IT discipline (advanced programming, advanced calculus, and technical networking infrastructure) and IM students study more management courses (accounting, economics, business trading, and e-business infrastructure).

Organizational attributes of educational institutions have also been found to affect student retention since institutions with greater size and complexity, coupled with a superior capacity to allocate graduating students to high-prestige social and occupational roles have lower rates of attrition than other types of higher education institutions (Kamens 1971). Administrative styles of behavior also affect student's levels of satisfaction with the university and students' adjustment to the university (Astin & Scherrei 1980). Additionally, administrative or organizational, behaviors may have a strong effect on student persistence (Astin & Scherrei 1980). More specifically, organizational attributes such as participation in organization decision-making, fairness in the administration of policies and rules, and communication have also been found to affect student departure decisions (Bean 1983; Braxton & Brier 1989).

Both Astin and Oseguera (2002) and Mortenson (1997; 1998) report on research designed to determine institutional and student characteristics that lead to higher retention and graduation. Astin and Oseguera used a regression analysis and pointed out that institution types (public, private, college, university) have an impact on student persistence. Mortenson's used regression to show that public institutions have lower graduation rates than private ones. Contrary to previous findings (Scott, Bailey & Kienzl 2006), the results identified that public institutions graduate a slightly larger percentage of students than private ones. Thus, types of institution may have various effects on academic outcomes.

Higher education in Taiwan is divided into two sub-systems, namely: general higher education (public and private universities) and technical and vocational education (public and private institutes of technology). Thus, there are four types of higher education institutions: public universities, public institutes of technology, private universities, and private institutes of technology. In general, public institutions have better academic reputation than private ones and the entrance scores to public institutions are higher than private ones. Since, the Taiwanese government allocate more resources to public institutions, students enrolled in public institutions gain more access to educational resources.

Our aim in this study is to investigate the relationship between academic integration and self-efficacy with regard to various types of institution and various IT related majors on student retention. The interaction effect on academic integration and self-efficacy was examined to determine differences due to institution types and study majors.

3 DATASET

The data used in this research was obtained from the Taiwanese national higher education survey database called National Survey College Student Life Experiences in Taiwan. The survey was conducted in 2005 under the auspices of the National Science Council and the Ministry of Education. It was performed by the Centre for Higher Education Research at National Tsing Hua University. The purpose of this survey was to understand the undergraduate experiences of Taiwanese higher education students.

In 2005, there were 186,709 first-year students enrolled at 161 public and private four-year and two-year institutions. Using stratified sampling from 17 academic majors, 75,084 first-year students were selected for this survey. There were at least 30 students in each major and at least 100 students from each institution. Out of a total of the 75,084 first-year students, 52,315 students returned the survey i.e. a response rate of 69.7%. The survey data were gathered on a broad range of topics: students' pre-higher education attributes, higher education life experience, academic performance, goal commitment, financial status/parents income, family background, social activities, hours spent in the library, self-efficacy, satisfaction of facility, accommodation and transportation status, and demographics data. For each student, 490 variables or attributes were collected.

Before the data was analysed, data cleaning was performed. This consisted of selecting records for IM and CS students only, selecting attributes relevant to our study for each record and deleting records with missing values. When selecting IM and CS students, only 3,209 records were retained from the 52,315 records and when the 314 records with missing data were deleted the dataset was reduced to 2,895 records. Based on the selected records, sixteen attributes were extracted. These are the attributes that are related to the concepts of academic integration and self-efficacy and are based on Tinto's (1975), Le (2005), Thomas's (2000), and Bean & Eaton's (2001) survey instruments.

4 METHODOLOGY

The methodology used in this research is made up of three phases. In the first phase, exploratory factor analysis (EFA) is used to search for structure among the sixteen attributes or variables that remained after data cleaning. The attributes were analysed using the principal component analysis (PCA) form of factor analysis as PCA which is recommended as the first step in factor analysis because it reveals a great deal of information on the probable number and nature of the factors (Tabachnick & Fidell 1989). The reliability of the attributes was tested for internal consistency using Cronbach's alpha. The validity of the scales used for measuring the attributes was measured using discriminant validity.

In order to determine the number of factors to extract, an eigenvalue (a value representing the amount of variance accounted for by a factor) of greater than 1 was used as threshold. Two statistics, Kaiser-Meyer-Olkin (KMO) index and the Bartlett's chi-squared value, were used to test the factorability. The KMO index is a measure of sampling adequacy while the Bartlett's test of sphericity is a statistical test for the overall significance of all correlations in the correlation matrix.

After having obtained an acceptable factor solution, names or labels were assigned to the factors that accurately reflect the attributes loading on that factor. Using the description of survey items and the constructs used in the student retention literature, the factors identified were named according to constructs that are related to academic integration and self-efficacy.

In the second phase of the research, the effects of the independent variables of interest in this study (institution types and study majors) on the dependent variables (academic integration and self-efficacy) were explored. An appropriate test to use is Multivariate Analysis of Variance (MANOVA). A correlation matrix of the variables was first established and following evidence of the existence of correlation, the interactions effects between the independent and dependent variables were determined using MANOVA. Three statistical measures were used to test the significance of the interactions

between the variables of the model. These are: the Wilk's lambda (or U statistic), the Pillai's criterion and the Hotelling's trace. The greater the value of these statistics is, the greater the significance of the relationships between the variables.

Finally, in the last phase of the study, after the significance of the relationships between the variables were found to be significant, univariate analysis was used to explore single relationships between dependent and independent variables.

5 ANALYSIS AND RESULTS

5.1 Exploratory factor analysis

In the EFA phase of the analysis, factorability was supported because of a high KMO index of 0.74 (on a scale of [0,1]) and a chi-squared value of 6645.57 with an observed significance level of 0.00. Thus, it was concluded that the strength of the relationship among the attributes are strong and appropriate for factor analysis.

Two attributes were discarded because one had a factor loading of less than 0.28 (Chattha et al. 2008) and the other one exhibited cross loading (i.e. had a significant loading on more than one factor). Factor analysis extracted four factors which accounted for 58.37% of the variance in the factor matrix and with eigenvalues ranging from 1.13 to 3.82. The rotated factor loading matrix is shown in Table 1.

With reference to prior studies on student retention, the four factors extracted were assigned the following labels and meanings. Factor 1 (study strategies and habits) represents the ability to develop effective study strategies and habits for learning in an academic environment (Le et al. 2005). Factor 2 (academic satisfaction) represents the individual's satisfaction with academic experience (Thomas 2000). Factor 3 (social self-efficacy) represents the ability to work collaborative with others and to develop and maintain relationships with others (Le et al. 2005). Factor 4 (self confidence) represents self confidence and the ability to develop higher levels of persistence to achieve a task and develop higher goals for task achievement (Bean & Eaton 2001). Thus, factors 1 and 2 can be categorized as academic integration, and factors 3 and 4 as self-efficacy as shown in Figure 1. Since the Cronbach's alpha coefficients were 0.62, 0.61, 0.80, and 0.67 for factors 1, 2, 3, and 4 respectively, and with an overall reliability of 0.60, the measurement scales used were judged to be sufficiently reliable for further analysis.

A factor correlation matrix was created to explore the relationship between self-efficacy and academic integration. Correlation was significant at the 0.01 level. This relationship validates the result of Bean & Eaton's study (2001), who found that as self-efficacy increases, academic integration also increases.

| Attribute no | Description | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|--------------|---|----------|----------|----------|----------|
| C2-16 | Feel confident in front of others | | | 0.75 | |
| C2-1 | Feel comfortable to make new friends | | | 0.73 | |
| C2-17 | Believe on what has been done by herself | | | 0.70 | |
| C2-2 | Worry of completing homework | | | -0.623 | |
| C2-5 | No difficulty on collaborative projects | | | 0.616 | |
| C2-20 | Self confidence on making own decision | | | | 0.87 |
| C2-19 | Difficulty on making decision | | | | 0.87 |
| C2-3 | Ability to solve out study problems | | | | 0.60 |
| B13-1 | Study hours for academic homework | 0.80 | | | |
| B9-1 | Searching materials related to academic courses | 0.74 | | | |
| B8-1 | Reading habits on non-academic subjects | 0.68 | | | |
| B4-1 | Satisfaction with academic faculty | | 0.80 | | |
| B4-2 | Satisfaction with handling academic homework | | 0.78 | | |
| C6-1 | Satisfaction with institution | | 0.54 | | |

Table 1. Rotated factor loading matrix

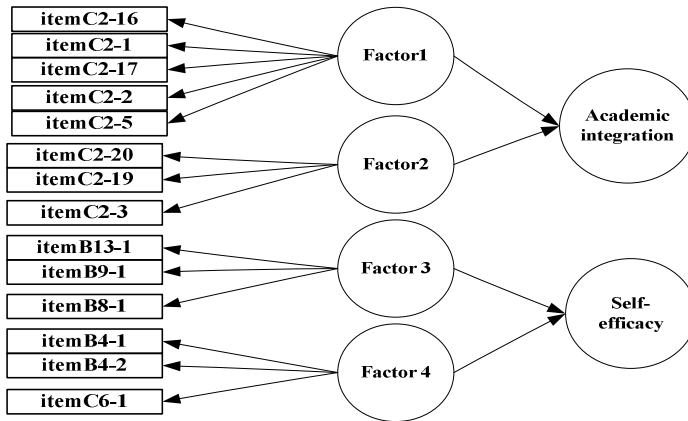


Figure 1. Relationship between survey items, factors and constructs

5.2 MANOVA analysis

A summary of the results of the MANOVA analysis is shown in Table 2. Only the Wilk's Lambda statistics are shown (the Hotelling Lawley Trace and Pillai Trace statistics show a similar trend). The analysis revealed significant effects ($p \leq 0.05$) for both the individual factors (institution type, majors of study) as well as the composite factor (institution type and majors of study).

| Effect | Wilk's Lambda value | F-Value | p-Value |
|-----------------------------------|---------------------|---------|---------|
| Institution type | 0.98 | 6.22 | 0.00* |
| Major of study | 0.97 | 10.35 | 0.00* |
| Institution type * Major of study | 0.99 | 2.37 | 0.00* |

Table 2. MANOVA summary table

5.3 Univariate analysis

5.3.1 Interaction effects of composite variable ('institution type' and 'major of study')

Table 3 shows that there were significant differences between students of the different types of institutes and the different majors only in respect to the 'social self-efficacy' variable. Figure 2 shows that in general, social self-efficacy appears to be higher for CS majors in most type of institutes (except for public institute of technology) than for IM majors.

This means that CS students have better abilities to collaborate with others than IM students. In the Taiwanese higher education sector, this could be explained by the fact that CS students have more technical skills than IM ones and they also have more projects to complete. The lower social self-efficacy among CS students of public institutes of technology is puzzling. No satisfactory explanation can be offered and further investigation is warranted to explain this phenomenon.

| Dependent variable | df | Sum of squares | Mean squares | F-Value | p-Value |
|-----------------------------|----|----------------|--------------|---------|---------|
| Study strategies and habits | 3 | 4.45 | 1.48 | 2.29 | 0.08 |
| Academic satisfaction | 3 | 2.50 | 0.83 | 2.37 | 0.07 |
| Social self-efficacy | 3 | 1.62 | 0.54 | 3.38 | 0.02* |
| Self confidence | 3 | 0.85 | 0.28 | 0.91 | 0.43 |

Table 3. Summary of results for composite variable ('institution type' and 'major of study')

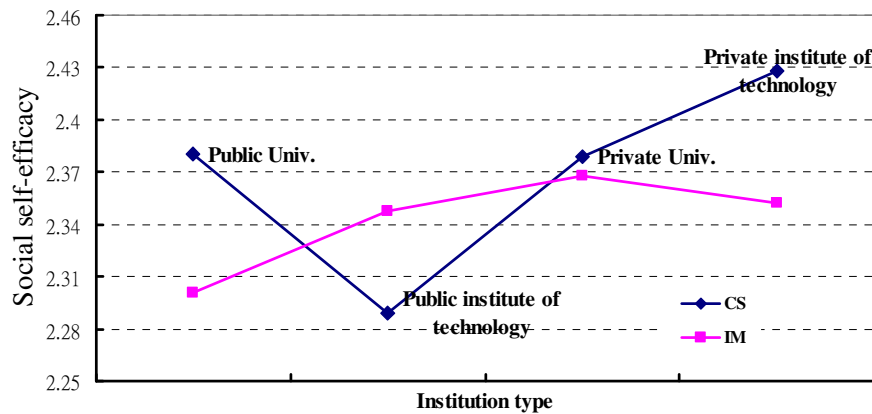


Figure 2. Effects of composite variable ('institution type' and 'major of study')

5.3.2 Interaction effects of 'institution type'

Table 4 shows that there are significant differences between students of the different types of institute in regards to the 'study strategies and habits' and 'academic satisfaction' variables. The effects of 'institution type' on these two variables are depicted in Figure 3. In the left part of the figure, it is evident that students of public institutions have higher levels of 'study strategies and habits' than private ones. In Taiwan, this could be due to the fact that public institutions always require higher entrance scores. Their students would already have developed good study strategies and habits to enable them enter these institutions. The right part of the figure shows that, in general, students of public institutions of technology have the highest levels of 'academic satisfaction'. This could be due to the fact that public institutions have better reputation as they are provided with more resources on an annual basis from the Ministry of Education than private ones. These resources would influence the facilities available on campus and the more the investments on facilities, the more satisfied students are.

| Dependent variable | Df | Sum of squares | Mean squares | F-Value | p_Value |
|-----------------------------|----|----------------|--------------|---------|---------|
| Study strategies and habits | 3 | 26.22 | 8.74 | 13.50 | 0.00* |
| Academic satisfaction | 3 | 11.29 | 3.76 | 10.70 | 0.00* |
| Social self-efficacy | 3 | 0.88 | 0.29 | 1.83 | 0.14 |
| Self confidence | 3 | 1.13 | 0.38 | 1.22 | 0.30 |

Table 4. Summary of results for 'institution type'

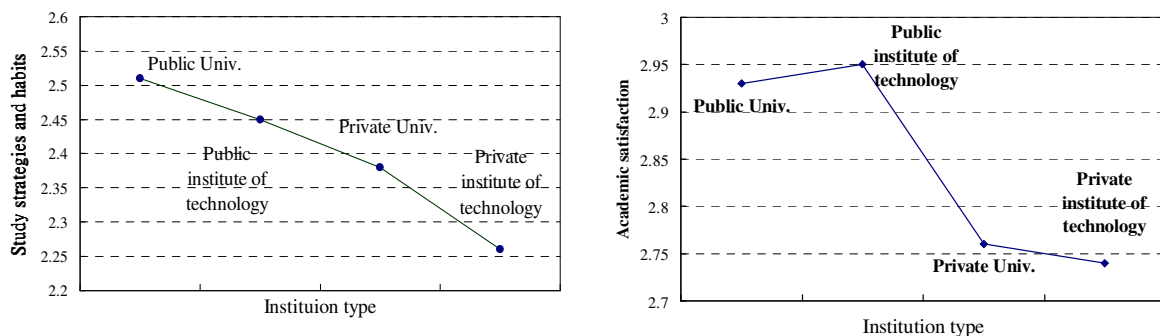


Figure 3. Effects of 'institution type'

5.3.3 Interaction effects of 'major of study'

Table 5 shows that there are significant differences between students of the different types of majors in regards to the 'study strategies and habits' and 'academic satisfaction' variables (as was the effect with 'institution type'). The effects of 'major of study' on these two variables are depicted in Figure 4. The lower line shows that the ability of 'study strategies and habits' is higher with IM majors than CS majors. IM students have more time to study on their own and hence develop more study strategies and habits than CS students. The upper line shows that 'academic satisfaction' is higher with CS majors than IM majors. CS students have more experience in using university facilities for their course projects than IM students.

| Dependent variable | df | Sum of squares | F-Value | p_Value |
|-----------------------------|----|----------------|---------|---------|
| Study strategies and habits | 1 | 12.89 | 19.91 | 0.00* |
| Academic satisfaction | 1 | 4.57 | 13.01 | 0.00* |
| Social self-efficacy | 1 | 0.44 | 2.74 | 0.10 |
| Self confidence | 1 | 0.90 | 2.90 | 0.09 |

Table 5. Summary of results for 'major of study'

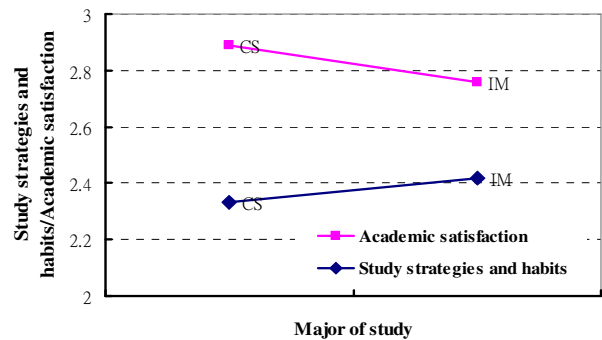


Figure 4. Effects of 'major of study'

6 DISCUSSION

One outcome of this study was the finding of a relationship between academic integration and self-efficacy. This result is consistent with other studies (Brown, Lent & Larkin 1989; Kahn & Nauta 2001). As mentioned in the previous section, CS students have higher levels of social self-efficacy (which is related to self-efficacy) and academic satisfaction (which related to academic integration) than IM ones. On the other hand, IM students have higher levels of study strategies and habits (which are related to academic integration) than CS ones. Public institutions' students have higher levels of academic integration and self-efficacy than students of private institutions. This is supportive of the theory that the higher self-efficacy is, the higher the degree of academic integration.

Since previous studies have found academic integration (Titus 2004) and self-efficacy (Gore 2006) to be contributing factors of student retention, it would be interesting to find ways to improve the abilities of CS students ('study strategies and habits') and IM students ('social self-efficacy' and 'academic satisfaction') in any type of institutions and students in private institutes ('study strategies and habits' and 'academic satisfaction'). In this regard, we propose two suggestions for improving the situation: better counselling and more team projects.

Two forms of counselling could be considered for students of private institutions and CS students of any institution. Career development counselling could be used to enhance the confidence of students private institutions by providing them a clear view of the requirements of their selected future career. Academic counselling could be used to enhance the 'study strategies and habits' of CS students by providing them with advice for improving their study strategies and habits. Providing these forms of counselling services to all students and in particular to at-risk students may prove to be valuable for retaining them (Kahn et al. 2002).

Another way of improving the 'academic satisfaction' and 'social self-efficacy' abilities of IM students in any institution, is to include more team projects (collaborative work) in the curriculum. Team projects can be used as means to group students together for pursuing the same goals. Clustered classes of students with similar characteristics has been found to have a positive effect on student retention (Mangold et al. 2002-3). Students forming cohort groups in big classes have also been found to a significant positive effect on student retention than those who did not form cohorts (Johnson 2000-1). The purpose of drawing up team projects is for students to combine academic and social aspects in order to improve academic performance and retention. Through discussions, students learn about how to collaborate and develop relationships with others. In doing so, students would utilize campus facilities more often and become more familiar with their campuses. Thus, more team projects could help improve students' satisfaction of study experience and social self-efficacy.

7 CONCLUSION

While accepting that student retention in higher education is an important and complex issue, this study explored the relationship between academic integration and self-efficacy with regard to institution types and students' majors in IM and CS in the Taiwanese higher education. The dataset used in the study was extracted from the Taiwanese national higher education survey database which was conducted in 2005. A cleaned dataset containing 14 student attributes was extracted into four factors, namely: 'study strategies and habits', 'academic satisfaction', 'social self-efficacy', and 'self confidence'. In order to examine the interaction effects between 'academic integration' and 'self-efficacy', MANOVA analysis was performed and revealed a significant effect for both 'institution type' and 'majors of study' on 'academic integration' and 'self-efficacy'. The analysis also found a significant interaction between 'institution type' and 'majors of study' on 'academic integration' and 'self-efficacy'. One outcome of this study was the finding of a positive relationship between 'academic integration' and 'self-efficacy'.

Based on the results of this study, the following conclusions can be drawn. CS students in the same institution type have higher social self-efficacy than IM students except for those in public institutes of technology. Study strategies and habits for IM students were higher than those of CS students. However, the trend for academic satisfaction was opposite. Public institution students have better study strategies and habits, and academic satisfaction than students of private institutes. More team projects in the curriculum and counselling services were suggested to enhance the capabilities of CS and IM students in Taiwanese higher education institutions.

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