The Effect of Math Ability and English Ability on Graduate Academic Performance Using Database of the International Private University

ความสามารถทางคณิตศาสตร์และภาษาอังกฤษมีผลต่อประสิทธิภาพการเรียนของบัณฑิต โดยใช้ฐานข้อมูลของมหาวิทยาลัยเอกชนนานาชาติ

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ABSTRACT

The purposes of this study were to examine the relationship between student demographics, including academic background, and Math and English ability. The study also examined the relationship between Math and English ability and graduates' academic performance by using the database from an international private university. The study collected the data of graduates from the database of the international private university to test hypotheses with three sets of data. The first set of data was combined from four graduate batches (batches 44-47). The second set of data came from the latest batch of graduates (batch 47), and the third set was a sample consisting of 10% taken from all four batches. Data were analyzed using multiple regression analysis, an independent sample t-test, and one-way ANOVA. The results found that student demographics (gender, age, and nationality), and their academic background (types of school, math skills in high school, and majors) determined their Math and English ability. The type of high school, however, did not impact Math ability. In addition, both Math and English abilities were found to influence graduates' performance.

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อ ศึกษาความสัมพันธ์ของความสามารถทางคณิตศาสตร์และความสามารถทาง
ภาษาอังกฤษกับผลการศึกษาโดยรวมของบัณฑิต รวมทั้งศึกษาความสัมพันธ์ระหว่างข้อมูลประชากรของบัณฑิตกับ
ความสามารถทางคณิตศาสตร์และความสามารถทางภาษาอังกฤษ และศึกษาความสัมพันธ์ระหว่างพื้นฐานทางวิชาการของ
บัณฑิตกับความสามารถทางคณิตศาสตร์และความสามารถทางภาษาอังกฤษ โดยใช้ฐานข้อมูลของมหาวิทยาลัยเอกชน
นานาชาติแห่งหนึ่ง งานวิจัยนี้ได้รวบรวมข้อมูลของบัณฑิตวิทยาลัยจากฐานข้อมูลของมหาวิทยาลัยเอกชนนานาชาติเพื่อ
ทดสอบสมมติฐานด้วยข้อมูล 3 ชุด ชุดแรกเป็นการรวมจากชุดบัณฑิตวิทยาลัย 4 รุ่น (รุ่นที่ 44-47) ชุดที่สองเป็นรุ่นที่ 47 รุ่นเดียว
ซึ่งเป็นรุ่นล่าสุด และชุดที่สามเป็นกลุ่มตัวอย่าง 10% จากทั้งหมด 4 รุ่น วิเคราะห์ข้อมูลด้วยการวิเคราะห์การถดถอยพหุคูณ
การทดสอบ T ตัวอย่างอิสระ และการวิเคราะห์ความแปรปรวนทางเดียว ผลการวิเคราะห์พบว่าข้อมูลประชากรของบัณฑิต
(เพศอายุและสัญชาติ) พื้นฐานทางวิชาการ (ประเภทของโรงเรียน ทักษะทางคณิตศาสตร์ในโรงเรียนมัธยม และวิชาเอก)
มีผลต่อความสามารถทางคณิตศาสตร์และทางภาษาอังกฤษ ยกเว้นปัจจัยประเภทของโรงเรียนมัธยมที่มีผลต่อความสามารถ
ทางคณิตศาสตร์อย่างเดียว นอกจากนี้ทั้งความสามารถทางคณิตศาสตร์และภาษาอังกฤษยังส่งผลต่อผลการศึกษาโดยรวม
ของบัณฑิตอีกด้วย

Introduction

Graduate academic performance has become a major topic for Human Resources and the labor market these days. For education providers, it is important to know where certain skill sets would fit in the industry and to design the curriculum accordingly. As Hodgman (2018) stated, the job of higher education institutions is to prepare graduates for the workforce, and thus it is important to work closely with employers or the industries to know what is required. The cooperative education programs between the providers and employers are essential as described by Coll (1996). Such programs were also discussed extensively in the study of Hodges & Burchell (2003), where employers were questioned of their views in the importance of business graduate competencies.

Previous research has studied student demographic factors affecting student performance. For example, Yousef (2011) investigated the factors, such as age, gender, nationality, and students' high school background. The findings from Feast (2002) and Harb & El-Shaarawi (2007) are in the same line that the English language is one of the most important factors in the performance of international students. A thorough literature review disclosed a research gap on the missing link between student characteristics and their background with their academic performance, especially in developing countries. Many previous studies have used current students as a sample in cross sectional study and ignored the students who have already graduated with the completed grade point average (Kruck & Lending, 2003; Nisbet, Tindall, & Arroyo, 2005) whom this study calls "graduates". Some research on academic performance have used subjective measure to measure academic performance (Harb & El-Shaarawi, 2007; Junco & Cotten, 2011).

The theoretical framework for this study was laid by expectancy–value theory (EVT) (Eccles et al., 1983; Eccles, 2009) and dimensions comparison theory (DCT) (Möller & Marsh, 2013). EVT postulates that achievement-related choices, performance, and engagement are motivated by a combination of individual's expectations for success and subjective task value in specific domains (Eccles et al., 1983). This means that people who believe they are better at math than other subjects, such as English, should be more likely to perform well in math subjects and finally pursue a math-related career. Complementing EVT theory, dimensional comparison theory is defined as an intraindividual comparisons that a person makes between his or her own accomplishments in two domains or subjects (Möller & Marsh, 2013). DCT

assumes that dimensional comparisons have an impact on students' academic self-concepts, resulting in greater variances in self-concept between subjects regarded as dissimilar, such as math and English, than between topics regarded as more comparable, such as math and physics (Helm, Mueller-Kalthoff, Nagy, & Möller, 2016). Consequently, developing on both EVT and DCT theories, this study examined potential cross-domain impacts of graduates' ability in math and English on their academic performance, and examined possible associations between students' cross-domain motivational beliefs in math and English, as well as potential individual-specific differences in motivations and academic performance.

There are four significances of this study. First, for university administrators: this study will provide the information of the effect of the variables under consideration on graduate performance in both math and English courses, the guidelines in developing more effective curriculum to enhance students' learning, and the criteria in recruiting students to join the university in the first year or to join each major in their third years. Second, for instructors: this study will reveal the students who are likely to struggle in either math or English courses, so that the instructors will take necessary actions to assist the students to improve their performance in those courses. Third, for future employers: this study will provide information for HR department to focus on specific skills during the recruitment process. Fourth, for graduates: they will know what other people expect from them in the recruiting process before entering university, joining a major, or getting in workplace, and the graduates will have clear pictures of their career paths and learn how to choose the career that is appropriate to their skills.

Thus, the objectives of this research paper are as follows: (1) to examine the relationship between Math ability (1.1) and English ability (1.2) and graduate academic performance; (2) to examine the relationship between student demographics and Math ability (2.1) and English ability (2.2); and (3) to examine the relationship between student academic background and Math ability (3.1) and English ability (3.2).

Literature Review and Hypotheses Development
Graduate Academic Performance

Academic performance is the extent to which a student has attained his/her educational goals e.g., completing bachelor's degree ("Academic performance," 2020). Academic performance plays an important role as a main factor considered by potential employers in recruiting employees especially the newly graduates. Thus, students should be encouraged to achieve academic performance to meet the requirement of the employer. The academic performance of students is calculated by the Cumulative Grade Point Average (CGPA) and CGPA reflects the overall academic performance of the students as it considers the average score of all tests for all semesters during studying in the university (Ervina & Othman, 2005). This current study used CGPA of newly graduate students to measure their overall performance while many studies used GPA from some subjects to measure student performance while they are still studying which in that case may not measure student performance properly.

Several studies have been established on the variables influencing the graduate performance such as demographics, previous knowledge in high school, and extracurricular activities. For example, Harb & El-Shaarawi (2007) found that non-national students in United Arab Emirates who had higher grade point average had high English ability than those of national students. Darling, Caldwell, & Smith (2005) reported that the students who involved in extracurricular activities had higher GPA, more positive attitude toward learning, and higher academic motivations. Bernard, Drake, Paces, & Raynor (1996) found a relationship between student ability and performance (GPA).

Math Ability

Kovas, Haworth, Petrill, & Plomin (2007) described one area of Math ability as the understanding of numerical and algebraic processes. Galli, Chiesi, & Primi (2011) stated that the grades of mathematics subjects had been used widely as the measurement of Math ability. Since the math skills are tested in the exams of math-related subjects, the results or the grades of these subjects are a good indicator of student's skills. In this current study, Math ability is defined as the grade point average of 10 math-related courses in Bachelor of Business Administration curriculum, comprising of Mathematics for Business, Statistics I, Statistics II, Fundamentals of Financial Accounting, Fundamentals of Managerial Accounting, Money, Banking and Financial Markets, Corporate Finance, Microeconomics, Macroeconomics, and Operations Management since these subjects are the basic and core subjects in relating to quantitative fields that all students in BBA program must study. Although other subjects in the curriculum are also related to quantitative analysis, those subjects are in different major, thus, they are for major students only. This serves as a measurement of the students' overall quantitative skills.

In general, many previous studies agreed that students' skills in mathematics is one of the indicators for overall academic performance, however not the strongest or the most important part that explained the variance (e.g., Lipnevich et al., 2011). There were other major factors, such as high school GPA or motivation. Rohr (2012) stated that both GPA and SAT scores were good predictors of students' performance, while Kruck & Lending (2003) argued that SAT was a predictor only for a certain group of students such as male. Brookshire & Palocsay (2005) also agreed that math skill was one of the factors, but to a lesser influence than GPA. Adeboyel (1999) concluded that students who were good in mathematics increased problem-solving skills and developed a better attitude toward quantitative subjects. Students with high Math ability also showed to do slightly higher than those with poor Math ability in chemistry (Udousoro, 2011).

English Ability

Gu (2015) defined academic English proficiency as the ability to use English language in academic context, which is normally measured by using English reading tests. Nisbet, et al. (2005) used ITP-TOEFL as a measurement of English proficiency of the samples. In this current study, English ability represents the students' skills in English, which is calculated by averaging the grade points of the four mandatory English courses, English I, English II, English III, and English IV which all BBA students must study regardless of their major. These subjects employ various reading and other English test methods and are considered as a valid measurement of English ability.

There are mixed results from numerous studies looking into the relationship between students' proficiency in the English language and their academic performance. For example, the study of Feast (2002) showed a strong positive relationship between students' IELTS result and performance. Harb & El-Shaarawi (2007) stated that English competency was the most important factor affecting the performance of business students. These findings are in line with the fact that most international universities put English language requirements upon admission. Thus, it stands to reason that English is an important element to consider when enrolling in a university where English is the primary medium of instruction. However, some other studies argue with contrary of results. Kerstjens & Nery (2000) stated that IELTS scores had a small to medium effect on academic performance, only in a certain group of students, while there was insignificant relationship in other groups within their study.

Based on the above literature, this study hypothesizes, as follows:

H1a: Math ability is related to graduate academic performance.

H1b: English ability is related to graduate academic performance.

Student Demographics: Gender

Gender is a societal concept that differentiates the roles, actions, behavioral and emotional traits that a culture establishes between females and males. Gender, described in psychology, defined human attitudes and characteristics assumed to be born as either male or female (Umoh, 2003). The concept of gender is not only identification of gender difference but also identification of responsibilities and conditions assigned to different gender. Therefore, the study of gender mostly focusses on equality in enhancing development and utilization of competencies of both genders. Traditionally, males as naturally perceived have power and superior status than females (Sheard, 2009). This reflects the high degree of gender stereotypes in education and society at large. However, Steffens & Jelenec (2011)'s study presented that males are more likely to perform better than females in mathematics; females, on the other hand, are more likely to perform better than males in languages and reading. Although the above studies have yielded inconsistent conclusions, gender does have impact on student ability. Thus, this study hypothesize as follows:

H2a: Student gender is related to Math ability.

H2b: Student gender is related to English ability.

Student Demographics: Age

Most studies on the relationship between student age and academic success focus on the chronological age, not maturational age. Jenkins (2003) referred to chronological age as a student birth age while maturational age as readiness to do assigned task. Some studies stated that first year students have less knowledge than third- and fourth-year students (Ebenuwa-Okoh, 2010; Sheard, 2009). Some studies used graduates as sample, and graduates at young age have higher ability than graduates at older age (Palmer & Wright, 1996; Hagedorn & Ren, 2012). Lincove & Painter (2006) also found that the younger students did the test better than the older students in both the 10th and 12th grades. Based on the above literature, empirical findings related to student age, skills, and academic performance are inconclusive. Thus, this study hypothesizes as follows:

H3a: Student age is related to Math ability.

H3b: Student age is related to English ability.

Student Demographics: Nationality

In this study, nationality was divided into Thai and non-Thai students. For non-Thai students, they are consisted of 14% of total sample. Most of these non-Thai students are from China and the rest is from other regions e.g., Southeast Asia, India, Europe, South America, Middle East, and Africa. Harb & El-Shaarawi (2007) found that non-national students outperformed national students in their study because of their English abilities. Eddey & Baumann (2009) also found that international students with high English ability had higher GPA than students with low English ability. However, the study of the students at the University of Newcastle, Australia, revealed that academic performance is no difference between international students and non-international students (Hartnett, Romcke, & Yap, 2004). Thus, this study hypothesizes as follows:

H4a: Student nationality is related to Math ability.

H4b: Student nationality is related to English ability.

Student Academic Background: Math skills in high school

Opstad (2018) found that students with theoretical background in mathematics from high school perform better in business core subjects, such as economics or statistics. This is to the degree that screening new students with only GPA without considering students' previous results of mathematics subjects is not recommended. Alcock, Cockcroft, & Finn (2008) also found that students with mathematics background, especially those who learned calculus or trigonometry apart from basic algebra in high school, would help improve results in accounting, economics, and other business subjects. Some studies found that students with low math skills

in high school frequently had high math anxiety that impairs their learning and performance (Baloglu, 2003). Thus, this study hypothesizes as follows:

H5a: Math skills in high school is related to Math ability.

H5b: Math skills in high school is related to English ability.

Student Academic Background: Type of high school

There are some studies that examined the influence of high school type (e.g. international and non-international high school) on student skills and performance. For example, Pritchard, Potter, & Saccucci (2004) and Yousef (2011) stated that high Math ability is related to certain business majors such as finance, accounting, or MIS. Alcock et al. (2008) and Opstad (2018) agreed that mathematical background in high school has positive relationship with the results of various math-related subjects in business study. Thus, this study hypothesizes as follows:

H6a: Type of high school is related to Math ability.

H6b: Type of high school is related to English ability.

Student Academic Background: Academic major

An academic major is the academic discipline to which an undergraduate student formally commits. An academic major typically requires completion of a combination of prescribed and elective courses in the chosen discipline ("Academic major", 2020). There were several previous studies on academic major affecting student skills. For example, Pritchard, et al. (2004) found that students majoring in accounting or finance generally had better skills in mathematics, while those weaker were in other majors, such as marketing or management. The link between quantitative skills and accounting or finance majors probably applies to business students at other universities as well, because most subjects would require working with numbers. In line with this argument, Malgwi, Howl, & Burnaby (2005) stated that the most important factor in choosing major was the student's interest in the subjects themselves. Yousef (2011)'s study showed that students in MIS (Management Information System) major outperformed management and marketing students in a number of quantitative subjects. Thus, this study hypothesizes as follows:

H7a: Academic major is related to Math ability.

H7b: Academic major is related to English ability.

Based on literature review and hypothesis development above, Figure 1 represents the conceptual framework of this study which included student demographics and student academic background as independent variables, Math ability and English ability as mediating variables, and graduate performance as dependent variable.
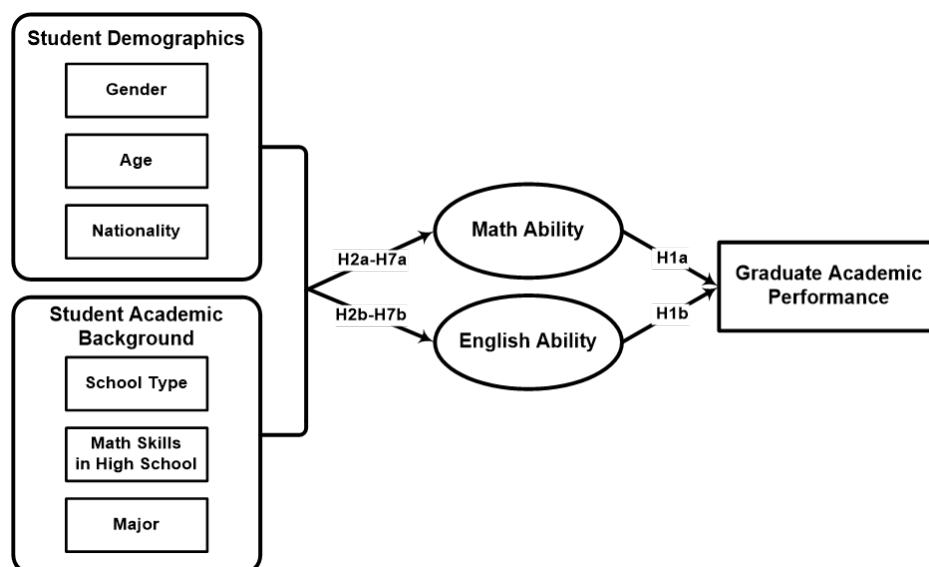

Figure 1 Conceptual Framework of This Study

Research Methodology

Data Collection and Analysis

Data was collected from database of one international private university for four batches of graduates (batch 44-47). The reason for selecting batch 44-47 was that batch 47 was the latest year of graduation during the data collection and batch 44-46 were selected because they were in the new curriculum with the batch 47 and the batch lower than 44 were under the old curriculum. The results in Table 1 present three different sets of data: the first set was total graduates including batch 44-47; the second set was the graduates only from batch 47 (latest batch); and the last set was a sample of 10% from the total four batches. The reason to present three sets of data was to verify that a large sample produced more accurate results than a small sample since there is less bias in the data set (Blair & Blair, 2015).

Table1. Sample Profiles

	BATCH 44 - 47		BATCH 47		10 % Sample	
	N	*%*	*N*	*%*	*N*	*%*
TOTAL	4545	100%	1179	100%	449	100%
MAJOR	*N*	*%*	*N*	*%*	*N*	*%*
ACT	858	18.9%	216	18.3%	76	16.9%
FIN	358	7.9%	83	7.0%	28	6.2%
HTM	381	8.4%	102	8.7%	48	10.7%
IBM	496	10.9%	116	9.8%	43	9.6%
MGT	446	9.8%	136	11.5%	49	11.9%
MKT	1479	32.5%	387	32.8%	153	34.8%
Others	527	11.6%	139	11.9%	52	9.9%
NATIONALITY	*N*	*%*	*N*	*%*	*N*	*%*
Thai	3917	86.2%	1009	85.6%	380	84.6%
Chinese	251	5.5%	64	5.4%	28	6.2%
Others	377	8.3%	106	9.0%	41	9.1%
GENDER	*N*	*%*	*N*	*%*	*N*	*%*
Male	1806	39.7%	493	41.8%	183	40.8%
Female	2739	60.3%	686	58.2%	266	59.2%
SCHOOL TYPE	*N*	*%*	*N*	*%*	*N*	*%*
Thai	4150	91.3%	1050	89.1%	404	90.0%
International	395	8.7%	129	10.9%	45	10.0%
SCHOOL MATH	N	%	N	%	N	%
Strong	2144	47.2%	514	43.6%	219	48.8%
Weak	2401	52.8%	665	56.4%	230	51.2%

Note: ACT = Accounting; FIN= Finance; HTM=Hospitality and Tourism Management; IBM=International Business Management; MGT=Management; MKT=Marketing

Measures

This study used the objective measures to measure all variables in the model as follows: Math Ability (MA): this study measures Math ability by using the average grade of subjects related to mathematics which were Mathematics for Business, Statistics I, Statistics II, Fundamentals of Financial Accounting, Fundamentals of Managerial Accounting, Money, Banking and Financial Markets, Corporate Finance, Microeconomics, Macroeconomics, and Operations Management. English Ability (EA): this study measures English ability by using the average grade of the four mandatory English courses which were English I, English II, English III, and English IV. Demographics characteristics: gender, age, and nationality were collected as demographics data of the graduates for this study. Academic background: types of high school which are Thai and international school; math skills in high school which are the entrance scores from mathematics subject; and selected majors were collected to represent the students' prior knowledge and their interest. Graduate performance: cumulative GPA (CGPA) was used to measure graduate performance which is consistent with previous studies (Ervina & Othman, 2005). Table 2 shows both grading and scoring which this study used to calculate Math ability and English ability measures.

Table 2. Course Grade

Course Grade	A	A-	B+	B	B-	C+	C	C-	D
Course GPA	4	3.75	3.25	3	2.75	2.25	2	1.75	1

Table 3 illustrates that means of Math ability were a little lower than means of English ability across the three data sets. Cronbach alpha values of both Math ability and English ability ranged between 0.816-0.917 which have attained the threshold of 0.7 (Cortina, 1993), indicating the reliability of these two measures. There was no cross loading across the three data set, indicating construct validity of Math ability's and English ability's measures (Hair, Black, Babin, & Anderson, 2010). Average variance extracted (AVE) and composite reliability (CR) were used to verify convergent validity, with values ranging from 0.718-0.791 for AVE above the threshold of 0.5 (Hair, et al., 2010) and 0.860-0.921 for CR above the threshold of 0.8 (Hair, et al., 2010).

Table 3. Descriptive and Factor Analysis

Constructs	N = 4545				N = 1179				N = 449			
	FL	*α*	Mean	*SD*	*FL*	*α*	Mean	*SD*	*FL*	*α*	Mean	*SD*
Math ability	0.659 – 0.791	0.917	2.12 – 2.69	0.70 – 0.91	0.619 – 0.792	0.914	1.94 – 2.63	0.64 – 0.91	0.589 – 0.781	0.908	2.05 – 2.59	0.66 – 0.92
English ability	0.763 – 0.843	0.834	2.55 – 3.25	0.62 – 0.74	0.741 – 0.813	0.816	2.51 – 3.26	0.58 – 0.74	0.752 – 0.821	0.818	2.52 – 3.22	0.61 – 0.76
	Variance extracted = 60.634% KMO =0.944, Bartlett's Test *p* value = 0.000				Variance extracted =59.588% KMO =0.941, Bartlett's Test *p* value = 0.000				Variance extracted = 58.353% KMO =0.925, Bartlett's Test *p* value = 0.000			

Note: *FL* = Factor Loadings

For discriminant validity, according to Fornell & Larcker (1981), square average variance extracted (AVE) should be higher than the correlation of two constructs to support discriminant validity. Based on Table 4, the value of square AVE was higher than the value of correlation across allthree data sets, indicating discriminant validity of these two constructs which are Math ability and English ability.

Table 4. Discriminant Validity

	N = 4545		*N* = 1179		*N* = 449	
	MA	**EA**	**MA**	**EA**	**MA**	**EA**
MA	0.859		0.853		0.847	
EA	0.485**	0.889	0.499**	0.882	0.480**	0.884

Note: ** *p* value < 0.001; square AVE was presented on the diagonal; the correlation between two constructs was presented in italic. MA = Math Ability; EA = English Ability

Research Results

Multiple regression, independent sample t-test, and one-way ANOVA were used to test the hypotheses for this study. To fulfil the first objective, multiple regression analysis was used to test H1a and H1b. Math ability and English ability were regressed on graduate performance representing by CGPA, revealing that both abilities were significantly (*F* value range between 1283.513-13661.548, $p = 0.000$) related to graduate performance across the three data sets (see Table 5) where adjusted R square range from 84.4%-85.7% which are quite high. In addition, Math ability (β= 0.742-0.753) has higher impact on graduate performance than English ability (β= 0.285-0.291) across all three data sets. Thus, H1a and H1b were supported.

Table 5. Hypothesis Testing for H1a-H1b (DV = Graduate Performance)

IV	*N* = 4545			*N* = 1179			*N* = 449			**Results**
	Std. beta	***t* value**	***p* value**	*Std. beta*	*t value*	*p value*	**Std. beta**	*t value*	*p value*	
MA	0.753	117.616	0.000	0.742	55.848	0.000	0.748	36.016	0.000	**H1a Supported**
EA	0.285	44.562	0.000	0.285	21.466	0.000	0.291	14.000	0.000	**H1b Supported**
	Adj. *R* = 0.857, *F* value = 13661.548, p value = 0.000			Adj. *R* = 0.844, *F* value = 3177.900, p value = 0.000			Adj. *R* = 0.851, *F* value = 1283.513, p value = 0.000			

To fulfil the second objective, independent sample t-test and one-way ANOVA were used to test H2a-H2b, H3a-H3b, and H4a-H4b, respectively. The results of independent sample t-test, testing H2a-H2b, as shown in Table 6, indicated that Math ability of graduates from the first two data sets, except the third data set (*N*=449) differed across gender and English ability of graduates of the first data set differed across gender but not from other data sets. However, this study focused on the first data set as mentioned earlier about the reason of using the second and third data set. Based on the first data set, the result showed that female graduates have higher both Math ability ($\bar{x}$= 2.46) and English ability ($\bar{x}$= 2.93) than Math ability ($\bar{x}$= 2.33) and English ability ($\beta\bar{x}$= 2.88) of male graduates. Thus, H2a and H2b were supported.

Table 6. Hypothesis Testing for H2a-H2b (DV=Math ability (MA) and English ability (EA))

IV	*N* = 4545			*N* = 1179			*N* = 449		
	N	**MA**	**EA**	*N*	**MA**	**EA**	*N*	**MA**	**EA**
Male	1806	2.3367***	2.8848***	493	2.3039*	2.8346	183	2.2893	2.8757
Female	2739	2.4619***	2.9330***	686	2.3836*	2.8960	266	2.3933	2.8877
		H2a Supported	**H2b Supported**		**Supported**	**NS**		**NS**	**NS**

Note: * *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.000, NS = Not Significant

The results of one-way ANOVA, testing H3a-H3b, as shown in Table 7, indicated that both Math ability and English ability of graduates from all three data sets differed across age. Based on all three data sets, graduates who are 21-year-old or below have higher both Math ability ($\bar{x}$= 2.64-2.77) and English ability ($\bar{x}$= 3.09-3.60) than graduates who are above 21 (for MA; $\bar{x}$= 2.02-2.53; for EA; $\bar{x}$= 2.72-2.95). Thus, H3a and H3b were supported.

Table 7. Hypothesis Testing for H3a-H3b (DV=Math ability (MA) and English ability (EA))

IV	N = 4545			N = 1179			N = 449		
	N	MA	EA	N	MA	EA	N	MA	EA
< 21	84	2.64***	3.60***	23	2.56***	3.43***	9	2.84***	3.52***
21	950	2.77***	3.09***	226	2.67***	3.09***	86	2.72***	3.12***
22	1684	2.53***	2.95***	420	2.47***	2.90***	163	2.49***	2.95***
23	1016	2.17***	2.72***	283	2.14***	2.69***	96	2.14***	2.68***
> 23	811	2.02***	2.80***	227	2.06***	2.76***	95	1.93***	2.71***
		H3a Supported	H3b Supported		Supported	Supported		Supported	Supported

Note: * p value < 0.05; ** p value < 0.01; *** p value < 0.000

The results of independent sample t-test, testing H4a-H4b, as shown in Table 8, indicated that both Math ability and English ability of the graduates only from the first data set (largest sample) differed across nationalities. However, this study focused on the first data set as mentioned earlier. Based on the first data set, the result showed that the Thai graduates have higher Math ability ($\bar{x}$= 2.42) than Math ability ($\bar{x}$= 2.33) of international graduates and have lower English ability ($\bar{x}$= 2.86) than English ability ($\bar{x}$= 3.20) of international graduates. Thus, H4a and H4b were supported.

Table 8. Hypothesis Testing for H4a-H4b (DV=Math ability (MA) and English ability (EA))

IV	N = 4545			N = 1179			N = 449		
	N	MA	EA	N	MA	EA	N	MA	EA
Thai	3917	2.4245**	2.8674**	1009	2.3539	2.8216	380	2.3702	2.8301
Non-Thai	628	2.3348**	3.2035**	170	2.3285	3.1592	69	2.2449	3.1730
		H4a Supported	H4b Supported		NS	NS		NS	NS

Note: * p value < 0.05; ** p value < 0.01; *** p value < 0.000, NS = Not Significant

To fulfil the third objective, independent sample t-test and one-way ANOVA were used to test H5a-H5b, H6a-H6b, and H7a-H7b, respectively. The results of independent sample t-test, testing H5a-H5b, as shown in Table 9, indicated that both Math ability and English ability of the graduates from all three data sets differed across math skills in high school. Based on all three data sets, the graduates who are strong in math skills in high school have higher both Math ability ($\bar{x}$= 2.53-2.62) and English ability ($\bar{x}$= 2.93-3.01) than graduates who are weak in math skills in high school (for MA; $\bar{x}$= 2.17-2.22; for EA; $\bar{x}$= 2.81-2.82). Thus, H5a and H5b were supported.

Table 9. Hypothesis Testing for H5a-H5b (DV=Math ability (MA) and English ability (EA))

IV	N = 4545			N = 1179			N = 449		
	N	MA	EA	N	MA	EA	N	MA	EA
Strong	2144	2.6214***	3.0151***	514	2.5429***	2.9336***	219	2.5396***	2.9563**
Weak	2401	2.2252***	2.8234***	665	2.2014***	2.8213***	230	2.1713***	2.8128**
		H5a Supported	H5b Supported		Supported	Supported		Supported	Supported

Note: * p value < 0.05; ** p value < 0.01; *** p value < 0.000

The results of independent sample t-test, testing H6a-H6b, as shown in Table 10, indicated that only English ability of the graduates from all three data sets differed across types of high school but not with Math ability. Based on all three data sets, the graduates from international high school have English ability ($\bar{x}$= 3.29-3.46) higher than graduates from Thai high school ($\bar{x}$= 2.80-2.86) but graduates from both types of high school have similar Math ability. Thus, H6b was supported, except H6a.

Table 10. Hypothesis Testing for H6a-H6b (DV=Math ability (MA) and English ability (EA))

IV	N = 4545			N = 1179			N = 449		
	N	MA	EA	N	MA	EA	N	MA	EA
Thai	4150	2.4161	2.8611***	1050	2.3525	2.8064***	404	2.3413	2.8373***
Inter	395	2.3706	3.4674***	129	2.3320	3.3905***	45	2.4372	3.2917***
	H6a NS	H6b Supported		NS	Supported		NS	Supported	

Note: * *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.000   NS = Not Significant

The results of one-way ANOVA, testing H7a-H7b, as shown in Table 11, indicated that both Math ability and English ability of the graduates from all three data sets differed across academic majors. Based on all three data sets, the graduates who major in Finance have both Math ability ($\bar{x}$= 3.17-3.21) and English ability ($\bar{x}$= 3.29-3.34) higher than the graduates from other majors. Thus, H7a and H7b were supported.

Table 11. Hypothesis Testing for H7a-H7b (DV=Math ability (MA) and English ability (EA))

IV	N = 4545			N = 1179			N = 449		
	N	MA	EA	N	MA	EA	N	MA	EA
ACT	858	2.69***	2.91***	216	2.59***	2.82***	76	2.58***	2.87***
FIN	358	3.21***	3.34***	83	3.21***	3.29***	28	3.17***	3.30***
HTM	381	1.94***	2.70***	102	1.98***	2.70***	48	1.84***	2.72***
IBM	496	2.67***	3.30***	116	2.64***	3.27***	43	2.73***	3.34***
MGT	446	2.47***	3.08***	136	2.40***	3.11***	49	2.46***	2.91***
MKT	1479	2.13***	2.73***	387	2.07***	2.68***	153	2.16***	2.74***
OTHERS	527	2.25***	2.80***	139	2.22***	2.79***	52	2.20***	2.84***
	H7a Supported	H7b Supported		Supported	Supported		Supported	Supported	

Note: * *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.000

Research Discussion

The purpose of this study was to examine the effect of graduates' demographics and their background of previous knowledge on Math and English ability which affected their academic performance. This study collected data from database of one private university in Bangkok, Thailand. This study found that **all seven hypotheses were supported, except one hypothesis** which was the relationship between types of high school (e.g., Thai high school or International high school) and Math ability.

The **first finding** was that Math and English abilities of the graduates were related to their academic performance where their Math ability had higher impact than English ability on academic performance. The possible explanation could be that the majority of sample are Thai, so their English ability naturally should be low compared to Math ability. The finding is in line with Badru (2004)'s study on Nigerian students that revealed students performed better in

science subjects when they have high Math ability, and Martirosyan, Hwang, & Wanjohi (2015)'s study on international students enrolled in North Central Louisiana in USA that found students with high GPA had reported high level of English ability.

The **second finding** was that gender was related to student ability both in Math and English where female graduates had higher ability on both Math and English than male graduates. The possible explanation could be that the majority of sample are females, so they may feel highly competitive which make them study harder, be more responsible, and be more disciplined. Besides, it could be that female students who decide to enter business school as their first choice to study, so they put more effort, but male students enter business school as their second choice because they could not study engineering, so they may not put enough effort in their study. The finding is in line with Balart & Oosterveen (2019)'s study on 15-year-old students' ability in math, science, and reading, which female students have more self-discipline, self-correction, and high levels of conscientiousness, thus female students performed better than male students. Wally-Dima & Mbekomiza (2013) also found that female students have to work harder to liberate the male-gender stereotypes and they become more contemplating with their studies than male students. Moreover, Al-Rofo (2010)'s study revealed that students who study specialization without desire cause their low cumulative GPA.

The **third finding** was that age was related to student ability both in Math & English where younger graduates had higher ability on both Math and English than older graduates. The possible explanation could be that the older graduates did not pay attention to the studies, they may spend time doing something else, e.g. playing game online except their studies or they may have to help family business. The finding is in line with Abadel & Hattab (2013)'s study on newly graduates and experts that the old graduates perceive their competency as inadequate in contrast with the young graduates' perception.

The **fourth finding** was that nationality was related to student ability both in Math and English where Thai graduates had higher Math ability but lower English ability than non-Thai graduates. The possible explanation could be that the majority of sample are Thai who cannot speak English well compared to international students. The finding is in line with Chen & Zimmerman (2007)'s study on American and Taiwanese students in Math ability that Taiwanese students outperformed American students in Math ability and also in line with Clarkson (2007)'s study on bilingual Australian Vietnamese students who switched between their languages while learning math, they performed well on math tasks.

The **fifth finding** was that math skills in high school were related to student's ability both in Math and English where graduates who were strong in math skills in high school had higher ability on both Math and English than graduates who were weak in math skills in high school. The possible explanation could be that students who are good at math since in their high school, tend to be good at other subjects as well. The finding is in line with Erdem, Şentürk, & Arslan, (2007)'s study. They found that students who were from science high schools perform better than students who were from standard high schools in Turkey. Koh, M. Y., & Koh, H. C. (1999)'s study in a Singapore-based study found that not only previous knowledge in high school related to first-year performance but also influenced the performance in the following three years of their studies.

The **sixth finding** was that types of high school (Thai vs International) were related to only English ability, and not to Math ability. The possible explanation could be that students who came from international high school had high English ability since they had more chance to practice their English and lived in the environment where everyone speaks English everyday but for Math ability, both types of high school could have similar math content subject since both schools are under the same regulation of high education authority in Thailand. The finding is in line with Evans & Schwab (1995)'s study on Catholic and public schools that the students

who were from Catholic schools outperformed students from public schools where in their study, Catholic schools are more effective than public schools.

The **last finding** was that academic major was related to student ability both in Math and English where the graduates majoring in Finance had highest ability on both Math and English. The possible explanation could be that students who are good at math, are normally good at other subjects especially the sample are from international university. The finding is in line with Umarji, McPartlan, & Eccles (2018)'s study on major selection that students who had high Math ability tended to choose major with intensive math.

Implication and Limitations

The results of this study have an important implication for the university recruitment policies as the universities are pursuing to recruit qualified students for better academic performance. Investigating the factors related to academic success is extremely important as the goal of policy initiatives is to advocate students to not just start but also finish higher education successfully. It is noticeable that the more knowledge educators have on factors affecting academic performance, the better they would be able to help students and suggest prospective students. According to the previous studies, students anticipate universities to help them develop appropriate skills and competences for their career which will make them feel confident in their ability to perform well.

Another implication for faculties' planning and teaching as the evaluation of Math and English ability can be useful in recognizing students with substantial impairments in this area who may have a serious problem to the completion of the course. When established, these students could be encouraged to develop their competencies and, as a result, to increase their Math and English abilities and academic success. Students' academic performance can be increased where their skills have been developed both in Mathematics and English, thus, the faculties should be able to prepare the class materials and contents effectively and more precisely. The findings about student demographics and their academic background could also benefit the faculties' planning and teaching. For example, the faculties could pay more attention to male students in class both math and English to avoid gender-stereotyping by assuming that male students are good at math, and they do not need help in this field. The faculties could design courses to improve the students' weaknesses since this study found that Thai students are weak in English and international students are weak in math to elevate both types of students to be qualified graduates who are capable of both math and English. For math skills in high school, the finding could benefit university administrators in terms of recruitment by focusing on students who have high math skills in high school so that the university graduates will be high quality since the finding indicated that students who are good at math in high school can do well both in math and English in university level. Another finding that could interest university administrator is that finance major is the most difficult major in business school therefore students who graduated from this major are good at both math and English and have better academic performance. For other majors to achieve same academic performance, they should find their own uniqueness and develop their major students into that direction. For example, students from marketing could be developed to the very talented and innovative marketers. For age of graduates, the finding could benefit HR department of future employers as most companies may value the older graduates more than young graduates affected by age-stereotyping when older students are more mature and more responsible than young ones, which our finding proved the opposite. Finally, the findings could serve as career guidance for graduates. They should be suggested to rigorously evaluate their strengths and weaknesses to determine if they have the abilities required to pursue the future career that they want.

For methodological contributions, this study uses objective measures to measure constructs by collecting data from database (e.g., single item measure, computer-generated trace data), comparing to studies that used subjective measures to measure the constructs by collecting data from questionnaire (e.g., multiple item measures, self-report) asking about respondents' experiences and perceptions. Prior research appears to include the assumption that objective measures can perform better than subjective measures of construct (Andrews, Boyne, & Walker, 2006). Tempelaar, Rienties, & Nguyen (2020) found that the objective measures contained no measurement bias when compared to subjective measures. In addition, this study used longitudinal data to test the hypothesis by collecting data of students who graduated in year 2016-2019 (Batch 44-47) and also tested with data from one recent batch which is batch 47, and lastly tested with random sample of 10% from total four batches. The benefit of doing this was to present the advantage of large sample reflecting more accurate results.

The following are some limitations of this study. First limitation was that the study collected data only from one international private university, thus suggesting future research to collect data from more universities especially from public university for the generalization purpose. Second limitation was that the study examined only demographics and background of previous knowledge of samples, thus suggesting future research to include other related factors affecting student abilities and academic performance. Third limitation was that the study examined only business school, thus suggesting future research to also include other schools for the generalization purpose.

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