

The Role of Educational Institutions in the Improvement of Engineering Education in Thailand: Mediating Role of Student's Motivation

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Abstract:

This study is about examining the role of educational institutions in the improvement of engineering education in Thailand with the help of mediating impact of students' motivation. The role of education includes skilled teachers, well operational labs and suitable environment for the education in the university. University students of graduation were the respondents of the study and data were gathered with help of survey questionnaires. The analysis was accomplished with the help of SMART-PLS by using PLS-SEM technique. The results found positive link between the role of education such as skilled teachers, well operational labs and suitable environment with engineering education. The results also reveal that students' motivation mediates the relationship among the skilled teachers, well operational labs, and a suitable environment with engineering education. The present study suggested to the policymakers that they should improve the role of universities in terms of engineering education that motivates the students towards engineering education.

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I. INTRODUCTION

The globalization of the world changes the thinking of the people and also their living standards in this modern world (Haseeb, Suryanto, Hariyatie, & Jermisittiparsert, 2019). The changing in the world to become it modern is due to the engineers who developed different things that made life easy and modern. The involvement of engineering is now in almost every sector of the society such as agriculture, banking, education institutions, automobile, health sector, and marketing. Engineering has prominently impacted in the sector of marketing nowadays (Biswas, 2012). Marketing is the business or action of the business in which we promoting as well as selling the products and services of the business. This promotion of goods and services has been doing in a modern and advanced way by the help of engineering that is more effective to attract the customers to the products of the business (Berglund & Grimheden, 2011). For example, internet is one of the outputs of software engineers, and in this advance world most of the businessmen use this internet for the marketing of their goods and services to attract the

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customers to the products of the business (Marra, Rodgers, Shen, & Bogue, 2009). This can be done by the people by using their computer system, and smartphone both of them are also the output of engineering. Presently, another way of earning and promoting yourself is the website developing. Most of the people created website and provided online services and earn money for their work or services (Council, 2012). Most of this type of websites are famous such as "Fiverr" that is used by millions of the people on a daily basis and provide and receive millions of services such as graphic and web designing, promotion of goods, sound cloud works, application designs and writing businesses (Duka & Zeidmane, 2012). On the other hand, engineering is also helpful for the customers who can demand and purchase through internet by using their mobile, and both are the output on engineers not only in the country but also other countries of the world (Singer & Smith, 2013). Moreover, business also uses the internet to connect people such customers, employees of different branches, and suppliers of the business. The stronger and quicker connection helps the business to groom in the

market, and that is possible through engineering output such as mobile, internet, computer system etc.

Figure 1 given below mentioned the importance of software engineering in terms of the number of users in Thailand. These figures only mentioned the importance of software engineering in terms of social media. The users of face-book only in one month in Thailand are more than 2 billion. On the other hand, the users of you-tube only in one month in Thailand are more than 1.5 billion. In addition, the users of “WHATS APP” and face-book messenger only in one month in Thailand are more than 1.2 billion. Moreover, the users of “WECHAT” only in one month in Thailand are more than 889 million. Furthermore, there are around 700 million users of “INSTAGRAM” only in one month in Thailand. Additionally, there are about 328 million users of “TWITTER” only in one month in Thailand. Finally, there are around 255 million users of “SNAPCHAT” only in one month in Thailand. These figures mentioned that too many people are affiliated with the products of software engineering and need to improve this sector with time. All figures mentioned above are given below in Figure 1:

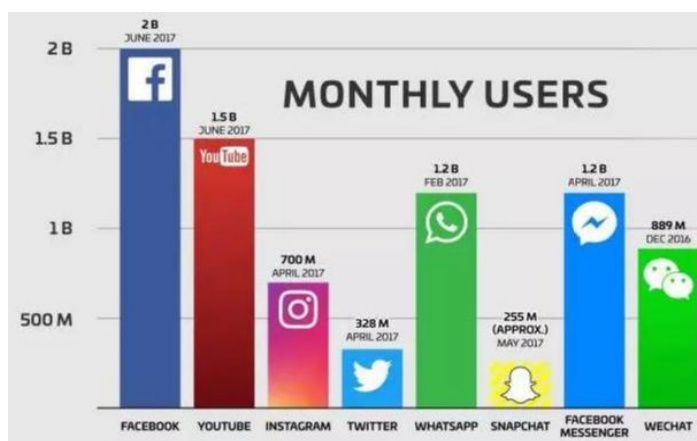


Figure 1

Users of Social Media in Thailand

The department of health also depends on the output of engineering in every country of the world because the achievement of the goals about the health status regarding the patients is only possible through the modern invention of engineering sector. A lot of instruments that are used in the hospital are the massive output of engineering. The instruments that are used by the doctors at the time of surgery are existed due to the long efforts of the engineers. Some of the examples of these instruments are surgical lamps, scalpel, stethoscope, and many of other necessary instruments that are only made by the professional engineers of the world. A sometimes manual checkup is not enough to diagnose the illness of the patient then doctors use the computers to diagnose the reason of disease that is also the output of

engineers who developed the detector by applying the principles of engineering that automatically detect the problems in human body (Borrego, Froyd, & Hall, 2010).

In this modern world, education is an essential element of life for every person in the world, and the involvement of engineering is the vital element of the education. Engineering education exists in every education level from primary to tertiary level, and without engineering education, we cannot survive in this modern world. Almost everything depends on engineering education. Even in education institution many things exist only due to the engineers such as multimedia that we use to show the slides to the student during lecture is the output of engineering education. Moreover, computer labs, chemistry labs and other necessary items that are necessary for providing education to the students are the outcomes of engineering (Monteiro, Leite, & Rocha, 2019). In addition, many other things in the institution that makes comfortable the learning of the students are also the outcomes of engineering such as air-conditioners, lights, and electricity that makes the healthy environment for the students in the institution. The dominant player for the twenty-first century is the profession of engineering that made every ones' life comfortable and meaningful because it is very unique and different profession that has the ability to change the entire face of earth. Now, world is seeing clearly and very upgraded only due to the engineering profession exist in society. Engineering profession changes the whole world into modern society by providing different kinds of products and innovations. Although it is a very tough profession, it improves the mind of the learning and the person who adopt it as profession. Thus, for the improvement of the society and the requirement of modern world, there is need on high level that students will take the engineering field and also select it as a profession in his life.

The contribution of engineering is much prominent in the automobile industry in the world. Such as metallurgical engineers play a prominent role in the development of an engine that is an essential component for all the vehicles. Moreover, the piston, gears and other vital parts are the primary productions of metallurgical engineers. In addition, design of the car is also a significant contribution to engineering in the automobile industry in the world. The innovation in the automobile is another contribution of engineering in the manufacturing of the automobile. The latest version and model of the vehicles are the results of those innovations. Figure 2 given below mentioned the production and sale of automobile industry of Thailand from 2005 to 2014 and showed the increasing trend in the output that is the most significant output of engineers for the country. The domestic sales of automobile were 703 thousand units while exports sales were 441 thousand units in 2005. After slight

increase the local sales of automobile were 682 thousand units while exports sales were 539 thousand units in 2006. In addition, the domestic sales of automobile were 631 thousand units while exports sales were 690 thousand units in 2007. Moreover, the local sales of automobile were also increased and reached to 615 thousand units while exports sales were 776 thousand units in 2008. However, after slight decrease the domestic sales of automobile were 549 thousand units while exports sales were 536 thousand units in 2009. Conversely, after slight increase the local sales of automobile were 800 thousand units while exports sales were 896 thousand units in 2010. Additionally, after slight decrease the domestic sales of automobile were 796 thousand units while exports sales were 736 thousand units in 2011. In addition, after dramatic increase the local sales of automobile were 1436 thousand units while exports sales were 1026 thousand units in 2012. Moreover, the domestic sales of automobile were 1330 thousand units while exports sales were 1,128 thousand units in 2013. Furthermore, the local sales of the automobile were 1,200 thousand units while exports sales were 1,200 thousand units in 2014. These figures mentioned that the engineering is playing effective role in the field of automobile that is the reason the production, domestic, and export sale of automobile increasing day by day.

among all the subjects. Similarly, the interest of the students in information technology is around 13.3 percent of all the subjects. Likewise, the interest of the students in arts is round 11.8 percent among all the subjects. Additionally, the interest of the students in management is round 23.1 percent among all the subjects. Moreover, the interest of the students in political science is round 3.4 percent among all the subjects. In addition, the interest of the students in other subjects is round 10.8 percent among all the subjects.

The interest of Thailand Students in Different Subjects

S#	Sectors	Percentage Interest
01	Economics	10.8%
02	Medical	12.8%
03	Finance and Banking	14.1%
04	Engineering	10.8%
05	Information Technology	13.3%
06	Arts	11.8%
07	Management	23.1%
08	Political Science	3.4%
09	Other	1.3%

The above figures show that the interest of students in the universities of Thailand is very limited. Only 10.8 percent students are interested in the engineering while interest in other subjects is more than the engineering such as in medical 12.8 percent, in finance and banking 14.1 percent, in information technology 13.3 percent, in arts 11.8 percent and in management 23.1 percent. Thus, the engineering subject is essential for every field that is mentioned earlier in the study, but the interest of Thailand students in engineering is very limited even less than the other subjects that are the main reason of lack of engineers in the country. This is the leading cause of left behind by Thailand in the engineering sector. There is need to improve this sector for the improvement of all other sectors of the country, and this study explores this area and used engineering education as a primary variable.

Thailand Automotive Production 2004-2013

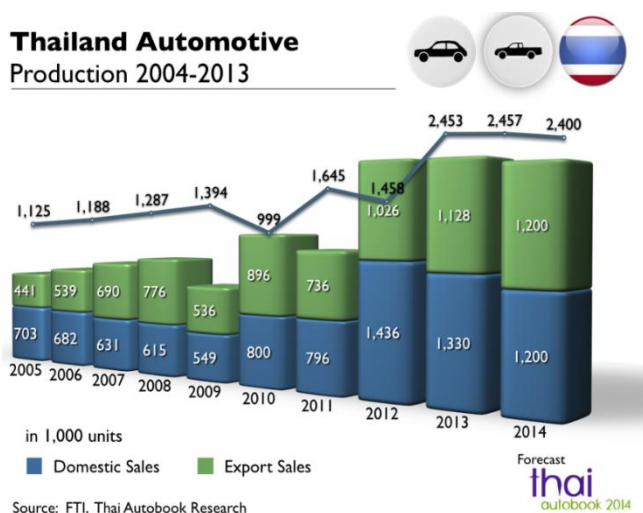


Figure 2

Production and Sale of Automobile in Thailand

Table 1 of the study shows the interest of the students in Thailand in different subjects. These figures show that the interest of the students in economics is round 10.8 percent among all the subjects. Moreover, the interest of the students in medical is around 12.8 percent among all the subjects. In addition, the interest of the students in finance and banking is round 14.1 percent among all the subjects. Furthermore, the interest of the students in engineering is round 10.8 percent

II. LITERATURE REVIEW

The critical review of previous studies has been taken in this section. It provides critical literature on understudy variables and their operational definitions. Moreover, the literature on all the relationships among the variables is also mentioned in this section.

Interest in Engineering Education

The interest of engineering education refers to the likeness and dis-likeness of the students regarding the engineering subject while studying at the university. Moreover,

“engineering education is the activity of teaching knowledge and principles to the professional practice of engineering. It includes an initial education (bachelor's and master's degree), and any advanced education and specializations that follow. Engineering education is typically accompanied by additional postgraduate examinations and supervised training as the requirements for a professional engineering license. The length of education, and training to qualify as a basic professional engineer, is typically 8–12 years, with 15–20 years for an engineer who takes responsibility for major projects and the likeness of this education is known as interest of engineering education”(Mirkouei, Bhinge, McCoy, Haapala, & Dornfeld, 2016). In addition, it also refers to the willingness of the students to take the engineering subject while studying at university level(Cunningham, Hoyer, & Sparks, 2015). Moreover, students’ likeness and willingness in the choice of engineering subject is referred to like the interest of students about engineering education. Furthermore, students choice always prefer while selecting the subject at university level and this choice depends about the students’ likeness and willingness that also refers to the interest of the students about the subject(Unlu, Dokme, & Veli, 2016). Similarly, interest of the student about engineering educations refers to the students’ choice about the selection of engineering subject at university level. Likewise, interest of the student about engineering educations refers to the students’ likeness about the selection of engineering subject at university level(Yoon, Dyehouse, Lucietto, Diefes-Dux, & Capobianco, 2014). Thus, interest of the student about engineering subject is necessary for the improvement of the engineering education in the study and present study take this construct as main construct of the study.

Skilled Teachers

Skilled teachers refer to the teachers that have the ability to build the students’ mind in the selection of any subject at university level(Lin, 2016). Moreover, it refers to the ability of the teachers that motivates the students towards the education of any type that is necessary for the country. In addition, “a teacher (also called a school teacher or, in some contexts, an educator) is a person who helps students to acquire knowledge, competence or virtue. Informally the role of teacher may be taken on by anyone (e.g. when showing a colleague how to perform a specific task)”(Connell, 2009).Furthermore, it refers to the person who have the ability to change the minds of the students in terms of subject selection in the university at the time specialization selection. Additionally, “skilled personal refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in

today’s world, particularly in collegiate programs and contemporary careers and workplaces”(Kazemi, Franke, & Lampert, 2009). Similarly, skilled personal are those who are ideal of the students and who have greater influence on the decisions of the careers of the students while they are taking decision regarding the course selection. Likewise, “the ability to use one’s knowledge effectively and readily in execution or performance, dexterity or coordination especially in the execution of learned physical tasks, a learned power of doing something competently, a developed aptitude or ability and skills”(Cannon, Kitchel, & Duncan, 2010).Thus, skilled personal such as teachers are necessary for the improvement of the engineering education in the study and present study take this construct as an independent construct of the study.

Well Operational Labs

It refers to the labs that are fully operational and well equipped or martial in terms of their operations that are ready to use for the students. In addition, “a laboratory operation may mean any of the following: Purchase or procurement of chemicals, supplies, equipment, or laboratory location for the unlawful manufacture of controlled substances. Transportation or arranging for the transportation of chemicals, supplies, or equipment for the unlawful manufacture of controlled substances”(Carlborg et al., 2010). Moreover, well operational labs refer to the lab that has all the material ready to use that is necessary for the students for the experiments(Inge et al., 2014). Furthermore, “labs a popular 'short-form' for laboratory work or other studies of analytics performed in a clinical laboratory Patient discussion about labs”(Voytenko, McCormick, Evans, & Schliwa, 2016). Similarly, labs that are well operational refers to the well martialled, properly managed and arranged lab that is easily excess able and all the experiments and function performed by the students perfectly. Likewise, “lab is a workplace for the conduct of scientific research. Laboratory, research lab, research laboratory, science lab, science laboratory. Bio lab, biology lab, biology laboratory - a laboratory for biological research. Chemistry lab, chemistry laboratory - a laboratory for research in chemistry” (Mitchell et al., 2012). Thus, well operational lab is necessary for the improvement of the engineering education in the study and present study take this construct as an independent construct of the study.

Suitable Environment

It refers to the environment that is suitable for the students of the universities for getting education in their specialized field(Sachs & Bernhard, 2011). Moreover, firstly, “environment means the sum total of all surroundings of a

living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damage”(Wikel, 2013). Secondly, suitable means adjustable for every person in the environment. In addition, “environment is radio waves and other electromagnetic radiation and magnetic fields. The environment of galaxy refers to conditions between the stars. In psychology and medicine, a person's environment is the people, physical things and places that the person lives with. The environment affects the growth and development of the person. Microeconomic environment, which affects business decision making - such as individual actions of firms and consumers - and the macroeconomic environment, which affects an entire economy and all of its participants”(Cocco, Agnelli, Gobran, & Corti, 2013). In education department, environment means the study environment in the university. “The natural environment encompasses all living and non-living things occurring naturally, meaning in this case not artificial. The term is most often applied to the Earth or some parts of Earth. This environment encompasses the interaction of all living species, climate, weather and natural resources that affect human survival and economic activity”(Manca & Ranieri, 2016). Thus, suitable environment is necessary for the improvement of the engineering education in the study and present study take this construct as an independent construct of the study.

Students' Motivation

Students' motivation refers to the willingness of the student to do or not to do something that is followed by the instructions of the teachers. In addition, it refers to the “act or process of giving someone a reason for doing something: the act or process of motivating someone: the condition of being eager to act or work: the condition of being motivated: a force or influence that causes someone to do something”(Tessier, Sarrazin, & Ntoumanis, 2010). Moreover, motivation of the students refers to the influence on decisions of the students by its parents and teachers. Furthermore, “motivation refers to behavior that is driven by internal rewards. In other words, the motivation to engage in a behavior arises from within the individual because it is naturally satisfying to you”(Lee & Reeve, 2012). Similarly, motivation of the students means to enhance the courage of the students in selecting any course regarding its education in the university. Likewise, “student motivation naturally has to do with students' desire to participate in the learning process. But it also concerns the reasons or goals that underlie their involvement or noninvolvement in academic activities”(Goodman et al., 2011). Furthermore, student's motivation means the increase the faith and courage of the students regarding subject matters(Acee & Weinstein, 2010). Thus, student motivation is

necessary for the improvement of engineering education in the study and present study take this construct as an independent construct of the study.

Skilled Teachers and Interest of Engineering Education

The interest of the student in engineering education can be developed by the skilled teachers of the institutions. There is a positive and significant link is found between the skilled teachers and the interest in engineering education in the universities of the world(Tran & Nathan, 2010). Moreover, skilled teachers are the essential element for the enhancement in the interest of engineering education in the education institution of the world. In addition, the effective skills of well-trained teacher are necessary for the improvement of students' interest in the subject of engineering in the universities(Kersting, Givvin, Sotelo, & Stigler, 2010). Furthermore, engineering education cannot be improved without the interest of the students, and this interest can be developed by the effective skills of the teachers. Similarly, positive link has been observed in the interest of the students in engineering education and effective skills of the teachers in the universities. Likewise, effective skills of teachers are the solution of developing the interest in the engineering education in the university students of the world(Barnhart & van Es, 2015). In addition, engineering education is necessary for the development of the economy and interest regarding engineering education has been developed by the skilled teachers of the universities in the world. Furthermore, skilled teachers are the necessary part of the facilities given by the universities to their students and the biggest source of development of interest in any subject such as engineering education to the students(Wang, 2012). Thus, based on above studies which found positive link between the interest of students regarding the engineering subject and the skills of the teachers, this study also develops the following hypothesis:

H1: There is a positive link between the skills of the teachers and interest of engineering students of private universities in Thailand.

Well Operational Labs and Interest of Engineering Education

The interest of the student for engineering education can be developed by the well operational labs of the institutions. There is a positive and significant link is found between the well operational labs and the interest in engineering education in the universities of the world(Lin & Tsai, 2009). Moreover, well operational labs are the essential element for the enhancement in the interest of engineering education in the educational institution of the world. In addition, the well operational labs of the universities are necessary for the improvement of students' interest in the subject of

engineering in the universities(Charyton & Merrill, 2009). Furthermore, engineering education cannot be improved without the interest of the students, and this interest can be developed by the well operational labs. Similarly, positive link has been observed in the interest of the students in engineering education and well operational labs in the universities. Likewise, well operational labs of the universities are the solution of developing the interest in the engineering education in the university students of the world(Wang, Wu, Wang, Chi, & Wang, 2018). In addition, engineering education is necessary for the development of the economy and interest regarding engineering education has been developed by the well operational labs of the universities in the world. Furthermore, well operational labs are the necessary part of the facilities given by the universities to their students and the biggest source of development of interest in any subject such as engineering education to the students(Vaughter, Wright, McKenzie, & Lidstone, 2013). Thus, based on above studies which found positive link between the interest of students regarding the engineering subject and the well operational labs, this study also develops the following hypothesis:

H2: There is a positive link between the well operational labs and interest of engineering students of private universities in Thailand.

Suitable Environment and Interest of Engineering Education

The interest of the student in engineering education can be developed by asuitable environment of the institutions. There is a positive and significant link is found between the suitable environment and the interest in engineering education in the universities of the world(Manca & Ranieri, 2013). Moreover, suitable environmentis the essential element for the enhancement in the interest of engineering education in the educational institution of the world. In addition, asuitable environmentis necessary for the improvement of students' interest in the subject of engineering in universities(Atkinson & Mayo, 2010). Furthermore, engineering education cannot be improved without the interest of the students, and this interest can be developed by asuitable environment of the university. Similarly, positive link has been observed in the interest of the students in engineering education and suitable environmentof the universities. Likewise, suitable environment of the universityis the solution to developing the interest in engineering education in the university students of the world(Walther, Sochacka, & Kellam, 2013). In addition, engineering education is necessary for the development of the economy and interest regarding engineering education has been developed by asuitable environment of the universities in the world. Furthermore, suitable environmentis the necessary part of the facilities given by the universities to their students

and the biggest source of development of interest in any subject such as engineering education to the students(Valsaraj & Melvin, 2009). Thus, based on above studies which found positive link between the interest of students regarding the engineering subject and the suitable environment of the university, this study also develops the following hypothesis:

H3: There is a positive link between the suitable environment and interest of engineering students of private universities in Thailand.

Mediating Role of Students' Motivation

The motivation of the students that are outcomes of the facilities given by the universities is necessary to develop the interest of the students regarding the engineering subject in the universities(Gillet, Vallerand, & Lafrenière, 2012). The skills of the teachers motivate the students towards the engineering subject that also enhance the interest of the student regarding engineering education. Moreover, well operational labs also can enhance the motivation about engineering education that improves the interest of the students regarding the engineering subject. In addition, suitable environment also can enhance the motivation about engineering education that improves the interest of the students regarding the engineering subject(Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015). Furthermore, students' motivation is a vital element that is improved by skilled teachers and also necessary for the development of student interest in engineering education. Similarly, motivation of the students is necessary for the development of interest in the subject of engineering by providing well operational labs(Guay, Ratelle, Roy, & Litalien, 2010). Likewise, students' motivation is a vital element that is improved by a suitable environment and also necessary for the development of student interest in engineering education. In addition, the facilities provided by theuniversities are the factors that develop the motivation in the students and move them towards engineering education(Dweck, 2013). Thus, for the students' motivation is necessary element for the interest of engineering education in the university student that is improved by the facilities provided by the universities such as skilled teacher, well operational labs and suitable environment and based on these studies, the present study develops the following hypotheses:

H4 (a): Students' motivation mediates the links between the skilled teachers and interest about the engineering education of the private universities students in Thailand.

H4 (b): Students' motivation mediates the links between the well operational labs and interest about the engineering education of the private universities students in Thailand.

H4 (c): Students' motivation mediates the links between the suitable environment and interest about the engineering education of the private universities students in Thailand.

III. RESEARCH METHODS

This study is about examining the role of educational institutions in the improvement of engineering education in Thailand with the help of mediating impact of students' motivation. The role of education includes skilled teachers, well operational labs and suitable environment for the education in the university. Private university students of graduation were the respondents of the study and data were gathered with help of survey questionnaires. The analysis were accomplished with the help of SMART-PLS by using PLS-SEM technique. Five-point Likert scale was used to answer the items in the questionnaire.

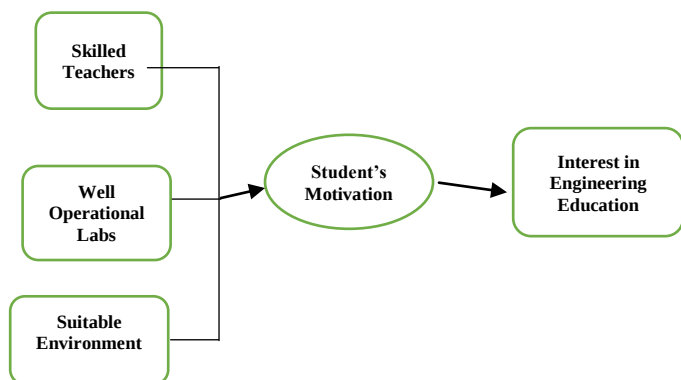
Measures

The interest in engineering education is the primary variable of the study and has ten items. In addition, the role of education includes skilled teachers, well operational labs and suitable environment used as independent variables and have fourteen, seven and twelve items respectively. Moreover, students' motivation used mediating variable that has eight items. Five-point Likert scale was used to answer the items in the questionnaire.

Data Collection Procedures

The students of private universities situated in the capital city (Bangkok) of Thailand were the respondents of the study. Around 650 questionnaires were distributed among the students by personal visit to the universities. After ten days of distribution, only 400 valid responses were returned back from the students that represent about 61.54 percent of response rate.

Theoretical Framework



IV. RESULTS

The results show the convergent and discriminant validity of the data and also the regression analysis of the study. Convergent validity is mentioned below in Table 2 that shows the convergent validity is perfect because the loadings are greater than 0.70, Alpha and composite reliability are also greater than 0.70, and AVE is greater 0.50. Convergent validity is given below Table 1.2:

Table 2
Convergent Validity

Constructs	Items	Loadings	Alpha	CR	AVE
Interest of Engineering Education	IEE1	0.706	0.849	0.884	0.523
	IEE10	0.782			
	IEE2	0.822			
	IEE3	0.632			
	IEE6	0.628			
	IEE7	0.679			
	IEE8	0.788			
	IEE9	0.741			
Suitable Environment	SE1	0.879	0.873	0.904	0.516
	SE11	0.864			
	SE12	0.733			
	SE2	0.654			
	SE3	0.805			
	SE4	0.754			
	SE5	0.779			
	SE7	0.907			
Students' Motivation	SM1	0.745	0.857	0.893	0.582
	SM2	0.734			
	SM4	0.777			
	SM6	0.801			
	SM7	0.752			
	SM8	0.766			
	SM9	0.741			
	SM10	0.734			
Skilled Teachers	ST1	0.793	0.911	0.927	0.534
	ST10	0.862			
	ST11	0.554			
	ST12	0.782			
	ST13	0.694			
	ST14	0.725			
	ST2	0.827			
	ST3	0.798			

Table 2

Continue

Constructs	Items	Loadings	Alpha	CR	AVE
Well Operational Labs	ST4	0.746			
	ST6	0.768			
	ST8	0.759			
	ST9	0.789			
	WOL1	0.880	0.806	0.862	0.558
	WOL3	0.780			
	WOL4	0.704			
	WOL5	0.671			
	WOL7	0.679			

Table 3 given below shows the FornellLarcker method of discriminant validity. According to this method, discriminant validity is perfect because the first value of the construct is greater than the rest that means constructs have a strong relationship with itself rather than other constructs. FornellLarcker method of discriminant validity is mention below in Table 3:

Table 3 Fornel lLarcker

	IEE	SE	SM	ST	WOL
IEE	0.723				
SE	0.571	0.718			
SM	0.721	0.667	0.763		
ST	0.541	0.388	0.501	0.731	
WOL	0.669	0.462	0.791	0.501	0.747

Table 4 Cross Loadings

	IEE	SE	SM	ST	WOL
IEE1	0.706	0.448	0.390	0.297	0.358
IEE10	0.782	0.418	0.558	0.362	0.453
IEE2	0.822	0.327	0.481	0.393	0.415
IEE3	0.632	0.364	0.340	0.300	0.307
IEE6	0.628	0.373	0.427	0.409	0.315
IEE7	0.679	0.470	0.613	0.441	0.627
IEE8	0.788	0.454	0.686	0.472	0.715
SE1	0.439	0.879	0.504	0.286	0.325
SE11	0.392	0.864	0.494	0.284	0.339
SE12	0.511	0.733	0.603	0.292	0.446

SE2 0.430 0.654 0.513 0.319 0.417

Table 4 Continue

	IEE	SE	SM	ST	WOL
SE3	0.336	0.805	0.400	0.226	0.255
SE4	0.023	0.160	0.049	0.103	-0.013
SE5	0.559	0.779	0.662	0.383	0.428
SE7	0.471	0.907	0.532	0.339	0.365
SE8	0.395	0.714	0.417	0.377	0.290
SE9	0.158	0.246	0.171	-0.154	0.106
SM1	0.496	0.651	0.745	0.356	0.438
SM2	0.634	0.414	0.734	0.442	0.653
SM4	0.508	0.626	0.777	0.393	0.413
SM6	0.532	0.651	0.801	0.360	0.489
SM7	0.517	0.339	0.752	0.354	0.756
SM8	0.589	0.415	0.766	0.379	0.804
ST1	0.351	0.170	0.237	0.793	0.281
ST10	0.504	0.419	0.483	0.862	0.470
ST11	0.246	0.240	0.274	0.554	0.252
ST12	0.478	0.358	0.479	0.782	0.452
ST13	0.437	0.386	0.464	0.694	0.392
ST14	0.438	0.293	0.462	0.725	0.380
ST2	0.424	0.244	0.359	0.827	0.410
ST3	0.410	0.218	0.305	0.798	0.370
-					
ST4	0.143	-0.042	-0.068	0.070	-0.050
ST6	0.302	0.160	0.236	0.768	0.257
ST8	0.351	0.243	0.298	0.759	0.332
ST9	0.408	0.349	0.384	0.789	0.446
WOL1	0.694	0.437	0.735	0.497	0.880
WOL3	0.638	0.357	0.589	0.537	0.780
WOL4	0.397	0.311	0.658	0.250	0.704
WOL5	0.289	0.249	0.407	0.206	0.671
WOL7	0.335	0.336	0.485	0.274	0.679

Table 5 given below shows the HTMT ratio method of discriminant validity. According to this method, discriminant validity is perfect because the values are less than 0.85, that means constructs have strong relationship with itself rather than other constructs. HTMT ratio method of discriminant validity is mention below in Table 5:

Table 5 HTMT Ratio

	IEE	SE	SM	ST	WOL
IEE					
SE	0.631				
SM	0.803	0.751			
ST	0.583	0.442	0.535		
WOL	0.713	0.523	0.706	0.527	

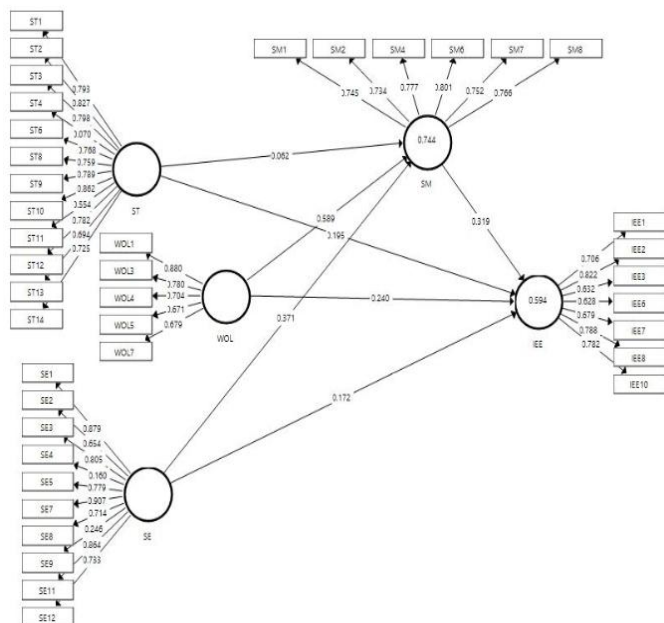


Figure 3

Measurement Model Assessment

Table 6 given below highlighted the impact of all variables on dependent variables. The results highlighted that 58.8 percent variation in the interest of engineering education is due to all other variables used in the study.

Table 6
Coefficient of Determination

	R Square	R Square Adjusted
IEE	0.594	0.588
SM	0.744	0.741

Table 7 given below highlighted the correlation between the variables. The results highlighted that variables are not highly correlated with each other because the values of Variance Inflation Factor (VIF) are less than 5.00.

Table 7 Multicollinearity

	IEE	SM
IEE		
SE	1.864	1.326
SM	3.906	
ST	1.408	1.393
WOL	2.858	1.505

Table 8 highlighted the path analysis that shows positive links between all the facilities given by the universities such as skilled teachers, well operational labs and the suitable environment with interest of engineering education in the private universities of Thailand. Moreover, results also highlighted that students' motivation mediates the relationship among suitable environment and interest of engineering education, well operational labs and interest of engineering education but does not mediates between the relationship of skilled teachers and interest of engineering education.

Table 8 Path Analysis

	Beta	S.D.	t-statistics	P-values	L.L.	U.L.
SE -> IEE	0.172	0.058	2.961	0.002	0.085	0.278
SE -> SM	0.371	0.039	9.508	0.000	0.309	0.436
SM -> IEE	0.319	0.095	3.355	0.000	0.140	0.462
ST -> IEE	0.195	0.045	4.281	0.000	0.119	0.268
ST -> SM	0.062	0.038	1.659	0.043	0.005	0.120
WOL -> IEE	0.240	0.070	3.444	0.000	0.132	0.367
WOL -> SM	0.589	0.034	17.391	0.000	0.537	0.649
SE -> SM -> IEE	0.118	0.037	3.192	0.001	0.051	0.177
ST -> SM -> IEE	0.020	0.015	1.322	0.093	0.001	0.047
WOL -> SM -> IEE	0.187	0.056	3.365	0.000	0.085	0.277

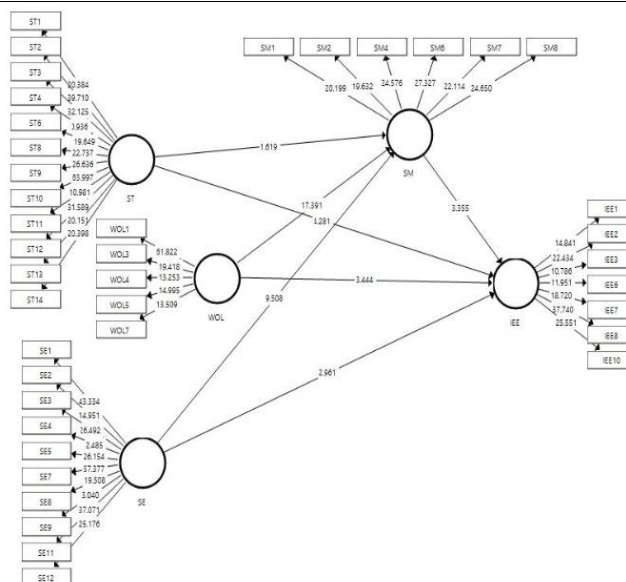


Figure 4

Structural Model Assessment

V. DISCUSSIONS AND CONCLUSION

This study is about examining the role of educational institutions in the improvement of engineering education in Thailand with the help of mediating impact of students' motivation. The results found that the universities of Thailand have skilled workers, well-operational labs and suitable environment that develop the interest of the student in the engineering education. The results also revealed that these facilities such as well operational labs and suitable environment motivate the students towards engineering education, but skilled teachers cannot motivate the student to adopt engineering education.

The present study concluded that private universities provided the facilities to the students, such as skilled workers, well-operational labs, and suitable environment that improve the interest of engineering education. In addition, well operational labs and suitable environment increase the motivation of students towards engineering education, but the skilled teacher is not effective enough to increase the motivation of the students towards engineering education. The current study recommended to the policymakers that they should focus on the training of skilled teachers that they become able to motivate the students towards engineering education.

The present study also has some limitation, firstly, this study take only private universities in Thailand and ignored the government sector for investigation, and future research may add them to expand the scope of study. Secondly, this study takes only three facilities such as skilled workers, well-operational labs and suitable environment provided by the universities and ignored other facilities and future study my add these facilities in their studies. Thirdly, this study took only one country and ignored the cross-country analysis, and prospective research may expand the scope by adding more countries. Finally, present study takes only one factor as mediation, such as students' motivation and ignored other factors, and future researchers may add other factors as moderation and mediation.

VI. REFERENCES

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