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Factors Influencing Technopreneurial Intention among Undergraduate Engineering Students in the Philippines

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Abstract : In the Philippines, students exhibit a low interest in entrepreneurship despite numerous programs implemented and mandated by the government. The emergence of technopreneurship is now confronted by several issues, mainly in developing competent and versatile technopreneurs. Until now, there are inadequate studies related to technopreneurship specifically those dealing with technopreneurial intention among engineering students. This study aims to determine the factors associated with technopreneurial intention. Simple random sampling was used to collect necessary data from 200 undergraduate engineering students from selected universities in the Philippines. Multiple Regression Analysis and Pearson Correlation Analysis were used to test the hypotheses and examine the relationship between independent and dependent variable respectively. The findings revealed that among the five identified factors, only Computer Ability, Access to Capital, and Entrepreneurial Experience have a significant and positive effect on intention towards technopreneurship.

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Keywords : Computer Ability; Entrepreneurial Experience; Entrepreneurial Orientation; Internet Ability; Technopreneurial Intention

1. Introduction

Through the years, the Philippine government has developed a variety of methods to assist and encourage youth involvement in technopreneurial activity. Particularly, the partnership between the Department of Science and Technology (DOST,) University of the Philippines (UP), and the Philippine Economic Zone Authority (PEZA) established the DOST-UP Enterprise Center for Technopreneurship in 2011 which aimed in assisting young entrepreneurs to taking the first steps toward establishing their enterprises through technopreneurship courses, grant application support, product testing, and tailored business support (DOST-PCIEERD, 2012). Aside from the diligent effort of the Philippine government through institutions like DOST and DTI, there are some private organizations that wish to offer ambition to underprivileged youths and university students with possibilities for self-determination in social and economic participation via entrepreneurship. Youth at Venture Philippines is a private, non-profit organization that helps disadvantaged, motivated, and passionate youth and university students with entrepreneurial mindset gain or improve their knowledge, skills, and attitudes towards entrepreneurship.

Additionally, it is worth noting that graduates of universities who start their businesses help the government reduce the responsibility of producing public-sector job possibilities (Singhry, 2015). Moreover, because of the unfavorable economic conditions following the COVID-19 pandemic, employment has been a challenge for youth and fresh college graduates. Although the Philippine government is eager to make attempts, not many Filipino youths regard entrepreneurship as their professional choice. Statistics have shown from a study that out of 5,953 youths, 86.12% were salaried and classified into Permanent Employment, Short-Term, Work on different jobs daily or week to week, and unclassified. In contrast, 248 or 4.17% are unemployed, and only 578 or 9.71% were self-employed. From this it can be interpreted that most youths are mainly employed rather than entrepreneurial (Gozun and Rivera, 2019).

The term "technopreneurship" refers to a new breed of entrepreneurship that is technology-based. As a result, it confronts various problems in training and developing competent technopreneurs (Jusoh & Halim, 2006; Tan, Karl & Mohamed, 2010). It entails bringing individuals together who are intelligent, determined, innovative, tech-savvy, enthusiastic, and willing to take measured risks. Unlike entrepreneurship, Technopreneurship is rarely a one-person show as the team's success depends on how effectively they work together. The concept of entrepreneurship can also be applied in technopreneurship, where the greater the person's intention to become an entrepreneur, the more likely they are to succeed (Hisrich, Peters & Shepherd, 2017). However, only few researchers have dealt with technopreneurship as most studies tend to focus on the conventional type of entrepreneurship. Additionally, the scarcity of literature has created a void in our understanding of the factors promoting technopreneurial purpose. Thus, the objective of this study will determine the characteristics that may impact engineering students' inclinations toward technopreneurship.

2. Review of Related Literature

A. Computer Ability

An analysis of the relationship between computer ownership and entrepreneurship at the individual level provides evidence that individuals with access to home computers are substantially more likely to become entrepreneurs over the following 12–15 months (Fairlie, 2006). From Buckley and Montes' (2002) study, majority of businesses make relatively large investments in computers and communication equipment. This is because exposure to computers make it substantially easier for a potential entrepreneur to create an experimental business plan, obtain information, research competition, and lower operating and marketing costs. Computer Ability such as using spreadsheets, word processing, and database programs, are valuable for creating and managing entrepreneurship.

B. Internet Ability

According to Bandura (1986), self-efficacy deals with “how people evaluate their ability to obtain a certain type of performance by planning and accomplishing the courses of action needed. Skills and knowledge in Information Communication Technology (ICT) are crucial in technopreneurship specifically for relaying and acquiring important information to maximize business opportunities (Watson, 2016). Students with adequate IT abilities and real-world experience in starting IT enterprises would be more successful in IT-related entrepreneurship. Moreover, the self-efficacy in terms of internet and computer are connected to the internet's perceived usefulness and the individual desire to use technology (Aesaert et al., 2015; Courtois et al., 2014; Ong & Lai, 2006)

C. Individual Entrepreneurial Orientation

According to Bolton (2012), Individual EO would be valuable at a collective level, which includes resourcefulness, dynamic, and courage, which may be possible by extending it to the level of individuals. In addition, the three components of EO were connected to a student's desire to its intent in pursuing entrepreneurship. Certainly, a person's willingness to take risks and tolerance for risk affected their entrepreneurial ambitions (Yurtkoru, Acar & Teraman, 2014). It was also discovered that Malaysian students' inclination for risk-taking was linked to their desire to engage in entrepreneurial activity (Embi, Jaiyeoba & Yussof, 2019). Additionally in Abdulgani's study (2016), personal attributes, enthusiasm, entrepreneurial and commercial enterprise abilities which are connected to an individual's preferences, mentalities, inclinations, and ability to recognize and seize the great opportunity, have been identified to affect the emergence of technopreneurship.

D. Entrepreneurial Experience

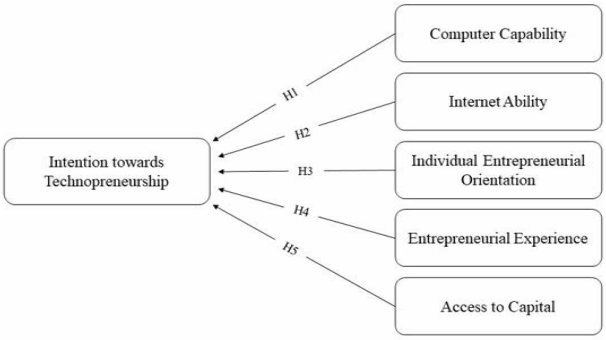

Fig. 1: Research Framework

According to (Kautonen et al. 2011), an individual's work experience and educational background have become the focus of attention of research in developing Entrepreneurial Intention. A better understanding of how Etrepreneurial Intention is influenced by an individual's type of work was derived from previous studies that analyze the difference between individuals with different work experiences (Zapkau et al. 2015). Scholars have also recommended prioritizing this type of experience and analyzing whether it is converted to knowledge (Politis, 2005), particularly, considering the concept of Entrepreneurial Experience as a factor that will describe the variation brought about by an individual's background in building Entrepreneurial Intention (Miralles et al. 2016).

E. Access to Capital

From Aragon-Sanchez, et al. (2017), the capacity of economic, personal, and material support was observed in response to individuals' decisions to establish new businesses and their succeeding sustainability, development, and revenue growth. Entrepreneurial inclinations are usually instilled in children from affluent households since the youth are already able to recognize the importance of economic resources in a company's success. Thus, university students are expected to understand that a financial constraint reduces the probability of success and increases potential risk, hence lowering the value and viability of pursuing the objectives.

3. Methodology

A. Data Collection

Due to the presence of COVID-19, the Philippine Government has enforced a lockdown that require the people to stay at home (Dizon, 2020). As a result, the researchers have gathered the data during the COVID-19 pandemic through an online questionnaire with the use of Google Forms which was distributed using different social media platforms such as Facebook and Twitter and relayed the questionnaire in different group chats via Facebook Messenger. The population of this study were engineering students from State Universities in Metro Manila that offer a variety of engineering courses such as Polytechnic University of the Philippines (PUP), Rizal Technological University (RTU), Taguig City University (TCU), and Technological University of the Philippines – Taguig Campus (TUP-T). The student participants have also took up the course Technopreneurship 101 as mandated by CHED to all Higher Education Institutes (HEIs) throughout the Philippines that provide engineering programs.

B. Theoretical Framework

The research framework of the study was based on the study of Alias, Arham, Koe, Krishnan, & Mahphoth (2021) on factors influencing technopreneurial intention. It became a driving factor for the researchers to find out the outcome in different populations with additional factors, which are also believed to be also significant. Each factor was gathered from a variety of other academics' investigations which lead to the development of the study's research model. It adopted the concept of an individual's orientation, resources, experience, and self-efficacy. This study determines whether the factors (Computer Ability, Internet Ability, Entrepreneurial Orientation, Entrepreneurial Experience, and Access to Capital) impact an individual's technopreneurial intention.

C. Hypothesis

Utilizing the theoretical framework presented in this study, the researchers identified the relationship of independent factors to the dependent factor:

H1: Intention towards technopreneurship is positively influenced by computer capability

H2: Intention towards technopreneurship is positively influenced by Internet Ability

H3: Intention towards technopreneurship is positively influenced by Individual EO

H4: Intention towards technopreneurship is positively influenced by Entrepreneurial Experience.

H5. Intention towards technopreneurship is positively influenced by Access to Capital.D. Hypothesis

D. Questionnaire

The researchers used a five-point Likert scale questionnaire (1=Very Unlikely to 5 = Very Likely), and the respondents were requested to input their answers on self-administered survey forms, which were sent online with the use Google Forms. To guarantee the credibility and efficacy of the items, the questions were adopted from past research (Aesaert, Voogt, Kuiper & van Braak, 2017; Bolton & Lane, 2012; Wu & Tsai, 2006; Liñán & Chen, 2009). The questions were divided into six sections: (a) Computer Ability (CA), (b) Internet Ability (IA), (c) Entrepreneurial Orientation (EO), (d) Entrepreneurial Experience (EE), (d) Access to Capital (AC), and (e) Technopreneurial Intention (TI).

Table 1 : Research Instruments

Factors	Items	Questions	Source
Computer Ability (CA)	CA01	Use a word processor to create documents.	Kay (1993)
	CA02	Learning a software package that you have never used before.	
	CA03	Identify basic parts of a computer and its functions.	
	CA04	Read a computer program.	
	CA05	Can operate Microsoft applications and other computer-aided software skillfully.	
Internet Ability (IA)	IA01	Search information by using keywords in search engines	Tsai (2004)
	IA02	Capable of searching information by using images in reverse image search engines	
	IA03	How good can you judge if the information on a website is true or false?	
	IA04	How good are you in creating a new product of information when gathering information from several websites using a computer?	
	IA05	How good can you use e-mail to ask a clear question that is completely understandable for the receiver?	
Entrepreneurial Orientation (EO)	EO01	I like to take bold action by exploring outside my intellectual capability	Bolton & Lane (2012)
	EO02	I am willing to invest a lot of time and/or money in something that might yield a high return	
	EO03	I tend to act "boldly" in situations where risk is involved	
	EO04	I usually act in anticipation of future problems, needs, or changes	
	EO05	I tend to plan ahead on projects	
	EO06	I prefer to "step up" and get things going on projects rather than sit and wait for someone else to do it	
Entrepreneurial Experience (EE)	EE01	Thanks to my experience, I know how to start a viable business	Miralles et al (2017)
	EE02	Thanks to my professional experience, I know well clients' problems	
	EE03	It is easy for me to identify business opportunities in my professional area	
	EE04	Thanks to my knowledge, I am comfortable at my work as I know how the business works	
Access to Capital (AC)	AC01	My immediate family would give me money when I start a business	Aragon-Sanchez et al (2017)
	AC02	If my family had a business, they would facilitate me in creating a business	
	AC03	My immediate family together with a financial institution will provide financial assistance for me to start a business	
Technopreneurial Intention (TI)	TI01	I am ready to do anything to be a technopreneur	Liñán & Chen, (2009)
	TI02	My professional goal is to become a technopreneur	
	TI03	I will make every effort to start and run my own firm	
	TI04	I am determined to create a firm in the future	
	TI05	I have very seriously thought of starting a firm	
	TI06	I have the firm intention to start a firm someday	

4. Data And Results

A. Data Analysis

With the use of the software Statistical Package for the Social Sciences (SPSS), the researchers were able to employ a quantitative approach by examining the relationships between independent variables, and independent variables to dependent variables with the use of Pearson Correlation Analysis. The researchers also conducted Multiple Regression analyses to test the hypotheses in this study. The table of Regression Coefficients, Model Summary, and F value from ANOVA will be used to determine the outcome of the study.

B. Demographics

The researchers successfully collected 200

Table 3 : Demographics Profile

Variable	Category	Number (N)	Percentage (%)
Gender	Male	117	58.5%
	Female	83	41.5%
Schools	PUP	50	25%
	RTU	50	25%
	TCU	50	25%
	TUP-T	50	25%
Age	18 to 20 years old	127	63.5%
	21 to 23 years old	69	34.5%
	24 to 26 years old	4	2%
Course	ME	82	41%
	CE	56	28%
	EE	17	8.5%
	ECE	15	7.5%
	BET	12	6%
	IE	10	5%
	CpE	8	4%

responses out of four different state universities. The percentage of the sample out of 200 per state university is 25%, wherein the researchers acquired 50 engineering students from four different state universities. It is found out that most of the respondents are Males (58.5%; n=117) and Females (41.5%; n=83). In terms of age, most of the respondents aged from 18- 20 (63.5%; n=127), second were ages 21-23 (34.5%; n=69), and lastly ages from 24-26 (2%; n=4). Moreover, majority the students are Mechanical Engineering (ME) students (41%; n=82), second are Civil Engineering (CE) students (28%; n=56), third are Electrical Engineering (EE) students (8.5%; n=17), fourth are Electronics and Communication Engineering (ECE) students (7.5%; n= 15), fifth are from the BET courses (6%; n=12), sixth are Industrial Engineering (IE) students (5%; n=10), and lastly are from Computer Engineering (CpE) students (4%; n=8). The table below are the demographic data of the respondents.

C. Descriptive statistics

Table 3 : Item Analysis

Factors	Items	$\bar{x}$	σ
Computer Ability (CA)	CA01	4.4600	.84971
	CA02	4.1150	1.12164
	CA03	4.4000	.83876
	CA04	3.8500	1.12420
	CA05	4.3750	.78579
Internet Ability (IA)	IA01	4.6500	.68546
	IA02	4.2300	1.03560
	IA03	4.3400	.75979
	IA04	4.0300	.86187
	IA05	4.2250	.81096
Entrepreneurial Orientation (EO)	EO01	4.2500	.91195
	EO02	4.4000	.82669
	EO03	4.0400	.97114
	EO04	4.2700	.80019
	EO05	4.3850	.84875
	EO06	4.3450	.79948
Entrepreneurial Experience (EE)	EE01	3.8750	1.12949
	EE02	3.8600	1.14760
	EE03	3.9600	.99668
	EE04	4.0000	1.01744
Access to Capital (AC)	AC01	3.6400	1.33390
	AC02	4.1100	1.11540
	AC03	3.7450	1.23597
Technopreneurial Intention (TI)	TI01	4.0700	1.02976
	TI02	3.8450	1.16954
	TI03	4.1400	.96178
	TI04	4.1650	.92849
	TI05	4.0550	1.02823
	TI06	4.1250	1.01217

Legend: $\bar{x}$= Mean; σ= Standard Deviation

As shown in Table III, the individual item analysis, the Computer Ability of engineering students has the highest rating in item CA01 in creating documents in a word processor ($\bar{x}$=4.6; from Likely to Very Likely), while they have the lowest rating on item CA04 on having difficulty in reading a program ($\bar{x}$ =3.85; from Neutral to Likely). In their Entrepreneurial Experience they have the highest score in item EE04 which assessed how knowledge helped them to know how business work and it makes them comfortable ($\bar{x}$=4.00; Likely on Likert Scale), while they score the lowest in the item EE02 regarding professional experience helping them in identifying their client's

Table 4 :Pearson Correlation Analysis And Reliability

	α	Mean	Std. Deviation	CA	IA	EO	EE	AC	TI
CA	.802	4.2400	.71369	1.00					
IA	.794	4.2950	.62121	.669**	1.00				
EO	.858	4.2817	.65917	.614**	.692**	1.00			
EE	.942	3.9238	.99155	.626**	.625**	.667**	1.00		
AC	.875	3.8317	1.10175	.688**	.596**	.598**	.696**	1.00	
TI	.935	4.0667	.89011	.634**	.529**	.555**	.528**	.667**	1.00

Legend: α: Cronbach's Alpha; CA: Computer Ability;
IA: Internet Ability; EO: Entrepreneurial Orientation;
EE: Entrepreneurial Experience; AC: Access to Capital;
TI: Technopreneurial Intentions;
**: Correlation is significant at level <0.001 (Two-tailed)

Table 5 : Correlation Coefficient Interpretation

Value of Correlation Size	Analysis
0.90 - 1.00 (-0.90 - -1.00)	Very High Positive (-) Correlation
0.70 - 0.90 (-0.70 - -0.90)	High Positive (-) Correlation
0.50 - 0.70 (-0.50 - -0.70)	Moderate Positive (-) Correlation
0.30 - 0.50 (-0.30 - -0.50)	Low Positive (-) Correlation
0.00 - 0.30 (0.0 - -0.30)	Insignificant Correlation

Source: Hinkle DE, Wiersma W, & Jurs SG (2003)

Table 6 : Rule of Thumb For Cronbach's Alpha

Cronbach Alpha Value	Strength of Association
Less than 0.6	Poor
0.6 - <0.7	Moderate
0.7 - <0.8	Good
0.8 - <0.9	Very Good
Greater than or equal to 0.9	Excellent

Source: Hair et.al (2003)

problem ($\bar{x}$=3.86). Lastly, in terms of financial access of the engineering students, they score the highest in item AC02, where an individual's family business can be a factor for them to create a new venture ($\bar{x}$ =4.11), while they rated lowest on item AC01, where an individual will most probably receive financial support from their family when they start a business ($\bar{x}$ =3.875).

From the results of Pearson Correlation Analysis, the correlations between all independent variables were moderately positive and significant. While reliability analysis shows that the questionnaire items of independent variables and dependent variable ranges from Good to Excellent.

The values correlation coefficient (r) for independent variables ranges from (r=.596; sig <0.01; IA to AC) as the lowest, to (r=.696; sig <0.01; EE to AC) as the highest. Moreover, the independent variables (CA, IA, EO, EE, AC) were all moderately positive and significant to the dependent variable (TI). The highest correlation was found between AC and TI (r=.667; sig <0.01) while the weakest correlation was found between EE and TI (r=.528; sig <0.01). Since none of the calculated values of r were higher than 0.9, the results show that there is no multicollinearity between the variables (Pallant, 1996). Furthermore, the values of Cronbach Alphas (α) ranges from (α=0.794; IA) as the lowest, too (α=0.942; EE) as the highest and shows internal consistency on all items from Good to Excellent.

E. Pearson Correlation Analysis

Multiple Regression Analysis was used to test the five hypotheses to determine which predictors are significant to the technopreneurial intentions of engineering students, and the results are indicated in Table VII.

Table 7 : Multiple Regression Results

Model	STD Beta (β)	t	Sig.	Tolerance	VIF
1					
CA	.285	4.298	<.001	.450	2.223
IA	.071	1.028	.305	.410	2.440
EO	.108	1.544	.124	.404	2.475
EE	.258	3.562	<.001	.379	2.638
AC	.214	3.439	<.001	.512	1.954

F Statistics: (F (5,194) = 62.086, p<0.05; sig<0.001)
R Square: 0.615

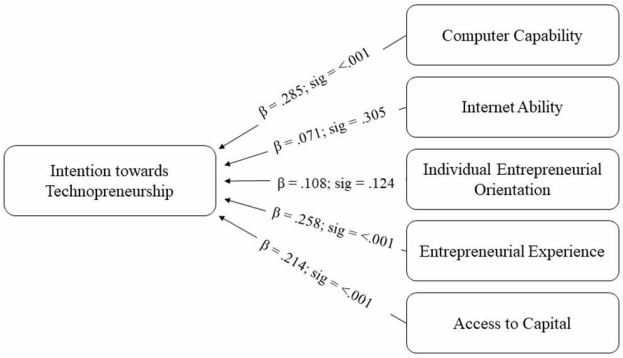

Fig. 2: Multiple Regression Results

In table XI, it shows that the overall study model was statistically fit (F statistics = 62.086; sig. <.001) by having a large value of F. The R2 = 0.565 indicates that 61.5% of the variance of technopreneurial Intention was explained by the predictors (Computer Ability, Internet Ability, Entrepreneurial Orientation, Entrepreneurial Experience, and Access to Capital). The results show that, the Computer Ability (β=.285; sig.= <.001), Entrepreneurial Experience (β=.258; sig.= <.001), and Access to Capital (β=.214; sig.= <.001) significantly affect the intention towards technopreneurship with a positive correlation. As a result, the hypotheses H1, H4, H5 were accepted.

F. Findings

After data analysis, the researchers interpret the data for each school. Entrepreneurial Orientation (sig.=.041) was the only factor that influences technopreneurial intentions for engineering students from PUP. While engineering students from RTU

indicated that Computer Ability influences intention towards technopreneurship (sig.=0.006). Additionally, results show that Computer Ability and Access to Capital were the most influential factor in technopreneurial intention of TCU students with a score of (sig.=0.29) and (sig.=0.16), respectively. Lastly, engineering students of TUPT believe that Entrepreneurial Experience is the sole factor that promotes technopreneurial intention with a score of (sig.=0.005)

Overall, three factors have been identified to have a significant effect to the intention towards technopreneurship of engineering students from selected universities, namely: Computer capability, Access to Capital, and Entrepreneurial Experience with a score of (sig. = <0.001) for all. As for the rankings, from the coefficient table (Table XI) they find that Computer Ability of an individual is the most influential factor among the three (β = .285) wherein every 1 unit in Computer Ability accounts for .285 units in technopreneurial experience. Secondly there was the Entrepreneurial Experience of an individual (β = .258), wherein every unit increase in Entrepreneurial Experience, the intention of being technopreneur as a career path increases by .258 units. Lastly, in terms of Access to Capital of an individual (β = .214), a unit increase increases technopreneurial intention by .214.

G. Practical Implications

The findings were able to analyze computer capability as a factor for technopreneurial intention which conformed to the discussion of prior studies of Aesert et al. (2017), Windarata (2014), and Okorie et al. (2014). According to Hidayat and Yunus (2019), technological proficiency or the capacity to utilize technology efficiently is inextricably linked to entrepreneurial since it equips entrepreneurs to deal with Industrial Revolution 4.0 that promotes further use of technology in a workplace. As a result, students were presumed to be adept and skilled at using the computer in an effective method. Since ICT is inextricably linked to technopreneurship, they must be familiar with the significance of ICT before they enter technopreneurial venture. Furthermore, the research was able to show that Entrepreneurial Experience (EE) has a strong influence on technopreneurial intention which is supported by discussions from previous studies of Kautonen et al. (2011), Miralles et al. (2016), and Zapkau et al. (2015). It implies that prior entrepreneurial experience is integral in gaining knowledge and skills needed to boost technopreneurial intention especially before embarking in technopreneurship. Lastly, Access to Capital has also been found to be a significant factor as explained in studies by Aragon-Sanchez et al. (2017) and Sandhu et al. (2011). Access to capital or the availability of resources is a strong determinant of a student's technopreneurial intention as it is perceived by students to be an important in starting a business and crucial to its success.

H. Social implications

Learning institutions should design an advanced curriculum that will support technopreneurship. The curriculum should prioritize developing creativity and analytical thinking, promoting innovation and most especially, the utilization of technology. Moreover, learning institution should have reliable employees that are competent of implementing new learning method for entrepreneurial education. With the collaboration initiated by CHED and a non-profit organization in the Philippines, Technopreneurship 101 was established to encourage science and engineering students to pursue entrepreneurial and Research & Development career opportunities. The program is based on PhilDev's entrepreneurial courses, which encompasses subjects including entrepreneurship fundamentals, conceptual design, feasibility and distinctiveness, market analysis, and company strategy development. They also introduced Technopreneurship 101 at all 539 Higher Education Institutes (HEIs) throughout the Philippines that provide engineering programs.

The government's responsibility in developing various technopreneur should really be addressed. The authorities should be the driving force behind the country's development of technopreneurship. To illustrate, government initiatives in encouraging technopreneur include creating a favorable market environment and implementing the tactical and systematic method (Okorie et al., 2014). In addition, the government should initiate and provide programs such as funding and granting capital that will support aspiring students who have interest to venture technopreneurship.

5. Conclusion

The researchers conclude that the Computer Ability, Access to Capital, and Entrepreneurial Experience of an individual significantly affect an

individual's technopreneurial intention while the Internet ability and Entrepreneurial Orientation are statistically insignificant.

Consequently, this study not only supports the statement of Hoque et al. (2017) that the self-efficacy of an individual had a substantial and favorable effect on their intention to pursue careers as technopreneurs, but also add another predictor (Computer Ability). The findings of this research further support the study of Aragon-Sanchez et al. (2017) that students with better access financially have a stronger technopreneurial intent not just on secondary students but also to the tertiary students

On the other hand, the results also imply that most of the engineering students are literate in creating documents in word processors but lack in program-reading. Families of these individuals will most likely encourage them in creating a business than providing financial support when they start a business venture. Also, they agreed that having knowledge of the business allows them to feel at ease at their job because they understand how it operates.

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