Impact of Information and Communications Technology on Technopreneurial Intention among Engineering Students

Zachariah John Belmonte, Rexmelle Decapia Jr., Kurt Emmanuel Tu, Missy Joy Lavado, Mark Neil Junio, and Pamela Eyre Victoria Lira

***Abstract*—Information and Communications Technology Self-efficacy is an essential factor in promoting technopreneurial interest and fostering technopreneurial competence. This study focuses on the impact of Information and Communications Technology Self-Efficacy on technopreneurial Intention, which technopreneurial Learning mediates. The researchers used an explanatory survey as the research method and gathered 200 selected participants from engineering students in the Philippines during COVID-19 Pandemic. The collected data was analyzed using Structural Equation Modelling (SEM). The results show that Information and Communications Technology Self Efficacy has a positive and significant effect on both technopreneurial Intention and technopreneurial Learning. Additionally, this study established that technopreneurial Learning mediates the relationship between Information and Communications Technology Self Efficacy and technopreneurship Intention. The result indicates that boosting Information and Communications Technology Self-Efficacy and technopreneurship Intention Learning will be more successful in improving technopreneurship Intention.**

***Index Terms*—ICT, self-efficacy, structural equation modeling technopreneurial intention, technopreneurial learning.**

I. Introduction

Over the last fifty years, the vast advancement of technology has evidently impacted our daily lives, especially in terms of business and economic growth [1]. In recent years, there has been an increase in technology enterprises that have contributed to the economy and created jobs attributed to university-based technology entrepreneurial activities and programs [2]. With the introduction of the internet, the information age has become an advantageous environment for entrepreneurs [1]. This has led to the emergence of technology entrepreneurship also known as technopreneurship which is a new type of entrepreneurship primarily focused on technology [3]. Furthermore, new technologies like the internet have become a strategic point in the process of the industrial revolution 4.0, especially in entrepreneurship where it is often referred to as the electronic business revolution or Electronic Business [4].

Technopreneurship Intention is crucial to research since it leads to increased economic efficiency, market innovation, new job creation, and job maintenance [5]. technopreneurship is one of the primary foundation areas of entrepreneurship in the ICT age as it creates a competitive advantage in various enterprises and organizations, with its primary reasons being reconstruction, economic growth, and addition of value to businesses to achieve sustainability [1]. Hence, a technopreneur can be defined as an entrepreneur who is tech-savvy and uses technology business opportunities through talent, cash investment, and real-time decision-making skills for entrepreneurship [6].

One theory shows that technopreneurial learning is an experiential process wherein a technopreneur learns knowledge through four different learning abilities: experiencing, reflecting, thinking, and acting [7]. When it comes to building entrepreneurial interest, self-efficacy becomes a crucial factor. A study revealed that individuals who were more likely to engage in entrepreneurial behavior are those with a high level of entrepreneurial self-efficacy [8]. Self-efficacy refers to beliefs about one's capabilities to learn or perform behaviors at designated stations [9] and is proposed to influence individual choices, goals, emotional reactions, effort, coping ability, and persistence [10]. Entrepreneurial self-efficacy may consist of deliberation of tasks related to the launch and development of new initiatives in entrepreneurship. This relationship between self-efficacy and technopreneurship is then associated with the concept of ICT. The concept of ICT self-efficacy (ICTSE) implies how individuals see themselves regarding their ability to utilize ICT. Moreover, it plays a positive and crucial role in an individual's decision to adopt and use ICT [11], [12]. There have been numerous studies on the relationship between ICT Self-Efficacy, Technopreneurship Intention, and Technopreneurial Learning [13], however, little is known on the relationship between the three variables.

This research intends to examine the impact of ICT self-efficacy on technopreneurship Intention which is mediated by Technopreneurial Learning. Furthermore, this study aims to enhance and expand knowledge on ICT Self-Efficacy, Technopreneurial Learning, and

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Zachariah John Belmonte is with the Mechanical Engineering and Allied Department of the Technological University of the Philippines, Philippines (e-mail: zachariahjohn_belmonte@tup.edu.ph).

Rexmelle Decapia Jr. is with the Mechanical Engineering and Allied Department of the Technological University of the Philippines, Taguig Campus, Philippines (e-mail: rexmelle.decapia@tup.edu.ph).

Kurt Emmanuel Tu is with Mechanical Engineering-Straight Engineering Program in Technological University of the Philippines, Philippines (e-mail: kurteman.tu@gmail.com).

Missy Joy Lavado and Mark Neil Junio are with the Technological University of the Philippines Taguig-Campus, Philippines (e-mail: missyjoy.lavado24@gmail.com, markn1918@gmail.com).

Pamela Eyre Victoria Lira is with the University of the Philippines Diliman, Philippines.

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Technopreneurship Intention Literature and contribute to a better understanding of Technopreneurship Intention.

II. Research Method

A. Data Collection

In abidance with the lockdown implementation to prevent the spread of COVID- 19 in Metro Manila as imposed by the local government [14], [15], data was gathered through an online survey questionnaire for the safety of both the researchers and respondents. To assess the impact of ICT self-efficacy on technopreneurship intention mediated by technopreneurial learning, the researchers prepared questions that can be answered using a 5-point Likert Scale. The first five questions were about their ICT Self-efficacy, the next five about their intention of pursuing technopreneurship, and the last five on their knowledge of technopreneurial learning. The survey was prepared using Google Forms and was disseminated via email and other social media platforms.

B. Theoretical Framework

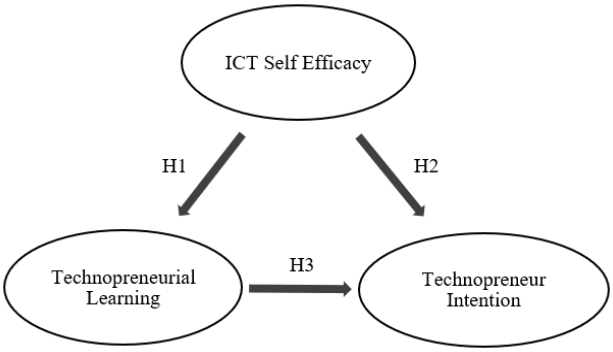

Fig. 1. Research framework.

C. Hypothesis Development

The researchers proposed to determine the effect of ICT Self-Efficacy on Technopreneurship Intention of its learning mediation based on the responses of the targeted students and using the theoretical framework provided in this study. Using the three main elements in Fig. 1 (ICT Self Efficacy, Technopreneurial Learning, and Technopreneur Intention), the researchers can effectively specify which key variables influence the concept behind it.

As a result, the following hypothesis was proposed:

H1: ICT self-efficacy has a positive influence on technopreneurs' learnings

ICT self-efficacy in terms of the usage of information systems refers to a user's perception that they are capable of using information systems, which has a significant impact on users' willingness to embrace such systems [16], [17]. Likewise, it refers to a person's assessment of their ability to use computers and the internet [18]. Computer and internet self-efficacy are the two capability domains that make-up ICT Self-Efficacy [19].

H2: ICT self-efficacy has a positive influence on technopreneurs' intention

Technopreneurial learning indicators used are contextual learning, personal and social emergence, and negotiated enterprise. The first one refers to the use of entrepreneurial knowledge in the long run which is eventually influenced by motivation, emotions, attitude, and personality [20]. The second specifies the interactive exchange of ideas and goals with other individuals carried out in a business context [21]. Finally, the last one defines the development of entrepreneurial identity together with career formation and social relations [22].

H3: Technopreneurial learning is significantly and positively related to technopreneurial intention

Individual Entrepreneurial Orientation (IEO) and ICT Self-Efficacy have direct and indirect implications on Technopreneurial Intention [5]. Technopreneurial Self-Efficacy and Technopreneurial Intention have a good and significant relationship [23], therefore it is projected that Technopreneurial Learning mediates the relationship between Technopreneurial Self Efficacy and Technopreneurship Intention [24].

D. Sample Profile

The researchers were able to gather 200 respondents composed of engineering students from different schools and universities in the Philippines. The respondents were categorized based on gender and age. Table I below summarizes the demographic profiles of respondents.

TABLE I: Summary of Demographic Profile of Participants

Variable	Category	Number (N)	Percentage (%)
Gender	Male	84	42%
	Female	116	58%
Age (in years)	17	1	0.5%
	18	4	2%
	19	37	18.5%
	20	89	44.5%
	21	43	21.5%
	22	10	5%
	23	11	5.5%
	25	1	0.5%
	26	2	1%
	27	1	0.5%
	31	1	0.5%

E. Research Instruments

Using the framework presented above, the researchers created a set of questionnaires (Table II) that respondents answered without an interviewer to determine the effects of Self Efficacy ICT on engineering students in the Philippines. It consisted of four sections:

1) Personal information of the respondents such as name (optional), age, and gender.
2) Information and Communication Technology Self Efficacy (5 items).
3) Technopreneurial Intention (5 items).
4) Technopreneurial Learning (5 items).

The researchers used a 5-point Likert scale to assess the latent constructs included in our theory.

F. Data Analysis

Using the Structural Equation Modelling (SEM) Analysis the hypotheses were tested using AMOS 26 and SPSS software with the data calculated using SEM. To examine whether the model was robust, the researchers used the confirmatory factor analysis with the following measurement

indices, namely: Goodness of Fit Index (GFI), Comparative Factor Index (CFI), Adjusted Goodness of Fit Index (AGFI), Tucker Lewis Index (TLI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation (RMSEA), and Minimum Discrepancy (CMIN/DF).

TABLE II: QUESTIONNAIRES FOR LATENT CONSTRUCTIONS

Construct	Items	Measures	Reference
Information and Communication Technology Self Efficacy	ISE1	I can easily recover my email /social networking account if I forget the password.	[25]
	ISE2	I can easily report a fake account pretending to be me.	
	ISE3	I can easily access the internet world.	
	ISE4	I feel confident using the computer to write a letter or essay.	
	ISE5	I can easily control the privacy settings of social networking sites that I mostly use (e.g., Facebook, Twitter, Skype, WhatsApp, Viber, etc.)	
Technopreneurial Intention	TI1	I am ready to do anything to be a technopreneur.	[26]
	TI2	My professional goal is to become a technopreneur.	
	TI3	I will make every effort to start and run my own technology-based firm.	
	TI4	I am determined to create a technology-based firm in the future.	
	TI5	I have the firm intention to start a technology-based firm someday.	
Technopreneurship Learning	TL1	Technopreneurship contributes to economic development.	[27]
	TL2	Technopreneurship can make someone self-independent.	
	TL3	Technopreneurship education has enabled me to identify business-related opportunities.	
	TL4	Through technopreneurship education, my skills, knowledge, and interest in entrepreneurship have all improved.	
	TL5	Technopreneurship education activities have stimulated my interest in technopreneurship.	

III. RESULTS

Based on the responses of our participants, the hypotheses of this research were empirically observed. Fig. 2 shows the SEM results for evaluating the influence of ICT self-efficacy on Technopreneurial Intention mediated by Technopreneurial Learning among Engineering students in the Philippines. Using AMOS 26 and SPSS software, it was able to show the relationships of the model by determining the factor loadings as well as the estimates of the path coefficients (β). As shown in Fig. 3, our model's path coefficient (β) showed a positive relationship with each other, notably in ICT self-efficacy to Technopreneurial Learning and Technopreneurial Intention, with values: β = 0.53, 0.45 and P = 0.001, 0.001; respectively. Although the results on the correlation of Technopreneurial Learning and Technopreneur Intention was the lowest, it still implies that Technopreneurial Learning is significantly and positively related to technopreneurial intention (β = 0.15, P < 0.068). Table III shows the summary of the mean, standard deviation, and factor loading results of our model. Additionally, to observe the measure of constructs exhibiting internal consistency, Cronbach's alpha was included in the table. All values greater than 0.70 indicate good reliability. Table IV sums up the path analysis of the SEM where it can be observed that all the paths with the latent variables are significant. Furthermore, Table V shows the list of the model fit of the SEM and how the model fits the data (GFI = 0.909, CFI = 0.974, AGFI = 0.875, TLI = 0.968, IFI = 0.974, RMSEA = 0.056, CMIN/DF = 1.684).

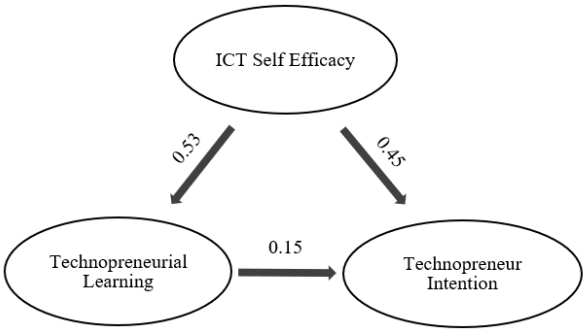

Fig. 2. Analytical results of model.

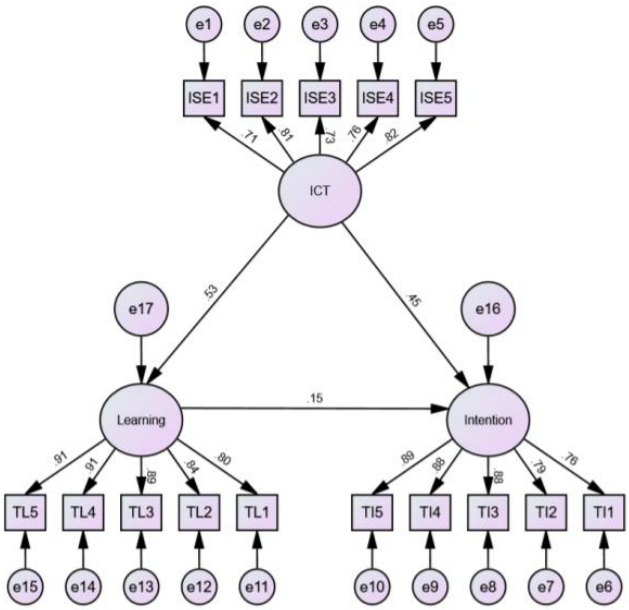

Fig. 3. Standardized regression weights for every path model.

TABLE III: STATISTICAL DESCRIPTIVE RESULTS

Factor	Item	M	SD	α	Factor Loading
ICT Self-Efficacy	ISE1	4.11	1.039	0.876	0.71
	ISE2	3.96	0.981		0.81
	ISE3	4.21	0.942		0.73
	ISE4	4.18	0.943		0.76
	ISE5	4.11	1.006		0.82
Technopreneur Intention	TL1	3.48	0.919	0.923	0.76
	TL2	3.33	0.913		0.79
	TL3	3.48	0.961		0.88
	TL4	3.62	0.928		0.88
	TL5	3.53	0.956		0.89

Technopreneurial Learning	TI1	4.14	0.932	0.941	0.80
	TI2	3.92	0.960		0.84
	TI3	3.93	0.961		0.89
	TI4	3.88	0.972		0.91
	TI5	3.93	0.966		0.91

TABLE IV: PATH ANALYSIS FOR SEM

Hypothesis	Estimate	S.E.	C.R.	P
ICT Self Efficacy ← Technopreneurial Learning	0.536	0.083	6.438	***
ICT Self Efficacy ← Technopreneur Intention	0.430	0.088	4.906	***
Technopreneurial Learning ←Technopreneur Intention	0.138	0.075	1.824	0.0680

TABLE V: MODEL FIT

The goodness of Fit Measurement	Estimates	Cut-off	Reference
The goodness of Fit Index (GFI)	0.909	>0.8	[28]
Comparative of Fit Index (CFI)	0.974	>0.90	[29]
Adjusted Goodness of Fit (AGFI)	0.875	>0.80	[28]
Tucker Lewis Index (TLI)	0.968	>0.90	[30]
Incremental Fit Index (IFI)	0.974	>0.90	[29]
Root Mean Square Error of Approximation (RMSEA)	0.059	<0.08	[31]
Minimum Discrepancy (CMIN/DF)	1.684	<5	[32]

IV. DISCUSSION

The goal of this study was to evaluate the impact of ICT Self-Efficacy on technopreneurial intention, mediated by technopreneurial learning among Engineering Students in the Philippines, and proposes to test the relationships between ICT self-efficacy, technopreneurial learning, and technopreneurial Intention using the concept of Structural Equation Modelling (SEM).

Based on the findings, the engineering students in the Philippines revealed that ICT (Information and Communications Technology) self-efficacy has a significant and positive impact on their Technopreneurial Intention and technopreneurial learning which therefore strengthens the relationship between the two. This result is consistent with previous literature [23] which presented a positive relationship between ICT self-efficacy and technopreneurial intention, mediated by technopreneurial learning. This indicates that students' technopreneurship intentions are strengthened by their belief in using the internet and computers driven by technopreneurial learning. The hypotheses derived by the researchers from their framework were also supported by similar findings [33], [34], where it was noted that student self-efficacy has the most significant and positive impact on a student's intention to become a technopreneur.

Furthermore, various research on ICT self-efficacy and technopreneurial learning have found a positive correlation between personality, nature, self-confidence, and communication abilities, influencing students' career paths [13]. The analysis was also able to show that most engineering students believed the help of technopreneurship education improved their skills, knowledge, and interest in entrepreneurship. Likewise, they viewed technopreneurship education activities as catalysts to their interest in entrepreneurship. However, one of their problems in ICT is their lack of knowledge in recovering social media accounts. From here, it entails that developing ICT Self-Efficacy and Technopreneurship Learning will be more effective in improving Technopreneurship Intention and Filipino students will be encouraged to pursue a career as a technopreneur through digital-based and entrepreneurial activities.

However, this study only focused on 200 engineering students in the Philippines, which is its fundamental limitation. The statistical analysis with the SEM was solely evaluated by factor analysis where factor loadings and path coefficients were tested, as well as the model of fit test which were all reported in the results. Therefore, an increase in the number of participants would improve the reliability of the data. Additionally, future research should also explore other fields and courses from different universities to assess the technopreneurial intention of students for a more robust analysis.

A. Theoretical Contributions

Similar to the results of previous literature, the findings revealed that ICT Self-efficacy has a positive and significant effect on technopreneurial intention and that technopreneurial learning aids in mediating the relationship between the two elements. Furthermore, this study provided information on the factors that determine engineering students' technopreneur intentions which may contribute to broadening the knowledge on ICT Self-efficacy and technopreneurial learning to understand Technopreneurship Intention better.

B. Practical Implication

The data suggest that providing a higher level of ICT Self-efficacy and technopreneurial activities will yield better outcomes on the technopreneurial intentions of the students in higher education. This is beneficial for universities and educational planners as they can utilize this to identify suitable ICT programs that can be incorporated into their curriculums to increase ICT education. Improving the curriculum and developing ICT programs aid in fostering students to become technopreneurs as it stimulates students' interest in entrepreneurship. In today's digital age, the results may encourage students to use their internet access to nurture their knowledge and develop vital skills through entrepreneurial activities that will guide them in becoming effective technopreneurs.

V. CONCLUSION

From the results, it can be concluded that Information and Communications Technology self-efficacy has a direct and positive effect on Technopreneurial Intention. Information and Communications Technology self-efficacy significantly affects Technopreneurial Learning, and Technopreneurial Learning showed a significant contribution in mediating the relationship between Information and Communications Technology self-efficacy and Technopreneurial Intention.

These findings imply that incorporating Information and Communications Technology in technopreneurial learning will also help in boosting the Technopreneurial Intentions of students. Upon utilizing Structural Equation Modelling (SEM) as the main statistical analysis method, the researchers conclude that the model presented is suitable. The study suggests that developing Technopreneurship Intention will be more successful if Information and Communications Technology Self-Efficacy and Technopreneurship Intention Learning are improved.

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTIONS

Conceptualization, Zachariah John Belmonte and Rexmelle F. Decapia; methodology, Zachariah John Belmonte and Missy Joy Lavado; software, Zachariah John Belmonte and Rexmelle F. Decapia; validation, Pamela Eyre Victoria Lira, Zachariah John Belmonte and Rexmelle F. Decapia; formal analysis, Zachariah John Belmonte and Mark Neil Junio; investigation, Kurt Emmanuel Tu and Pamela Eyre Victoria Lira; resources, Rexmelle F. Decapia, Missy Joy Lavado, and Zachariah John Belmonte; data curation, Pamela Eyre Victoria Lira and Zachariah John Belmonte; writing—original draft preparation, project administration, Zachariah John Belmonte; funding acquisition, Zachariah John Belmonte All authors have read and agreed to the published version of the manuscript.

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Zachariah John Belmonte is currently a faculty member of the Mechanical Engineering & Allied Department under the Nondestructive Testing Technology Section in one of the leading engineering schools in the Philippines, The Technological University of the Philippines (TUP). He received his diploma in non-destructive testing engineering technology & with the degree of bachelor of engineering major in manufacturing and production from TUP. He took his Master of Science and currently taking his Doctorate Degree under College of Industrial Engineering and Engineering Management at Mapúa University- Manila, Philippines.

Rexmelle F. Decapia Jr., Ph. D. is a licensed mechanical engineer and the head of the Mechanical and Allied Department of the Technological University of the Philippines-Taguig Campus. He has been teaching for more than 12 years handling professional undergraduate courses and graduates of Mechanical Engineering and other allied programs in various universities. Dr. Decapia holds a degree in BS in mechanical engineering (2007) and graduated cum laude from the Technological University of the Philippines-Taguig. He obtained a master's degree in Technology Management under a scholarship program from the Department of Science and Technology- Science Education Institute (DOST-SEI). He also earned his Doctor of Philosophy in Energy Engineering under a scholarship program from Engineering Research and Development for Technology (DOST-ERDT). Both degrees were earned from the University of the Philippines- Diliman. His current research works involve various renewable energy resources, ocean wave resource exploration (resource assessment, modeling, and utilization), ocean modeling, and coastal engineering.

Kurt Emmanuel B. Tu is currently taking up the bachelor of science in mechanical engineering-straight engineering program at one of the campuses of the prestigious Technological University of the Philippines located in Taguig. He is a consistent dean's lister and is currently in the second year of his department's 4-year program. He finished high school at one of the two science high schools in Taguig, Senator Renato Compañero Memorial Science and Technology High School (SRCCMSTHS). He considers basketball and calisthenics as his favored sport among others with playing online games and chess close behind.

Missy Joy V. Lavado is currently a student at the Technological University of the Philippines Taguig-Campus. She is currently a 2nd-year student taking a bachelor of science in mechanical engineering. For her senior high school level, she graduated at Moreh Academy taking STEM (Science, Technology, Engineering, and Math) Strand. Awarded as the Most Amiable student and became included in With Highest Honors List. Board games like Chess, Game of Generals, and Scrabble are the things that she considers her hobby. She likes to play these games in her free time.

Mark Neil T. Junio is currently a 2nd-year student at Technological University of the Philippines – Taguig Campus taking up a bachelor of science in mechanical engineering. He finished his Senior High School level at Taguig Science High School and received extracurricular awards and became included on the honor roll of the student's list. Some of his hobbies in sports like cheerleading, playing musical instruments, mobile games, bicycle rides. and traveling in and out of the Philippines.

Pamela Eyre Victoria R. Lira is currently a 3rd-year student at the University of the Philippines Diliman taking up a bachelor of science in geology. She graduated high school with high honors and as a scholar at Philippine Science High School – Eastern Visayas Campus where she was also a consistent director's lister. Her knack for writing has made her garner awards in national press and media competitions, research competitions in the Philippines, and conferences abroad.