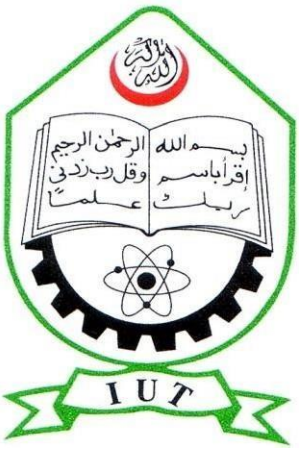

Polytechnic Students' Perceived Satisfaction of Using Technology in the Learning Process

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It is recommended that this thesis prepared by **Nsangou Youmo Souleman Sadam** titled **Polytechnic Students' Perceived Satisfaction of Using Technology in the Learning Process** has been accepted as fulfilling part of the requirements for the degree of Master of Science in Technical Education (M.Sc.T.E.) with specialization in mechanical and production engineering (MPE)

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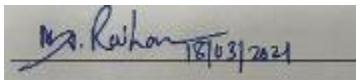

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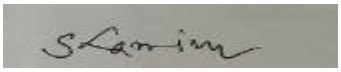

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Dedication

Dedicated to my parents

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Abstract

Over the decade, technology has undoubtedly entered all areas of human affairs. Specifically, it becomes ubiquitous in the education system. Its integration into tertiary education has contributed significantly to the improvement of teaching and learning experience. However, despite significant progress in the integration and optimal use of these tools by tertiary education stakeholders, there are still grey areas that requires further calibration and understanding to get the maximum benefit of the technology. One such area is the polytechnic students' perceived satisfaction of using technology in their study. This study proposes a structural model that explains polytechnic students' perceived satisfaction and investigates the relationships among the factors that affect polytechnic students' perceived satisfaction in the use of technology in their learning process. Moreover, the influence of some demographics data (gender, age, district, level of the academic year, living place, study time using technology and type of internet connection) on the factors that affect students' perceived satisfaction require to be scrutinized carefully.

Therefore, this study attempts to address this gap by designing a quantitative survey research method in the context of Polytechnique institutes of Bangladesh. An online survey was conducted and a total of 847 polytechnic students from 16 polytechnic institutes in Bangladesh effectively participated in this study. Data collected from the students were analysed using Structural Equation Modelling (SEM) and independent multivariate analysis of variance (MANOVA). The results revealed that social interaction, attitude and self-efficacy have a significant impact on perceived satisfaction; social interaction has a positive effect on attitude; attitude has a positive effect on self-efficacy; perceived usefulness, perceived ease of use, and anxiety have non significant effect on attitude. Furthermore, the study finds that gender, living place, study time and type of internet connection have a significant effect on both social interaction and polytechnic students' perceived satisfaction of using technology in their learning, while attitude and self-efficacy are influenced only by study time and type of internet connection. Finally, implications for theory and practice are discussed, limitations are highlighted, and the future research directions are suggested.

keywords: Technology in learning, Polytechnic students, Perceived satisfaction, Technology acceptance model (TAM), Structural equation model, Bangladesh

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Chapter 1 Introduction

This study investigates the relationships among the factors that affect polytechnic students' perceived satisfaction in the use of technology in their learning process. A structural equation modelling has been examined in this regard to explain polytechnic students' perceived satisfaction. Thereby, it proposes a model of polytechnic students perceived satisfaction of using technology in their learning, and further it examines the effect of some demographic parameters on perceived satisfaction constructs. The introduction and background of the study, statement of the problem, purpose of the study, research questions, the significance of the study, and the definition of terms are presented in the current chapter.

1.1 Introduction

The scope of technology is growing significantly on all aspects of life, including communication, working, housing, shopping, education and transportation (Burke, 1985). Nowadays, the use of technology is inseparable from the daily life of individuals (Malinowsky et al., 2015), especially in the field of education. This trend may be illustrated by a growth of high internet connection throughout the world. Internet statistic accounted 4.54 billion internet users in January 2020 around the world (Kemp, 2020). The affordance and the potential power of these technologies have fostered improved teaching and learning in higher education settings (Arenas, 2015; Kennewell, 2006). In this regard, technology offers other alternatives for educators to prepare and impart knowledge, provides students the access of that knowledge and learn it(Glover, Hepplestone, Parkin, Rodger, & Irwin, 2016). Some of the benefits of technology in learning is undeniable, such as ability to create independent, personalized and interactive learning environment, low cost education etc. (Olanrewaju & Ikuereye, 2019). Therefore technologies becomes an obvious solution to the many educational institutions, specially in developing countries to offer education to students.

However, efficient integration of education technologies in higher education do not always lead to achieve the desired outcomes in terms of the acceptance and appreciation of the role of these new tools by the actors of education, particularly the students. Yet, recent trend shows an increasing penetration of the use of technology in higher education in general. As a result, several studies have been initiated in order to elucidate the role of technology and its beneficial use in the teaching

and learning environment. Along these lines, some studies have shown that the technologies used in the good way by teachers has considerably improved the transmission of knowledge and interaction with students and improve the quality of the learning process (Jhurree, 2005). Others studies have analyzed the constraints of integrating technologies (Shahadat Khan, Mahbub, & C Clement, 2012) as well as the perception of the student about its role in their studies. With students' increasing reliance on technology, the student perceived satisfaction of technology has been the subject of numerous studies in higher education (Korableva, Durand, Kalimullina, & Stepanova, 2019; Santos, Batista, & Marques, 2019; Xue, Sharma, & Wild, 2019). Thus, student perceived satisfaction has become an important objective for institutions of higher learning (Guo, 2016).

Satisfaction of learner is pointed out as an important key in the learning process. In the light of previous studies, satisfaction in the educational setting is defined as the appreciation that one makes or the perceived value of one's educational experiences in an educational institute (Astin, 1993; Horvat, Dobrota, & Krsmanovic, 2015). Recently Estriegana, (2019) showed that perceived satisfaction is one of the factors that exert most influence on student's appreciation of the role of technology in their study. learners' satisfaction of the use of technology enhance learners' perceptions of technology that might promote their fruitful participation in the learning processes (Liaw, 2008). Also, this position is in perfect coherence with the conclusions of Liaw (2008) who recognized that the perceived satisfaction acts positively in the behavior of the students toward the use of e-learning. It is therefore clear that the perceived satisfaction of students is a fundamental factor that deserves a lot of attention in the educational environment, especially with regard to the positive feedback from effective integration and use of technologies by students in their studies. Though there are numerous researches exist in higher education, yet in the context of polytechnic institute, little research has been done to determine the factors that affect perceived satisfaction and attitude of polytechnic students with regard to the role of technology in their study. Therefore, this study attempts to focus on polytechnic students perceived satisfaction and attitude toward the use of technology in their learning.

1.2 Background of the study

The ease of access to technologies has contributed to increasing the ubiquity of these tools, whether or not they are tangible in the daily life of individuals. The use of multiple varieties of technologies like computers, tablets, smartphones, Internet, video, online games etc. is so

widespread, that this trend has even given rise to the expression of "digital native" (Prensky, 2009). Digital native is a terminology devoted to people who have experienced a certain proximity or a strong relationship of attraction with technology since their birth and who use the services of the latter as part of their daily life Activities. It has been reported that that 4.54 billion people in the world use the Internet, 5.19 billion of people use mobile devices (any type of handsets) and more than 3.8 billion people access to social media (Kemp, 2020). These figures are indicative of the essential roles played by technology in the people life.

This strong penetration and use of technology are also noticeable in terms of learning and instruction. Thus Pew Internet Research's report (Smith, 2013) indicates that 95% of student access to Internet regularly, 93% of them possess a computer at home, and 78% of them own a smartphone. Further, it has been revealed that 87% of US young adults possess a smartphone with Internet access, 74% of them have a computer with Internet access and 41% a tablet with Internet access, and 97.5% of them manage at least one social media account in a regular manner(Villanti et al., 2017). The affordance and the potential of technologies have fostered rapid growth in technologies' use for the teaching and learning purpose in higher education settings. Thus, educational content is delivered to learners through computers, laptops, tablets, or smartphones.

Technology does not only save time but opening many doors for interactive learning. Rather than being in a passive experience, learners can choose what they need to learn quickly and easily, wherever they are. Also, Benefits of technology in learning such as getting information across to the previously unreached**,** multimedia and mobility nature of learning devices (Olanrewaju & Ikuereye, 2019) enable the use of technology to be a real solution to many of the barriers that characterize teaching and learning in polytechnic institutions in developing countries. Therefore, it is a right time to explore in the structural way how the technology and its potential affordances are impacting educational environment, specifically on the polytechnic students perceived satisfaction of using technology in their learning in the context of Bangladesh.

1.3 Statement of problem

Recent trend shows an increasing penetration of the use of technology in higher education in general. As a result, several studies have been initiated in order to elucidate the role of technology and its beneficial use in the teaching and learning environment. However, little attention is paid to the perceived satisfaction of students of developing countries towards the use of technology in

their learning. Specifically, the research related to polytechnic students' perceived satisfaction towards the use of technology is almost non-existent. This study, in this endeavour, investigate structurally the factors affecting polytechnic students' perceived satisfaction towards the use of technology in their learning.

1.4 Purpose of the study

The purpose of current study is to propose a model to characterize the polytechnic students perceived satisfaction of using technology in their learning and depicting the relationship between individual and environment factors. To be more precise, the current study aims to determine how individual perception and attitude predict students' perceived satisfaction of using technology and how the environmental and individual factors affect this perceived satisfaction of using technology in the learning process. Furthermore, this study scrutinizes the effect some demographic parameters on polytechnic students perceived satisfaction on using technology in their learning.

1.5 Objective of the study

The main objective of this study is to provide an insight on polytechnic students perceived satisfaction of using technology in their learning in the Bangladesh setting. More precisely it aims to show how some aspect inherent to polytechnic student and their learning environment interact and impact their perceived satisfaction. Therefore, polytechnic students' perceived ease of use, perceived usefulness, polytechnic students anxiety, polytechnic students self-efficacy, polytechnic student social interaction, and polytechnic student attitude and polytechnic student perceived satisfaction are considered. Further, another objective is to scrutinize how some demographic parameters specific to Bangladesh polytechnics students can be the indicators of their perceived satisfaction.

1.6 Research questions and hypotheses

The purpose of this study revolved around the two points: *a)* to investigate the relationships among the factors that affect polytechnic students' perceived satisfaction in the use of technology, and *b)* to develop a structural model that explains polytechnic students' perceived satisfaction about using technology. Consequently, while designing the perceived satisfaction model the following research questions have been addressed in the study:

RQ1. To what extent the perceived ease of use (PEU), perceived usefulness (PU), anxiety (AX), attitude (AT), self-efficacy (SE), social interaction (SI), and perceived satisfaction (PS) are related to each other?

RQ2. What role can attitude (AT) play to mediate the relationships between perceived ease of use (PEU), perceived usefulness (PU), anxiety (AX), and perceived satisfaction (PS)?

RQ3. To what extent gender, age, district, level of the academic year, living place, and study time using technology influence the students' perceived satisfaction?

Under the foregoing research questions (RQ1 and RQ2), the following hypotheses are formulated:

H1: Polytechnic students perceived ease of use of technology in their learning has a positive impact on their attitude

H2: Polytechnic students perceived usefulness of technology in their learning has a positive impact on their attitude

H3: Polytechnic students' anxiety of using technology in their learning has a negative impact on their attitude

H4: Polytechnic students' self-efficacy of using technology in their learning has a positive impact on their attitude

H5: Polytechnic students' attitude toward technology in their learning has a positive impact on their social interaction

H6: Polytechnic students' attitude toward technology in their learning has an impact on their perceived satisfaction

H7: Polytechnic students social interaction has a positive impact on their perceived satisfaction of using technology in their learning

H8: Polytechnic students' self-efficacy of using technology in their learning has a positive impact on their perceived satisfaction

1.7 Significance and originality of the study

Many researches have addressed some of concerns about integration and use of technology of the perception of educational stakeholders. Moreover, the helpfulness of technologies in teaching, learning and research processes and the preference of using media and communication platforms have got important interest that led to several considerations which logically have contributed to

improve the effectiveness of using technology. Many initiatives proposed by the government and certain international institutions are facing difficulties which lead to the failure to some extent. The observable growing reliance of students towards technologies is an opportunity to investigate the student's perceived satisfaction of using technology and the impact of their demographic parameter on their perceived satisfaction. Know how some factors influence polytechnic students perceived satisfaction of using technology in their learning increase the possibility to promote meaningful and effective learning by providing further to a frame of learning technology the needs and preferences of student in terms of inherent factors. This study also add knowledge to a great extent into the existing literature regarding the polytechnic students' perceived satisfaction of using technology in their learning process.

1.8 Definition of terms

The key terminology used in the study are defined as follows-

Perceived usefulness: Personal beliefs about benefits arising from using technology; in other words, the catalyst role of technology in individual performance and efficacy while learning through technology.

Perceived Ease of Use: Personal appreciation of whether the technology involved is easy or effortless enough to be used effectively for predefined tasks.

Attitude Toward Technology: A form of motivational belief emanating from both current and previous technology experiences, knowledge, habits, and judgement on general technology usefulness and efficacy in terms of meeting academic needs and interests.

Anxiety towards technology: the personal condition or the state resulting from mental pressure while using technology for learning purposes and which causes emotional discomfort.

Self-efficacy: refers to an individual's confidence and belief of the ability in using technology and performing or executing learning activities through the technology environment.

Social interaction: the relationship between self, instructor and peers in terms of communication, discussion and instructional support and in terms of regulating behaviors and activities being involved

Perceived satisfaction: it is the individual's perceived level of pleasure and contentment derived from the performance and achievement in learning through technology at the individual level and the technology use level.

Chapter 2 Literature review

2.1 Introduction

This chapter reviews past studies covering the background of the present study. Many academic electronic resources have been used comprising Google Scholar, Educational Resources, Taylor & Francis Online Journals, Information Center (ERIC), ScienceDirect, JSTOR, ProQuest and Dissertations & Theses Global, as well as other prominent journals on technology used for learning, were consulted to access these studies. The chapter consists of sections covering technology used in the learning process and technology in the polytechnic institutes of developing countries.

2.2 Technology used in the learning process

Technology has a two-dimensional character since it is both defined as a process on the one hand and as a tool on the other hand that is developed and built on the basis of systematic knowledge and whose objective is to play a very precise role on the intellectual level or on the material level (Rocci Luppicini, 2005). In light with this understanding, technologies used by polytechnic students' may be considered as the set of hardware and software which contribute to access the learning content, to increase their comprehension, interact with content, peer and instructor, and empower them to be more effective in problem solving in their social and educational setting.

Many studies discussed that technology was merely a vehicle used to deliver and access the content without significant effect on learning, yet others shown that proper use of technologies may improve significantly the instruction and learning (T. Anderson & Elloumi, 2004). These contradictory opinions prompted numerous investigations aiming to understand the affordances and benefits of technologies in the teaching learning situation. S.A. Onasanya and R.A. Shedu (2010) indicated that technologies have increased access to knowledge without time and place restrictions by making possible for students even in the most remote locations to have access to high quality knowledge that their home schools which were previously unable to provide. Also Coast (2015) found that technology has improved engagement, knowledge retention, encourage individual learning and collaboration and enable the students to learn useful life skills which are fundamental for tertiary education. In the context of Polytechnique institutes, Dickson et al (2010)

showed through his study that polytechnics' student creativity, searching activities and access to information increased with the use of the technologies.

Entwistle (1991) recognizes that the understanding of the relationship between the approach to learning and perception of the learning environment remains crucial to understand learning habit or learning behavior. A panel of learning technologies have been scrutinized by numerous studies in order to shed light on the perception of students. The analysis of technology assisted learning (TAL) has shown how the students have become very reliance on technology to aid their study or that technology as learning aid has gained increase acceptance among the students since technology offers many way to learn (Parai et al., 2015). Beside it has been found that student perception of use technology are not influenced by their learning style (Parai et al., 2015). Peart & Al (2017) found through a qualitative study about how the perception of technology enhance the use of technology in the study. Firstly, some of learning technologies are useable both on computer and mobile devices and then it is perceived as useful for preparing assessment by helping students find out what they actually know, tailor and personalize the delivery, and provide information in a various format. In other hand and conversely to aforementioned remark student perceives assessment as an area for improvement with social media such as Twitter event and recognized it as convenience and easy to access (Farrell & Rushby, 2016; Peart et al., 2017).

Similarly Technologies used in online and blended learning situations have the potential to enrich the learning experience, to do more than what can be done in face-to-face or in distance mode (L. Smart & J. Cappel, 2006). Additionally, the study on open technology or web 2.0 technology to which belong social media reveals that the set of the Web 2.0 (blog, wiki, podcasting) had a positive appreciation of majority of the participants (Karvounidis, Chimos, Bersimis, & Douligeris, 2014). Justified by the fact that factors such as students' interest and experience, frequent and regular visits over the platform, searching and downloading of educational material, collaborative activities over the wiki, The *discussion forum visiting*, infrastructure and support have a positive impact on students' academic performance (Hanover Research, 2017; Karvounidis et al., 2014). Thereby web 2.0 is perceived as promoting meaningful study for learning outcomes achievement when it is used positively.

L. Smart & J. Cappel (2006) also remarked that students rate elective online courses positively than required online courses consequently, they show their preference to study what they are

interested in compared to what is framed by the educational institution. through curriculum. Students also show strong attraction to mobile devices and their perceived usefulness become important indicator for their academic success. Mobile devices offer them a variety of ways to learn, communicate and collaborate (Gikas & Grant, 2013).

2.3 Technology in polytechnic institution of developing countries

In developing countries the role of technology in students' learning process shows a great benefit to overcome the knowledge barriers due to lack of expertise and delay in the field of science and engineering (I & Arif, 2013; Shahadat Khan et al., 2012). Technology is perceived as being a real rescue for the polytechnic's student in countries where the access to good education and updated knowledge is still challenging to access (Amanortsu & Dzandu, 2013; Kumar & Daniel, 2016; Mends-brew, 2012). The factors fostering integration and the use of technology have been explored in many way and some recommendations have been emitted for effective use (Mends-brew, 2012; Rivers & Rivers, 2015). Apart from the recommendations regarding infrastructure aspect some of these prescriptions related to the perception and attitude of students are targeted to be crucial for fruitful use of technology.

Mamun (2015) examined the use of technology in the government polytechnic institute of Bangladesh and reported the limited use of computer and internet by polytechnic's students due in part to the quality of technology service, poor infrastructure and lack of training. However, despite of different statistical approaches involved in the analysis a limited emphasis has been placed on student's perception on the role of technology in his study.

The use of technology in polytechnics of developing countries is widespread, with a number of initiatives and projects currently being undertaken for its effective use by the student in their study. Even if the growing attraction of polytechnic students in favour of technologies is observable, it is quite difficult to measure the level of integration of these technologies in the field of education and especially the perceived satisfaction both at individual and social level that students have of its use in learning as well as its impact on their performance (Rivers & Rivers, 2015). This is justified by the proven lack of a system which is devoted to the monitoring and follow-up of the use of technology and its perceived satisfaction by student in their education (UNESCO, 2015). Hereby it is necessary to have a glance at the student perceived satisfaction of the role of technology in their study.

2.4 Theories of technology use

a multitude of theories has been developed to find out and to refine the understanding of what condition the convenient use of technology in all fields where it is integrated, through human, material and environmental parameters. Fundamentally theories provide perception and foresight to appreciate underlying dimensions of use's motivation by delving into user needs, beliefs and desires, and how and to what extent these dimensions might ascertain to act in a certain way. Among these theories one can point out social cognitive theory (SCT), and the technology acceptance model (TAM).

2.4.1 Social Cognitive Theory (SCT)

Social Cognitive Theory (SCT) of Bandura (1986) acknowledge that an individual's behavioral development is subordinated to the relationship of social interactions, individual experiences and context variables. In other words, personal, behavioral and environmental factors estimate 2 motivational beliefs as outcome expectancies and self-efficacy in which ultimately predict appreciation.

2.4.2 Technology Acceptance Model

Technology Acceptance Model (TAM) by Davis (1989) is the most contextualized, investigated and criticized causal technology adoption model in the literature theorizing that when individuals interact with technology, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) as beliefs estimate specify their judgement to adopt it. PU is defined as the perceived advantages emanating from using a specific technology. PU is regarded in technology adoption models as a motivational belief resulting in enthusiasm to benefit from a particular technology thus signifying approval of the value or utility of it. PEOU is defined as a personal judgement of whether the technology is straightforward enough to be able to use effectively.

2.5 Conclusion

Technology undeniably occupies a prominent place in learning globally, but especially in polytechnic institutions in developing countries. Further, technology has gained an important role in the design of learning environments as it has been an essential point of 21st-century students for the past decades. However, the questions inherent in efficient and prolific integration of technology for learning have certainly made considerable headway but still remain limited as to the specificity of polytechnics in developing countries. In this logic, the researchers agree in recognizing that

despite the constraints which are of a material nature, i.e., linked to the technology itself, it is more crucial to question the motivation and the students' perceived satisfaction of using technology in the learning process.

Chapter 3 Methodology

3.1 Introduction

This chapter provides details about the research methodology which guided this study. The chapter includes information about the theoretical framework, research design, research context, population and sampling technique, the instrument design, instrument reliability and validity, data collection procedure and data analysis. The purpose of this study is twofold: to investigate the relationships among the factors that affect polytechnic students' perceived satisfaction in the use of technology in their learning, and to develop a structural model that explains polytechnic students' perceived satisfaction of using technology. Consequently, three research questions have been formulated in this study to address these two points:

1) To what extent the perceived ease of use (PEU), perceived usefulness (PU), anxiety (AX), attitude (AT), self-efficacy (SE), social interaction (SI), and perceived satisfaction (PS) are related to each other?

2) What role can attitude (AT) play to mediate the relationships between perceived ease of use (PEU), perceived usefulness (PU), anxiety (AX), and perceived satisfaction (PS)?

3) To what extent gender, age, district, level of the academic year, living place, and study time using technology influence the students' perceived satisfaction?

3.2 Theoretical Framework

3.2.1 Perceived Satisfaction

Satisfaction is the output variable of the motivational design model ARCS (Attention, Relevance, Confidence, Satisfaction) (Keller, 2010). In order to support researchers and practitioners with a theoretical basis from which they can design motivationally supportive instructional interventions, Keller (2010) developed the ARCS model of motivational design. In his model the satisfaction of learner is pointed out as an important key in the learning process. Previous studies defined satisfaction, in the educational setting, as the appreciation that one makes or the perceived value of one's educational experiences in an educational institute (Astin, 1993; Horvat et al., 2015). Perceived satisfaction from technology is conceptualized as an essential key in student's outcomes.

Student satisfaction is an important concept as it can lead to higher levels of motivation, engagement, learning, performance, and success(Shelley, 2008). However, satisfaction remains a complex construct as it is influenced by several factors and thus requires to conceptualize it within the current study context to understand it fully.

3.2.2 Factors Affecting Perceived Satisfaction

Many authors have investigated students' perceived satisfaction as a critical issue in better understanding learners learning process. Recently Estriegana, (2019) proposed an extended model of technology acceptance (TAM) framework in which he shows that perceived satisfaction is one of the factors that exert most influence on student's appreciation of the role of technology in their study. Learners' perceived satisfaction of the use of technology enhance learners' perceptions of technology that might promote their fruitful participation in the learning processes (Liaw, 2008). Liaw (2008) further recognized that the perceived satisfaction acts positively in the behaviour of the students toward the use of e-learning. It is therefore clear that the perceived satisfaction of students is a fundamental factor that deserves a lot of attention in the educational environment, especially with regard to the positive feedback from effective integration and use of technologies in the student learning process.

Student's perceived satisfaction while studying through technology environment is subjected to many elements. Bolliger and Halupa (2012) scrutinized the relationship between student satisfaction and technological anxiety and found a negative relationship between them. Students with low levels of technological anxiety had significantly higher levels of satisfaction than students with high levels of technological anxiety. Bradford (2011) explored how satisfaction is related to cognitive load with a sample consisting of online college students. He came out with the findings reported a significant relationship between satisfaction and cognitive load in which cognitive load explained a major portion of the variance in satisfaction. However Al-azawei, Parslow, & Lundqvist (2017) found a weak effect of learning styles in predicting student's perceived satisfaction with eLearning. In order to highlight the factors that condition student satisfaction, Shelley (2008) identified flexibility, expertise, and usefulness as being associated with student satisfaction in learning through technology. Others factors, such as instructor behavior, reliable technology, and interactivity influence students' perceived satisfaction of technology (M. Bolliger, 2004; Dennen, Darabi, & Smith, 2007). Yalcin (2017) in his study, combining the social cognitive theory (Bandura, 1999) and macro model (J. M. Keller, 1983, 1979), showed that satisfaction was

structurally influenced by personal factor (Self-regulation, self-efficacy, task value) and environmental factor (learning design).

According to Bradford (2011) when technology fails to meet student expectations, it leads to unappreciated experience which is manifested by low level of perceived satisfaction. Thereby student's expectation and experience are likewise as basic indicator of his satisfaction. Some authors (D. U. Bolliger & Wasilik, 2009; M. Bolliger, 2004; Gregory, 1999) have identified in their respective study three common key factors central to a student's perceived satisfaction of technology: instruction, technology and interaction. This findings have been confirmed in the recent literature which reveals once again the effect that the factors relating to technology, instructor, and peers have on students' perceived satisfaction with the learning experience while using technology (Ke, 2013; Lee, Choi, & Kim, 2012).

Some researchers investigated learner satisfaction in technology settings in relation to the elements of the Technology Acceptance Model (TAM). In a general sense, TAM hypothesizes that the perceived usefulness and the perceived ease of use of a system affect its adoption and obviously its use. Concerning TAM, the literature shows a positive relationship between the elements of TAM and perceived satisfaction. According to the findings of recent research studies, perceived usefulness, and perceived ease of use of an online learning system positively influence satisfaction (Estriegana et al., 2019; Liaw & Huang, 2013). Some researchers reported a non-significant effect of social presence on satisfaction (Ju, Yon, & Kyung, 2011; Rubin, Fernandes, & Avgerinou, 2013). In opposition to the aforementioned finding, Arbaugh (2014) reported that social presence was a significant predictor of satisfaction with the delivery medium.

3.3 Research Design/ Conceptual Framework

In this study, the conceptual framework that has been conceptualized to understand the student perceived satisfaction is originated from the technology acceptance model (TAM) and the Yalcin's (2017) model emanating from the combination of social cognitive theory (SCT) of Bandura (2001) and macro model of motivation and performance of Keller (1983;1979).

The technology acceptance model (TAM) is a theoretical model that structurally showed how users come to accept and use technology. The basic structure of TAM focuses on the effects of external variables on the two main constructs of users' acceptance of technologies such as perceived ease of use and perceived usefulness. The TAM's core model integrates the attitude of the learner as an

important construct influenced by perceived ease of use and perceived usefulness. Further, attitude is theorized as an important determinant in the actual behavior and intention of use technology or merely a perceived satisfaction indicator. In this study polytechnic students perceived ease of use of technology, perceived usefulness, and attitude are the constructs of TAM model considered to conceptualise the model for the current study.

Social cognitive theory (SCT) enlights on the essence of interactions among the learner, behavior, and the environment in individual learning, while the Macro Model of Motivation and Performance explains the learner's effort, and the consequences of behavior with personal and environmental variables. The model developed by Yalcin (2017) based on the two aforementioned models, groups the various elements that affect perceived satisfaction in two main factors, namely personal factors and environmental factors. This approach is consistent with many others from the current literature on perceived satisfaction in technology used for learning purpose.

Self-efficacy with technology is one of the personal variables that SCT and Macro Model of Motivation consider as being very important. In this study self-efficacy with technology and individual anxiety related to technology use, constitute the personal variable.

Yalcin model also places great emphasis on the environment variable in the evaluation of satisfaction. In the Yalcin's model, the environment variable is two-dimensional since it provides students with the information necessary to induce action and it is also supported by the factors associated with motivation, learning and contingency. The environment variable in this study is illustrate by the Social interaction of polytechnic students with their peer as well as interaction with their teachers.

- *TAM variable*

The main variables of TAM (Technology Acceptance Model) are Perceive ease of use, perceived usefulness and attitude. Perceived ease of use (PEU) refers to "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). Users' perceived ease of use of a technology is related to their acceptance and attitude to use the technology (Venkatesh, & Davis, 2000). Thus, using technology enables the polytechnic's students to realize the easiness of the technology and feel comfortable in their studies. Perceived usefulness (PU) refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). A student's perceived usefulness (PU) of technology is

found to be a significant determinant of the attitude (AT) of the students toward technology (V. Venkatesh et al., 2000). Similarly, using technology for the learning purpose, enables polytechnic students' (the learners) to see the usefulness of the technology in their learning and therefore to adopt an attitude that will be favorable or not to their perceived satisfaction. Elkaseh et al. (2016) and Abdullah et al. (2016) demonstrated that perceived usefulness and perceived ease of use have a significant effect on students' attitudes toward technologies. Moreover, some studies found that perceived usefulness and perceived ease of use positively impacted students' attitudes toward learning technologies (Lane, 2014; Park, 2014). Similarly, Ifinedo (2017) in his study, which is in part dedicated to investigating the student's attitude toward technology, found that perceived usefulness (PU) and perceived easy to use (PEU) are determinant in understanding and predicting student attitude besides his findings corroborated with Davis's findings.

Khan and Hasan, (2012) in their study regarding the barriers of integrating technology reported that students' positive attitude toward technology is developed when they are sufficiently comfortable with technology and have knowledge about its use. Moreover, other research (Jwayyed et al., 2011; Parai et al., 2015) supported that a learner's attitude toward instructional technology determines the learner's general perception about using technological assistance. In that sense students' attitudes toward technology influence his perceived satisfaction.

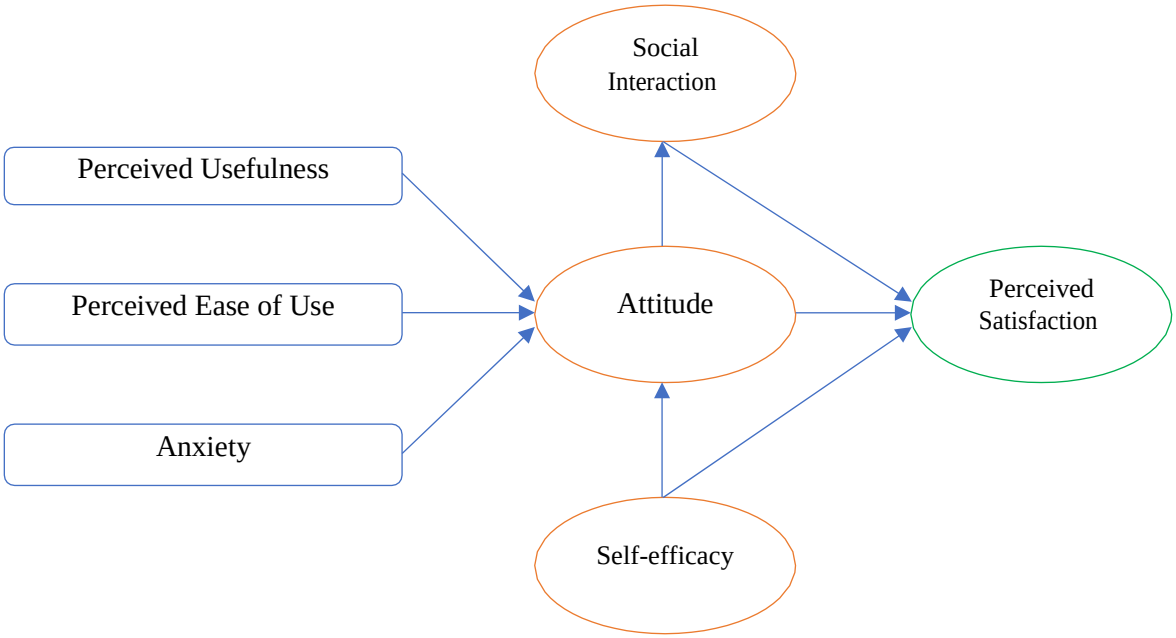

Figure 3-1 conceptual framework of the study

- *Anxiety*

Liaw & Huang (2013) in their study underlined one of the fundamental definitions of anxiety from researchers Spielberger, Gorsuch, & Lushene (1970) that the emotional state or condition that causes apprehension, tension, and worry is considered to be anxiety. Further technology anxiety is characterized as an affective responses or fillings, and emphasized fear of using technology (Chua, Chen, & Wong, 1999). Liaw & Huang (2013) indicated that the performance of students with a high degree of technology anxiety might be poorer than those with little or no computer anxiety. Sun, et al (2008) confirmed that the higher the computer anxiety, the lower the level of learning satisfaction. In e-learning environments for example, anxiety has a negative relationship with learners' motivation, and self-regulation (Tsai, 2009). Sun et al (2008) concluded that perceived anxiety is a negative predictor to influence perceived satisfaction toward e-learning.

Users' anxiety does not have to be confused with the attitude which illustrates beliefs and feelings toward technology. Some research recalled from the literature about the harmfulness effect of perceived anxiety of technology in individuals' attitudes. Both attitude and satisfaction are negatively affected by anxiety therefore, in our model anxiety can negatively influence attitude which mediates its effect on perceived satisfaction too.

- *Self-efficacy*

Self-efficacy is referred to as the set of beliefs that emanate from the image individual has of his aptitudes and capacities to initiate and carry out an action that will lead to a precise result (Bandura, 1997). It is in some instances the degree of confidence the individual has about his ability to perform successfully a certain action or achieve a certain goal. Liaw & Huang (2013) indicated that this confidence, or lack thereof, has an influence on the choice of activities, degree of effort expended, and persistence of effort. Self-efficacy is not a constant construct as Hodges (2008) underlined in his study that it is context-specific, which indicates that an individual's self-efficacy beliefs are subject to variation with the change of the nature of education. Furthermore Yalcin (2017) concluded that a learner who has self-efficacy beliefs

for learning in face-to-face settings may not have sufficient confidence for learning through technology environments. Several researchers investigated the relationship between self-efficacy for learning through technology and satisfaction with technology. The researchers found that there is a significant relationship between self-efficacy and satisfaction, specifically, self-efficacy is a significant predictor of satisfaction in technology learning settings (Artino, 2008, 2009; Cho & Heron, 2015; Joon Lee, Srinivasan, Trail, Lewis, & Lopez, 2011). Moreover, the research studies based on a structural equation modelling approach showed the direct impact of self-efficacy for learning on satisfaction technology learning environments (Joo, Lim, & Kim, 2013; Lin, Lin, & Laffey, 2008).

- Social interaction

Social Interaction (SI) is regarded as one of the essential constructs of environmental factors in both traditional and technology-mediated (eLearning) environment (Holmberg, 1983; Moore, 1989; Zhu, Hua, Wing, & Greg, 2020). Researches are suggesting that various types of interaction are related to increase learning outcomes and the students' perceived satisfaction while learning online (Ekwunife-orakwue & Teng, 2014; Ga, Loughin, Kovanovi, & Hatala, 2015; Jaggars & Xu, 2016). Liaw (2008) reported that in e-learning environments, environmental characteristics, such as synchronous or asynchronous interaction, will create a high-level communicative environment that allows learners not only to share information, but also to determine how to retrieve useful information. Moore (1989) identified three important types of interactions namely student-content, student-instructor, and student-student interaction. All technology-based learning courses must have some form of content with which learners must interact, but not all courses have an instructor with whom learners interact (Ekwunife-orakwue & Teng, 2014). As a result, learners would have to spend more time on the course content to increase their understanding which may lead to poor satisfaction of technology.

Students who don't interact adequately with their instructors feel that they learn less and are less satisfied with their learning environment (Hong, 2002). Student-instructor interaction have a significant effect on both overall satisfaction with learning outcomes and satisfaction with the role of technology in study setting (Jaggars & Xu, 2016). Study shows that without conspicuous interactions between instructor and students, students are more prone to

distractions and facing difficulty concentrating on the learning (P. Sun et al., 2008). Instructional guidance to learning represents the essence of student-instructor interaction through which achieving positive perceived satisfaction of the role of technology which implies answering students' questions, correcting their misunderstandings, providing clear instruction, relevant resources, and constructive feedback on their assignments and performance (Lee et al., 2012). This is in step with Bolliger's (2004) suggestion in favor of the fact that instructors should motivate and encourage students and monitor student progress for increasing their interest in e-learning.

Student-student interaction also known as peer-to-peer interaction refers to learning which involves students supporting each other on academic or non-academic issues (Joon Lee et al., 2011). In this way, student-student interaction increases students' participation and fosters collaborative learning which arises when students collectively work towards a common academic objective (Mora, Signes-Pont, Fuster-Guilló, & Pertegal-Felices, 2020). Gregory (1999) reported earlier that the opportunity to interact and collaborate with peers during the learning process is linked with students' perception of satisfaction. Students who use available communications technologies to interact with each other during their respective studies may perceive positive engagement, more interaction, and greater satisfaction. In this study, the emphasis is given to polytechnic students' interaction with peers and their teacher.

3.3.1 Populations and sample

The sampling process was comprised of several stages. The first stage was to define the population of concern. For the purpose of this study, this population is polytechnic's students from the first years to the fourth year, in the various fields. Next, a sampling frame was specified to provide a set of items or events that are possible to measure. In the case of this study, the sampling frame was comprised of polytechnics students who use technology in their learning.

The population of this study is the students at different government polytechnic institutes in Bangladesh. Bangladesh has 49 government polytechnic institutes spread over 8 divisions as follows: 4 polytechnics institutes in Barisal division, 11 polytechnics institutes in Chittagong division, 11 polytechnics institutes in Dhaka division, 7 polytechnics institutes in Khulna division, 2 polytechnics institutes in Mymensingh division, 7 polytechnics institutes in RajShahi division, 4 polytechnics institutes in Rampur division and then 3 polytechnics institutes in Sylhet division.

However, the large number of polytechnic institutes and their geographic distribution across the divisions of Bangladesh leads us to be interested in an approach which is likely to guarantee optimal representativeness of the population. Then it was more convenient to group the polytechnic institutes selected within the framework of this study in order to form representative cluster of each division of Bangladesh. Thus, for this study the target population was restricted to 8 clusters namely cluster Barisal, cluster Chittagong, cluster Dhaka, cluster Khulna, Cluster Mymensingh, cluster RajShahi, cluster Rampur and cluster Sylhet.

To select the polytechnic institutes within each cluster, a purposive sampling technique has been used. Polytechnics institutes selection in each cluster is based on their reputation and where the students use of technology seems to be most advanced in each division. The polytechnic institutes selected for each cluster are represented in the table below.

Table 3-1differents clusters of Bangladesh polytechnic institutes

Clusters	**Region**	**Selected Polytechnic Institutes**
Cluster 1	Dhaka	Dhaka polytechnic institute, Dhaka Mohila Polytechnic Institute
Cluster 2	Chattogram	Chattogram polytechnic institute, Bangladesh Sweden Polytechnic Institute
Cluster 3	Barishal	Barisal polytechnic institute, Barguna polytechnic institute
Cluster 4	Khulna	Khulna Polytechnic Institute, Khulna Mohila Polytechnic Institute
Cluster 5	Rajshahi	Rajshahi Polytechnic Institute, Rajshahi Mohila Polytechnic Institute
Cluster 6	Mymensingh	Mymensing Polytechnic Institute, Sherpur polytechnic institute
Cluster 7	Rangpur	Rangpur Polytechnic Institute, Thakurgaon Polytechnic Institute
Cluster 8	Sylhet	Sylhet Polytechnic Institute, Habiganj Polytechnic Institute

Finally, the convenience sampling technic has been used to select the respondents in each of the selected polytechnic. Convenience sampling is a non-probability sampling technique where participants are selected due to their convenient of accessibility and their proximity with the researcher. To overcome the representativeness resulting from this sampling technique having an important sample size is essential. this sampling technique is appreciated and preferred by several researchers who recognize its advantages in terms of easiness, accessibility, rapidity inexpensiveness, and the participant are readily available. The identification of the appropriate sample opens the possibility of osculating the tool implemented for optimal and objective data collection in adequacy with the objectives of the study defined beforehand. Then the sample of

respondents was polytechnics students from aforementioned polytechnic clusters who use technology in their study.

3.3.2 The Questionnaire Design

The main measuring instrument used in the frame of this study was the questionnaire. Bernhard (1991) states that "questionnaires may be the best way to assess perceptions because they can be completed anonymously and re-administered to assess changes in individuals' experiences and thinking over time.'' A questionnaire is a system for collecting information to describe, compare, and explain knowledge, attitudes, perceptions, or behaviour. The use of questionnaire was appropriate because it provided the opportunity for respondents to express their opinions and views freely. It also guaranteed the anonymity of the respondents, leading to unbiased data. Thus, the questionnaire allowed respondents to relax and provide the information they could not provide during the interview survey, thereby allowing the researchers to obtain reliable data.

This instrument was structured around two (2) mains parts: Part A dedicated to demographic information and Part B dedicated to constructs related to perceived satisfaction (perceived ease of use, perceived usefulness, anxiety, attitude, self-efficacy, social interaction, and perceived satisfaction) Towards Technology.

3.3.2.1 Demographics information

Demographics questionnaire consisted of a set of ten (10) questions related to respondents' information such as gender, age, polytechnic's division, department, year of study, technology device used for study purpose, duration of daily study with aid of technology, type of internet connection used, place of living during the study and then the permanent home of the respondents. The questionnaire is presented in Appendix A

3.3.2.2 Perceived usefulness (PU)

Perceived usefulness was operationalized as the believes polytechnics students had about the catalyst role of technology in their performance and efficacy while leaning. Three (3) observed items used to measure perceived usefulness construct were drawn from the TAM's (technology acceptance model) perceived usefulness construct modified by Yuen, Cheng, & Chan(2019) in their study. A slight modification was performed on these items to be in line with the frame of this study. 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree was adopted to measure the items in the questionnaire. The construct is represented in Appendix A

3.3.2.3 Perceived ease of use (PEU)

Perceived ease of use was operationalized as the degree to which polytechnic students found technology effortless to use in their learning. And also, the easiness they found when they want to access learning content and do other learning activities they want to do through the technology environment. A total of six (6) observed items had been considered in such a way to display the operationalized figure of this construct in this study. Thereby these six(6) items have been drawn from both Yuen, Cheng, & Chan(2019) and Sun et al (2008). 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree was adopted to measure the items of this construct in the questionnaire. The construct is represented in Appendix A

3.3.2.4 Attitude (AT)

The attitude was operationalized as the polytechnics students' impression of participating in learning activities through technology. Since students use technology as a learning aid tool to access learning content their attitude or in other words their responses resulting in the student and technology relationship is crucial. It can therefore be reflected in the degree of skill required, the behavior elicited, and the resulting level of comfort. The attitude construct was defined in this study by three (3) observed items. In this set of items, three (3) drawn from Sun et al. (2008) attitude construct items' were slightly reworded. The items were scored on a 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree to measure attitude construct in the questionnaire. The construct is represented in Appendix A

3.3.2.5 Anxiety (AX)

Anxiety towards technology was operationalized as the condition or the state resulting from mental pressure while using technology for learning purposes. Anxiety is declined in two-part composed of trait anxiety (a stable and enduring internal personal characteristic) and state anxiety (results from the external environment)(P. Sun et al., 2008). This construct is measured at first by 6 items among which four (4) items drawn and reformulated from Sun et al (2008) study and two items were self-written items. All these items were scored on a 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree. The construct is represented in Appendix A

3.3.2.6 Self-efficacy (SE)

Self-efficacy was operationalized as a polytechnics' student self-efficacy beliefs' for using technology and performing learning activities through the technology environment. The self-efficacy construct scale used in this study stressed the confidence in use technology and the

confidence of improving learning through a technology learning environment. Four (4) items defining self-efficacy in this study were drawn and modified from Sun et al., (2008) self-efficacy construct items. They were scored on a 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree to measure self-efficacy construct in the questionnaire. The construct is represented in Appendix A

3.3.2.7 Social interaction (SI)

Social interaction construct was operationalized as the feeling of communication and the confidence in the possibility of being able to interact of the students with their teachers and with their peers during their learning through technology. the four (4) items measuring social interaction in this study are made up of two sets of two items drawn and modified from Sun et al. (2008) and Yuen et al. (2019) and the later set of two items were self-written. These items were scored on a 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree to measure social interaction construct in the questionnaire. The construct is represented in Appendix A

3.3.2.8 Perceived satisfaction (PS)

Perceived satisfaction construct was operationalized as the polytechnic students' perception of the achievement in learning through technology at the individual level and the technology use level. Additionally, it takes into account the appreciation student makes for their relationship with their teachers. Polytechnic students' Satisfaction in technology use in learning was measured using four (4) items perceived satisfaction technology scale. This scale was originally developed by Liaw (2008) to measure learners' perceived satisfaction in Blackboard environments, and they were modified to adapt to technology environments in line with our definition of polytechnic students' perceived satisfaction. The items are scored on a 7-point Likert scale, ranging from 1: strongly disagree to 7: strongly agree. Perceived satisfaction (PS) construct is presented in Appendix A

3.3.3 Reliability and Validity of the Questionnaire

In order to guarantee prior reliability and validity of the questionnaire, the content validity of the questionnaire was ensured along the process of questionnaire development and further after the data collection process. Questionnaire Items were drafted based on the existing literature. Then measurement items in the questionnaire were pre-assessed for internal consistency (reliability), and construct validity. The steps supporting the development of the questionnaire involved students' and experts' opinions followed by a pilot test. For content validity, student opinions on

the questionnaire followed by the experts' opinions have been taken into consideration to improve the content validity of the questionnaire. To check the internal consistency, a pilot test has been conducted. After the data collection process, the reliability of the measurements has been evaluated through- individual item reliability, internal consistency reliability, and average variance extracted. In addition, the validity has been assessed through- discriminant validity of the construct and convergence validity of the construct that has been shown in the actual data analysis.

3.3.3.1 Content validity: Students' opinion

Students' opinion on the instrument is a crucial step in the survey questionnaire development process to check the content validity. After developing the questionnaire from the literature review with all the constructs and their associated items, the opinions of students on drafted questionnaire contributes to enhancing the content validity. The opinion on questionnaire consisted of checking if respondents understand the statements (measurement items) as well as if they can complete the tasks or have the information that questions require. Our main goal while collecting the opinion on the questionnaire was to improve both the content of the measuring items and reword items that were seemed redundant and confusing. Therefore, eleven (11) students randomly selected from the Islamic university of technology in Dhaka (capital city of Bangladesh) and were asked to examine the meaningfulness, relevance, and clarity of each statement in the questionnaire. The students were provided a questionnaire sheet (pre-test questionnaire in appendix B) in which they could tick the box Yes or No to express whether they find meaningful or no, relevant or no and clear or no each of the statements related to the construct entailed in polytechnic students' perceived satisfaction questionnaire.

3.3.3.2 Content Validity: Expert's Opinion

The questionnaire has been sent to four experts through e-mail with the instructions which specified the direction of the desired examination. Experts provided the necessary remarks, suggestions, and comments regarding the meaning, relevance, and clarity of each statement and as well as the meaningfulness of the whole questionnaire. Also, the experts had to give their opinion on the organization of the items of each construct and whether these items are likely to support the measurement of the constructs to which they are intended to measure. According to the feedback, the following modifications have been taken on the measurement items in the initial questionnaire (represented in appendix A).

- Items 1, 2, 6, 8, 9, 10, 11, 14, 16, 17, 18, 20, 25, 27, and 30 in the initial questionnaire were refined in wording, to clarify their meaning, make them more understandable and clearer for the respondents.
- Items 5, 7, 12, 16, 23, and 24 items were kept in the questionnaire although they were considered as irrelevant by some students and by experts who find that they are similar to items already appearing on the questionnaire, which therefore makes them redundant.
- The experts find item 19 more suitable to be answered by the teacher instead of students. Therefore, it has been reworded to suit with student's context.

After taking into account the opinion of both experts and students, a questionnaire with 10 questions for part A and 30 items for part B have been finalised. This new questionnaire has been submitted to the appreciation of the experts which acknowledged that it is ready to be used in the pilot test.

3.3.3.3 Reliability check: The pilot test

After the content validity check, a pilot test of the questionnaire was performed with a random sample of thirty-seven (37) volunteers from different polytechnics students. The main purpose of the pilot-test was to empirically validate the reliability of the questionnaire in order to check whether the set of items associated with each construct of the measurement instrument has sufficient accuracy or precision. Reliability here refers to the consistency of different constructs implied in the measurement instrument (Chiang, Jhangiani, & Price, 2015). There are three types of consistency namely:

- over time (test-retest reliability), is the extent to which the researchers' measure of construct that they assume to be consistent remains consistent across the time.
- across items (internal consistency), is the consistency of people's responses across the items on a multiple-item measure.
- and across different researchers (inter-rater reliability) is the extent to which different observers are consistent in their judgments.

Given that in this study, we wanted to make sure that the set of items that defined each construct allowed us to measure it optimally, so it was obvious that internal consistency is a convenient way to determine reliability.

Internal consistency shows the extent to which a group of items measures the same construct and to quantitatively support how they vary together or intercorrelated. One way to estimate the internal consistency of constructs results is by calculating Cronbach's alphas or the mean inter-item correlation (Frey, 2018). Cronbach's alpha measures the internal consistency of a group of items by measuring the homogeneity of the group of items. It assesses how well the different items round off each other in their measurement of different aspects of the same construct. The numeric value of Cronbach's alpha is between zero and one. The values closer to one indicate a higher internal consistency, unlike values closer to zero which indicate a lower internal consistency. Frey (2018) in his study reports a suggestion from McMillan and Schumacher that groups of items with alpha values less than 0.7 should be used with caution. Therefore, the group of items with Cronbach's alpha greater or equal to 0.7 shows a high and acceptable internal consistency.

The internal consistency of a construct can also be scrutinized through the average inter-item correlations. Inter-item correlations examine the extent to which the measure of one item are related to the measure of all other items in a construct. It provides an assessment of item redundancy: the extent to which items in a construct are assessing similar content. Ideally, the average inter-item correlation for a set of items should be between 0.15 and 0.5, suggesting that, although the items are reasonably homogeneous, they contain sufficiently unique variance not to be similar to each other(Frey, 2018). When values are lower than 0.15, then the items may not be representative of the same construct. If values are higher than 0.5, the items may be only capturing a small bandwidth of the construct.

Data collected from the pilot-test was analyzed using IBM SPSS to conduct internal consistency of the measurement items of each involved construct. As displayed in the table below the statistical test results confirmed solid reliability for all measurement constructs with all the values of Cronbach's alpha are above 0.70 and average inter-item correlations are within the acceptable range.

Table 3-2 Cronbach's alpha and average inter-item correlations of each construct

Construct	Cronbach's Alpha	Average Inter-Item Correlations
Perceived Usefulness	.766	.530
Perceived Ease of Use	.763	.442
Anxiety	.874	.300
Attitude	.802	.411
Self-efficacy	.698	.365

Social interaction	.757	.336
Perceived satisfaction	.707	.386

3.3.4 Data Collection Procedure

Response rate was very important in this research to ensure a good and acceptable data set. The following measures were incorporated into the data collection. In accordance with research ethics, institutional approval was sought from selected organizations before data collection began. For this purpose, emails were sent to the administration of each selected polytechnic institute, besides, telephone calls allowed us to follow up and provided many necessary details for approval. After institutional approval granted, the consent of participants was sought before the questionnaire was administered to them. In this period of a global pandemic where social estrangement is an obstacle to spread, physical contact, therefore, represents a risk. An online questionnaire was the main channel for collecting data from study participants. The Google form questionnaire was established with a single response option activated and a shuffled order of questions from one respondent to another. However, not having direct access to the participants, the good cooperation of the managers of the said polytechnics institute helped us to spread the online questionnaire within the polytechnic's students. Additionally, teachers have helped to share the link generated from the online questionnaire with their students.

Also verbal pre-survey consent was sought from the heads of department and instructors to announce the intention of using their Department for the study, and to ask for assistance and cooperation. Finally, the online questionnaire was administered to participants who consented to participate in the study.

3.4 Data preparation and data Analysis

Before embarking on any data analysis process, it is imperative to ensure that the data collected is free from any irregularities. In this regard, data screening and preparation is an essential prerequisite for effective data analysis. To describe the profile of the respondents in this study, descriptive statistics is used on the respondents' characteristics data. The statistical analysis method was chosen accordingly to the nature of our research questions. Since they entailed the investigation of the relationship between polytechnics' students perceived satisfaction and other factors that affect this perceived satisfaction, the structural equation modelling (SEM) is utilized in this study to find the relationship model among the constructs. Structural equation modelling

(SEM) is used for assessment of the measurement model and to test the fit of the proposed theoretical model with the collected data. The measurement model was estimated using confirmatory factor analysis to test whether the proposed constructs possessed sufficient validation and reliability. To assess the reliability and validity of the measurement instrument used in this study convergent reliability and discriminant validity had been demonstrated. After assessing the reliability and validity of the measurement instrument, the measurement model was estimated. After the final measurement model passed the goodness-of-fit tests, the structural part of the research model had been estimated using SEM on the structural model. The structural model was also tested for a data fit with appropriate goodness-of-fit indices. Then, the MANOVA test analysis procedure had been implemented to assess the effect of some demographic parameters on the constructs which structurally define the satisfaction model adopted in this study.

3.4.1 Data preparation

Before starting data analysis, the dataset was prepared and screened, the purpose of which was to ensure that the dataset collected was completed for each participant and that the scale scores of the observable variables were also appropriate for the stage of data analysis. In this study the missing data corresponded to the responses of those who deny giving their consent for data collection since the consent of each single participant was obtained before continuing to respond of the rest of questionnaire. In others words the online questionnaire was designed in such a way that all the negatives consent leads to end-of questionnaire when the positive consent enables the respondent to pursue the response of the remaining questions of the questionnaire. These uncompleted responses were eliminated from the dataset. Additionally, the eight negatively worded items (AX2, AX4, AX5, AT1, AT2, AT3, SI3 and SI4; for more details for the questionnaire items see the appendix) were reverse coded in the way to suit the positive logic of other items entailed in the data analysis. Since we are going from the negative configuration to a positive one it responds to the logic in the table below:

Table 3-3: reverse coded from negative to positive configuration

Negative configuration		**Positive configuration**	
Appreciation	*Score*	*Corresponded appreciation*	*Corresponded score*
Strongly Disagree	1	Strongly Agree	7
Disagree	2	Agree	6

Somewhat Disagree	3	Somewhat agree	5
Neutral	4	Neutral	4
Somewhat agree	5	Somewhat Disagree	3
Agree	6	Disagree	2
Strongly Agree	7	Strongly Disagree	1

3.4.2 Data analysis

Within the framework of this study, the sample size of participants was governed by the structural equation modelling (SEM) which is the mode of analysis implemented for our study. A sample size of around 200 respondents is recommended in studies where SEM is used. This number is nothing more than the approximate median sample size in early and recent review of published articles in which SEM results are reported (Breckler, 1990; Goldstein, Bonnet, & Rocher, 2007). However, others research have indicated that sample size in structural equation modelling (SEM) research depends on the complexity of the tested model, the estimation method, and the data distribution (Kline, 2011). Further Kline (2011) remarked that the complexity of the model increases with number of estimated parameters in the model which decreases the degrees of freedom. Therefore, more complex models require larger sample sizes (Yalcin, 2017). Having the minimum sample size required for an acceptable study remains one of the major concerns of researchers. However, many researches in this direction have given rise to one method adopted by many researchers to evaluate the minimum sample size for research that use SEM. This method proposed by Kline (2011) states that the adequate calculation of the sample size can be done using *N:q ratio*, where the ratio of *N* (sample size) to *q* (number of parameters that will be freely estimated) can be 20:1 in the ideal case, 10:1 Less ideal (Kline, 2011) and 5:1 ratio (Yalcin, 2017) is also acceptable. But it is worthy of underlining that as the N:q ratio decreases below 10:1 (e.g., 5:1 ratio), so does the trustworthiness of the results. Although the larger sample sizes are always desirable when conducting SEM research, sample size of our study, is based on the 5:1 ratio.

Data analysis was performed using the IBM SPSS statistical package together with IBM AMOS 21.0 software. Structural equation modelling (SEM) was used for the assessment of the measurement model and to test the fit of the proposed theoretical model with collected data and finally, multivariate analysis of variance (MANOVA) was used to examining the influence of

some demographic data (e.g., gender, age years of study, daily time spent studying with technology and permanent home) on the constructs entailed in the perceived satisfaction model.

Many authors (J. C. Anderson & Gerbing, 1988; Kline, 2011; Šumak, Hericko, Pušnik, & Polančič, 2011) suggested that Structural Equation Model (SEM) used as the data analysis technique is carried-out into two different steps of data analysis: **a measurement model step** and **a structural model step**.

The measurement model step deals with the relationships between observable variables(items) and latent variables (constructs). The measurement model will be estimated using confirmatory factor analysis to test whether the proposed constructs possessed sufficient validation and reliability. According to Anderson & Gerbing's (1988) approach, the measurement model is assessed in terms of overall model fit and loadings of the items on the constructs. The items that do not fit properly to a construct can be subtracted from the model at this stage. Additionally, modification indices can be used to improve the overall model fit to the data. Assessment of the measurement model also involved evaluating the constructs through the convergence reliability and discriminant validity. The evaluation of the reliability and validity of the constructs and the factor loadings of the items was intending to better the measurement model. The second step is proceeding after determining that the overall model fit was good, and the items loaded well on the constructs.

The structural model step deals with the relationships between the constructs only. The direct and the mediated effects among the constructs (latent factors) should be evaluated in this step. Direct effects Evaluation involves removing non-significant paths and entering the paths that are supported by the literature, and modification indices. Also, the fit of the structural model should be compared to the fit of the final measurement model to ensure the adequacy of the fit of the structural model. In SEM, several tests and fit indices are used to evaluate the model fit. Generally, the chi-square test of model fit is one of the common methods of evaluating model fit. The chi-square goodness-of-fit test evaluates the degree to which the observed covariance matrix is consistent with the specified model. Poor model fit values to the data results in High chi-square values. Thereby, it is preferable to have a non-significant chi-square value. In addition to the chi-square goodness-of-fit test, several fit indices are used to evaluate the model fit in SEM research. Root Mean Square Error of Approximation (RMSEA), Root mean square residuals (RMSR), Non-normed fit index (NNFI), Parsimony normed fit index (PNFI), Comparative Fit Index (CFI), and

Normed fit index (NFI) or Tucker-Lewis Index (TLI) are used to evaluate the model fit in SEM (Šumak et al., 2011). The recommended cut off values for these fit indices are (Šumak et al., 2011; Yalcin, 2017):

- Root mean square error of approximation (RMSEA) < 0.08
- Comparative fit index (CFI)/ Tucker-Lewis Index TLI > 0.90
- Root mean square residuals (RMSR) < 0.10
- Normed fit index (NFI) > 0.80
- Non-normed fit index (NNFI) > 0.90
- Parsimony normed fit index (PNFI) > 0.60

Evaluation of the measurement and structural model fit was conducted based on the chi-square goodness-of-fit test and the fit indices mentioned above.

3.4.2.1 Convergence Constructs reliability of the measurement.

The construct reliability of the measurement model consisted of evaluating the individual item reliability (squared factor loadings of the observed variables), internal consistency reliability (Cronbach alpha), and average variance extracted (AVE).

Individual item reliability

In very simple words, individual item reliability refers to the reliability of each observed variable(item). In other words, the individual item reliability captures the share of the variance in each measurement item explained by the construct (latent variable). The observed variable specified to load on a single latent variable, standardized factor loadings estimate correlations between the observed variable (item) and its latent variable (construct). Thus, squared standardized factor loadings are proportions of explained variance, or (^{2}) (Kline, 2011). Since the squared factor loading of an observed variable (^{2}) represents the proportion of variance that is explained in the observed variable by the latent factor, then this parameter is appropriate to establish the individual item reliability. Therefore, ($1 - ^2$) the remaining variance is the error variance that the latent factor (construct) fails to explain. In the structural equation modeling (SEM) the ideal factor loading is greater than 0.7 (^{2} = 0.49) (Kline, 2011) and when the factor loadings are lesser than 0.30 (^{2} = .09) they indicate that the latent factor may not explains well the observed

variable and this later should be removed from further analyses (Yalcin, 2017). Therefore, all the value of factor loadings equal or greater than 0.3 should be considered.

internal consistency reliability

Internal consistency reliability for each construct in the measurement model was evaluated by calculating Cronbach's alpha coefficient of each construct. Cronbach's alpha was explained largely in the pilot test of the questionnaire section.

Average variance extracted.

Average variance extracted (AVE) measures the level of variance captured by a construct versus the level due to measurement error. The AVE for each construct can be obtained by the sum of squares of completely standardized factor loadings divided by this sum plus the sum of error variances for the observed variable. The values of AVE lesser than 0.5, reflect the fact that the variance due to measurement error is greater than the variance captured by the respective construct(Segars, 1997). Thereby the acceptable values of AVE should be equal or greater than 0.5 however, the values above 0.7 are considered very good.

3.4.2.2 Discriminant Validity of the Measurements

discriminant validity establishes that a set of observed variables presumed to measure different constructs do it in reality(Kline, 2011). In the more intelligible way, the discriminant validity of a construct refers to the construct's distinctiveness from other constructs. In this logic, its essence is to show evidence that the items or observed variables loaded in the distinct constructs or latent variables contribute to measuring only the construct under which they are load. Since correlation allows to clearly and easily quantify the strength of a relationship between constructs (Jackson, 2009) in that way, to ensure that the constructs are distinct from each other, low correlations among constructs are preferable and high correlations are investigated to ensure that the constructs are different from each other. Thereby the values of correlations among the constructs or the bivariate correlations that are higher than 0.700 are highlighted for further investigation (Yalcin, 2017). The validation of the distinctiveness of constructs that show the bivariate correlations higher than 0.7, a chi-square (^{2}) difference test is performed for each bivariate correlation to compare the model in which those constructs are two different constructs and the model in which those constructs are combined to form one constructs. A significantly lower ^{2}value for the model in which the

constructs are distinct would indicate that they are not perfectly correlated and that discriminant validity is achieved(J. C. Anderson & Gerbing, 1988; Yalcin, 2017).

3.4.2.3 MANCOVA

Multivariate analysis of variance commonly called MANOVA examines the differences between groups. More precisely MANOVA examines the group differences across multiple dependent variables simultaneously. Sthle & Wold (1990) indicated that the procedure for implementing this analysis technique requires two or more dependent variables and is often followed by significance tests involving individual dependent variables separately. Moreover, they highlighted some subjective assumptions (Normal Distribution, Linearity, Homogeneity of Variances) that are necessary to be made and tested as prerequisites of the analysis itself. As part of this study, this analysis aims to specify the effect or influence of certain demographic parameters such as gender, age range, year of study, time spent studying through technology, permanent home on the constructs involved in the conceptual model governing this study. In order to respond unambiguously to this concern, we have opted for the composite variables which are in fact the fusion of the items which characterize each construct. this results in the average of the measurements produced by each item of the construct. Thus, dependent variables can be represented directly by constructs instead of being represented by items. From this point of view, the dependent variables are attitude, self-efficacy, social interaction, and perceived satisfaction and the independent variables are the evoked demographic parameters. Then a multivariate analysis of variance (MANOVA) was used to test the effect of the independent variable on the dependent variables. For example, the effect of gender through either one was female, or male was evaluating simultaneously on attitude, self-efficacy, social interaction, and perceived satisfaction. Spss allow to perform it by using either Wilks, Hotelling's trace or Pillai’s statistics criterion.

3.5 Ethics

All formal research work is subject to ethics and safety obligations which not only contribute to the smooth running of the research but also gives more credibility to the finding which results from it. A fair explanation of the procedures to be followed and their purposes was given to all the participants in such a way that they were clearly aware of.

Access to the polytechnics institutes where the research was conducted and acceptance by those whose permission was needed before embarking on the task were the prior conditions to start the

research. In the case of this study since the data was collected by the mean of online questionnaires due to the pandemic barrier measures issued by the government of Bangladesh, the agreement and cooperation of the establishment managers were essential and quite beneficial. However, the anonymity of respondents was guarantee while collecting the data from them.

The essence of anonymity is that information provided by participants should in no way reveal their identity. All participants had been given the chance to remain anonymous. To maintain anonymity and to ensure an honest response, information that could especially identify the student was not asked.

3.6 Conclusion

In short, this chapter has made it possible to examine the theoretical framework governing perceived satisfaction and to be able to develop a conceptual framework through a model allowing to highlight the polytechnics' students perceived satisfaction of technology in their learning. The interest being focused on a population made up of the students at the polytechnic institute and the circumscription of the context of research made it possible to appreciate the extent of our population. However, because of the large number of polytechnics students who constitute this population, we were able to define the sample size under the constraint of the data analysis technique as well as the sampling technique adopted. Thus, the sample was intended to provide data employing an online questionnaire made up of 32 questions spread over seven constructs and scored on a 7-point Likert scale ranging from 1: strongly disagree to 7: strongly agree. the questionnaire used constitutes items from the literature that has undergone a rigorous pretest and pilot test, leading to its development and its implementation. Finally, the data were displayed through descriptive analysis and the data analysis was done through measurement step analysis and structural step analysis whose represent the steps of the Structural equation model. Furthermore, MANOVA allows us to evaluate the effect of gender, age, year of study, time of study using technology, and permanent living place on the perceived satisfaction constructs entailed in the conceptual model.

Chapter 4 Data analysis and result

4.1 Introduction

This chapter provides the statistical analysis and insights into data collected from the survey and explains students perceived satisfaction in terms related theoretical constructs by investigating their underlying relationships. In other words, this chapter explores the relationships among the factors that affect polytechnic students' perceived satisfaction and validates a model to explain students' perceived satisfaction in using technology in their study. In this process, first the participants and the demographic information has been presented using descriptive statistics. Next, the validity and reliability assessments are given to assess the underlying relationships between the measured and latent variables. Further, structural model analysis is used to shed the light on the factors interrelation and by extension, the mediating role played by the attitude construct between the perceived usefulness (PU), perceived ease of use (PEU), the anxiety (AX) constructs with perceived satisfaction construct. Finally, the results obtained via the MANOVA analysis procedure showed the effect of some demographic parameters (gender, age, district, level of the academic year, living place, study time using technology and type of internet connection used) on students' perceived satisfaction.

4.2 Descriptive Statistics

The online questionnaire was reached to a total of 1002 polytechnic students in which 43 of them refused to give their consent to be a participant for this study. In total 959 students took participate in this study. During data screening, we identified 112 pattern responses which revealed the same response pattern (either strongly agree or disagree in all the items) across the questionnaire. This type of response usually indicates a lack of attention or lack of devotion from participants when completing the online questionnaire. Thereby, these 112 students' responses were deleted from the data set. Thus, the final sample consisted of 847 polytechnics for this study. Figure 4-1 shows the data collection and data screening procedure.

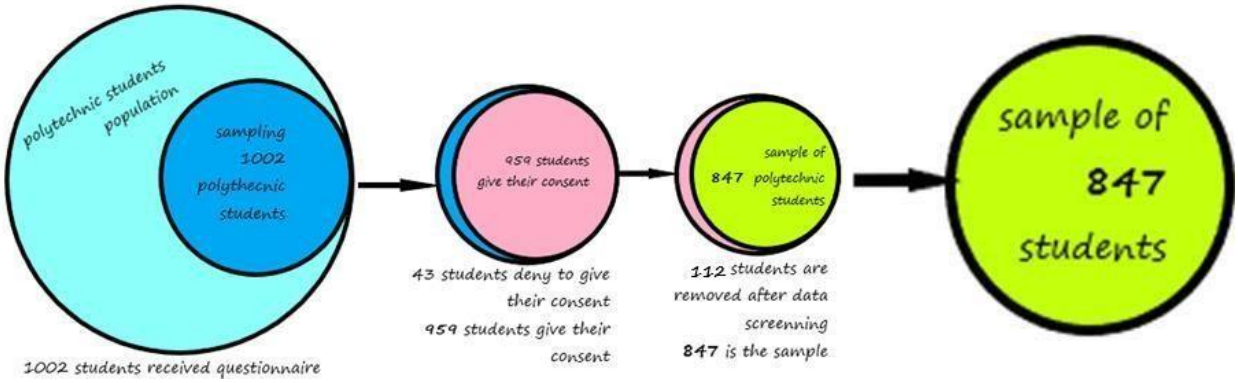

Figure 4-1 data screening process

It is to be noted that the demographic parameters that were taken into account within the framework of this study were mainly gender, age, division of the polytechnic institute, department, year of study, devices used by students in their study, daily study time using technology, type of internet connection while studying using technology, place of living during study, and permanent living place (home).

4.2.1 Gender, age, living place and permanent home of participants

847 polytechnics students with an important proportion of the male gender (almost 2 times the proportion of female) effectively participated in this study. The students that the age is situated in the range 18-22 Years represent the majority of the participants (77.8% of the total participants) inversely the students with age above 27 years represent the minority of the participants (.5%). The majority (56.6%) of participants live at home and only 11.2% of participants live in the institutional halls. 61.5% of participants live in the village only 16.9% of participants live in the city. Also, very few of the participants (9.1%) live in the district town. Table 4-1 below displays the distribution of the participants according to gender, age ranges, living place and their permanent home location.

4.2.2 Year of study, department and polytechnics' division of participants

40% of the participants have their polytechnics institute located in the Dhaka division which is a significant percentage compared to only 2.1% percent of participants coming from Khulna and Rampur combined. Also, there is almost a balance between the participants from the first half of the study program (first and second years) 47.1% and the participants from the last half of the study program (third and fourth years) 52.9%. further, the participants from the Electrical and Electronic department (30%), the participants from computer sciences department (24.1%), the participants from the architecture department (19.4%), and the participant from mechanical engineering department (13.1%) represented more than three fourth (86.6%) of the participants in

this study. Tables 4-2 and 4-3 below display the distribution of the participant based on the division of their polytechnics institutes and year of study and their department respectively.

Table 4-1 gender, age, living place and permanent home distributions of the participants

Demographic variables	Variants	Frequency (N= 847)	Percentage	Cumulative Percentage
Gender	Male	528	62.3	62.3
	Female	319	37.7	100
Age	Less than 18 years	166	19.6	19.6
	18-22 Years	659	77.8	97.4
	23-27 Years	18	2.1	99.5
	Above 27 Years	4	0.5	100
Place of living during study	Home	479	56.6	56.6
	Institutional Halls	95	11.2	67.8
	Rental houses	273	32.2	100
Permanent Home Location	City	143	16.9	16.9
	District town	77	9.1	26
	Thana Town	106	12.5	38.5
	Village	521	61.5	100

Table 4-2 polytechnics' institute division and year of study distribution of participant

Demography variables	Variants	Frequency (N=847)	Percentage	Cumulative Percentage
Division (your polytechnic's Division)	Barishal	123	14.5	14.5
	Chittagong	68	8	22.6
	Dhaka	339	40	62.6
	Khulna	7	0.8	63.4
	Mymensingh	109	12.9	76.3
	Rajshahi	36	4.3	80.5
	Rangpur	11	1.3	81.8
	Sylhet	154	18.2	100
Year of Study	First Year	126	14.9	14.9
	Second Year	273	32.2	47.1
	Third Year	185	21.8	68.9
	Fourth Year	263	31.1	100

Table 4-3 distribution of participants according to their department

Demographic variables	Variants	Frequency (N= 847)	Percentage	Cumulative Percentage
Department	Architecture	164	19.4	19.4
	Architecture and interior design	1	0.1	19.5
	Civil	41	4.8	24.3
	Computer Science	204	24.1	48.4
	Construction	8	0.9	49.4
	Electromedical	30	3.5	52.9
	Electrical and Electronic	254	30	82.9
	Environmental	10	1.2	84.1
	Food	1	0.1	84.2
	Mechanical	111	13.1	97.3
	Mechatronics	2	0.2	97.5
	Power	21	2.5	100

4.2.3 Devices used by participants in their study

78.7% of participants spent 1-5 hours daily to study through technology and 8.6% participants spent above 5 hours studying through technology. Also, we noted 64.2% of participants use only the mobile phone device for learning purposes, 19.6% use mobile devices combined with other devices (tablet, laptop, desktop). Very few participants (3.5%) used only desktop for learning purposes further poor rate (5.7%) of participants do not combine desktop with other devices. Furthermore, 68.4% of participants use only mobile data internet when they study through technology and only 17.6 % of participants use broadband to access internet connexion when they learn through technology. Table 4-4 shows an insight into the distribution of the participants according to the daily time spent to study through technology and the type of internet connexion used. and Table 4-5 displays the number of participants associated with technology devices used in their learning.

Table 4-4 distribution of the participants according to the daily time spent to study through technology and the type of internet connexion used

Demographic variables	Variants	Frequency (N= 847)	Percentage	Cumulative Percentage
time spend daily for study using technology	Less than 1 hour	107	12.6	12.6
	1-2 hours	357	42.1	54.8
	2-5 hours	310	36.6	91.4
	Above 5 hours	73	8.6	100
type of internet connection normally uses while studying using technology	Broadband	149	17.6	17.6
	Mobile data	579	68.4	86
	Both	111	13.1	99.1
	None	8	0.9	100

Table 4-5 distribution of participants according to the devices used during learning

Demographic variables	Variants	Frequency (N= 847)	Percentage	Cumulative Percentage
devices used in while studying	Desktop	30	3.5	3.5
	Laptop	96	11.3	14.9
	Mobile	544	64.2	79.1
	Tablet	9	1.1	80.2
	Desktop;Laptop	3	0.4	80.5
	Desktop;Mobile	28	3.3	83.8
	Laptop;Mobile	114	13.5	97.3
	Mobile;Tablet	3	0.4	97.6
	Desktop;Laptop;Mobile	12	1.4	99.1
	Desktop;Mobile;Tablet	1	0.1	99.2
	Laptop;Mobile;Tablet	3	0.4	99.5
	Desktop;Laptop;Mobile;Tablet	4	0.5	100

4.3 Measurement model evaluation

Initially, the measurement model defined as part of this study is made up of 30 observed variables or indicators distributed across 7 constructs or latent variables. The following figure shows the initial measurement model of the proposed conceptual framework.

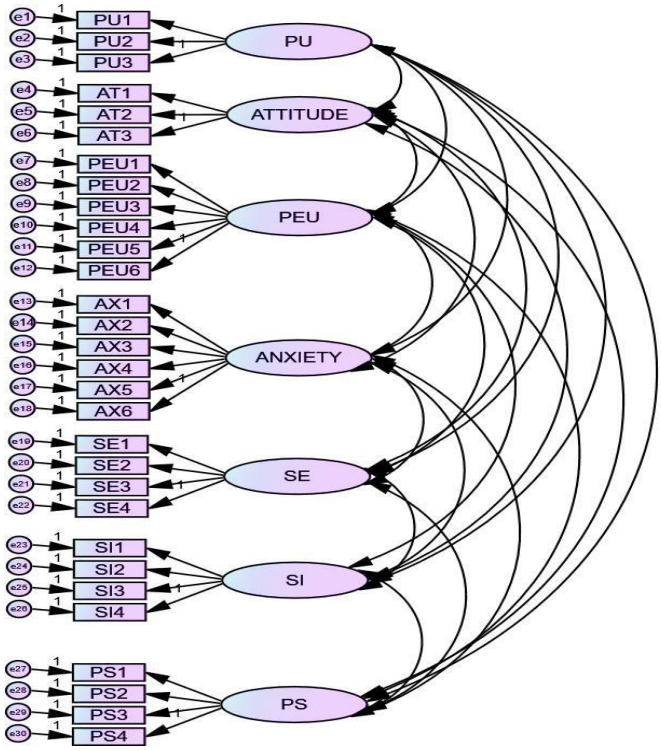

Figure 4-2 Initial Measurement Model of Learners' Satisfaction through technology

4.3.1 Construct Reliability of the Measurements

Construct reliability of the measurement model was evaluated taking into account the individual item reliability, internal consistency of the items, and average variance extracted (AVE).

4.3.1.1 Individual item reliability

The individual item reliability is the reliability of each observed variable or the proportion of variance of the observed variable that can be explained by the latent variable (construct). The observed variable specified to load on a single latent variable denoted as standardized factor loadings (λ) estimates correlations between the observed variable (item) and its latent variable (construct). Thus, squared standardized factor loadings (^{2}) are proportions of explained variance (Kline, 2011). Since the squared factor loading of an observed variable (^{2}) represents the proportion of variance that is explained in the observed variable by the latent factor, then this parameter is appropriate to establish the individual item reliability. Therefore, $(1 - ^2)$ the

remaining variance is the error variance that the latent factor (construct) fails to explain. For example, in table 4.12 the standardized factor loading of PU1 is0.745 and the squared standardized factor loading is 0.550. it means that 55% of the PU1 variance is explained by the Perceived Usefulness construct and it fails to explain 45% (1-55%) of the variance this later is also known as error. In SEM all the value of factor loadings either equal to or greater than 0.3 was considered. In the table 4-12 the standardized factor loadings are ranged from the minimum 0.137 (^{2} =0.019) to the maximum 0.832 (^{2} =0.692). It is worthwhile to mention that apart from the observed variable loaded under the Anxiety construct all other observed variables loaded under other constructs showed acceptable standardized factors loading. Therefore, we have the evidence of significant individual reliability for all items loaded except the Anxiety construct. However, some observed variables of the Anxiety's construct with lower and insufficient factors loading had been deleted to better the standardized factors loading of the observed variables of this construct. Thereby, items AX2, AX3, and AX6 had been removed from the Anxiety latent variable as shown in figure 4-3 below. This helped to increase the standardized factor loading of the items AX1(0.611), AX4(0.653), and AX5 (0.577). Thus, allowing us to admit through the values contained in table 4-13 that all the constructs explain in a reasonable proportion the variances of their respective observed variables. Then all the observed variables presented a significant individual items reliability.

4.3.1.2 Internal consistency reliability

Internal consistency reliability for each construct in the measurement model was evaluated by calculating Cronbach's alpha coefficient of each construct. For a suitable internal consistency, the Cronbach alpha value must be equal or above 0.7. As part of this study, the maximum value of Cronbach alpha in table 4-13 was 0.865 (Perceived Ease of Use) and the minimum was 0.640 (Anxiety). therefore, we can consider that all our constructs showed acceptable internal consistency reliability.

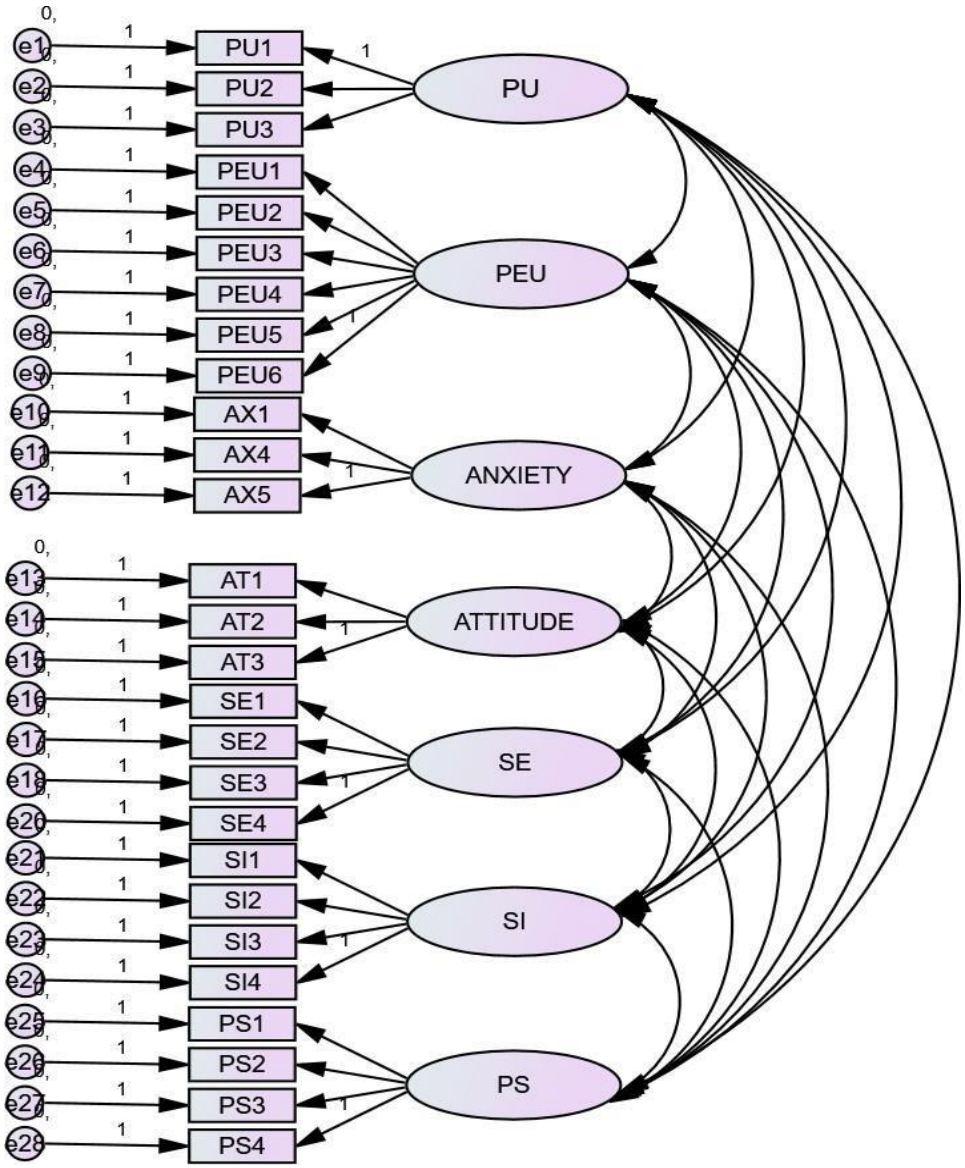

Figure 4-3 measurement model after removing AX2, AX3 and AX6

Table 4-6 descriptive statistics of the observed variables

constructs	Observed variable codes	frequency (N=847)	Mean	Std. Deviation	Skewness	Kurtosis
perceived usefulness (PU)	PU1	847	5.84	1.464	-1.501	1.798
	PU2	847	5.69	1.491	-1.279	1.145
	PU3	847	5.62	1.508	-1.211	0.88
perceived ease of use (PEU)	PEU1	847	5.54	1.614	-1.184	0.682
	PEU2	847	5.54	1.5	-1.162	0.827
	PEU3	847	5.56	1.543	-1.19	0.825
	PEU4	847	5.51	1.517	-1.123	0.668
	PEU5	847	5.44	1.561	-0.992	0.258
	PEU6	847	5.61	1.569	-1.293	1.047
Anxiety (AX)	AX1	847	4.03	2.011	0.017	-1.294
	AX2	847	3.57	2.06	0.294	-1.263
	AX3	847	3.11	1.777	0.643	-0.558
	AX4	847	3.67	1.99	0.224	-1.234
	AX5	847	3.7	2.081	0.225	-1.344
	AX6	847	2.27	1.54	1.34	1.154
Attitude (AT)	AT1	847	5.88	1.367	-1.518	2.031
	AT2	847	5.86	1.384	-1.487	1.898
	AT3	847	5.75	1.474	-1.394	1.392
Self-efficacy (SE)	SE1	847	5.41	1.564	-0.995	0.249
	SE2	847	5.6	1.504	-1.244	1.024
	SE3	847	5.61	1.409	-1.099	0.693
	SE4	847	5.57	1.487	-1.144	0.692
Social interaction (SI)	SI1	847	5.93	1.422	-1.593	2.131
	SI2	847	5.69	1.585	-1.361	1.134
	SI3	847	5.75	1.515	-1.366	1.183
	SI4	847	5.49	1.592	-1.062	0.289
Perceived Satisfaction (PS)	PS1	847	5.68	1.443	-1.294	1.235
	PS2	847	5.6	1.538	-1.254	0.939
	PS3	847	5.34	1.68	-1.018	0.168
	PS4	847	5.58	1.519	-1.258	1.036

4.3.1.3 Average variance extracted (AVE)

The AVE for each construct was obtained by the sum of squares of completely standardized factor loadings divided by this sum plus the sum of error variances for the observed variable. The values obtained as part of this study are ranged from 0.58 (Perceived Ease of Use) to 0.4 (Anxiety).

Table 4-7 items and construct reliability in the initial measurement model

constructs	observed variable codes	λ	R^2	Cronbach's Alpha	AVE
Perceived usefulness (PU)	PU1	0.753	0.567	0.795	0.56
	PU2	0.754	0.569		
	PU3	0.746	0.557		
Perceived ease of use (PEU)	PEU1	0.745	0.555	0.865	0.52
	PEU2	0.678	0.46		
	PEU3	0.671	0.45		
	PEU4	0.719	0.517		
	PEU5	0.74	0.548		
	PEU6	0.754	0.569		
Anxiety (AX)	AX1	0.832	0.692	0.68	0.174256
	AX2	-0.214	0.046		
	AX3	-0.238	0.057		
	AX4	-0.399	0.159		
	AX5	-0.27	0.073		
	AX6	-0.137	0.019		
Attitude (AT)	AT1	0.722	0.521	0.804	0.58
	AT2	0.777	0.604		
	AT3	0.784	0.615		
Self-efficacy (SE)	SE1	0.66	0.436	0.813	0.53
	SE2	0.755	0.57		
	SE3	0.779	0.607		
	SE4	0.706	0.498		
Social interaction (SI)	SI1	0.718	0.516	0.824	0.54
	SI2	0.781	0.61		
	SI3	0.7	0.49		
	SI4	0.743	0.552		
Perceived Satisfaction (PS)	PS1	0.771	0.594	0.821	0.55
	PS2	0.798	0.637		
	PS3	0.592	0.35		
	PS4	0.794	0.63		

Table 4-8 items and construct reliability of measurement model after removing AX2, AX3, and AX6

constructs	observed variable codes	λ	R^2	Cronbach's Alpha	AVE
Perceived usefulness (PU)	PU1	0.753	0.567009	0.795	0.56
	PU2	0.754	0.568516		
	PU3	0.746	0.556516		
Perceived ease of use (PEU)	PEU1	0.745	0.555025	0.865	0.52
	PEU2	0.678	0.459684		
	PEU3	0.671	0.450241		
	PEU4	0.719	0.516961		
	PEU5	0.74	0.5476		
	PEU6	0.754	0.568516		
Anxiety (AX)	AX1	0.611	0.373321	0.64	0.4
	AX4	0.653	0.426409		
	AX5	0.577	0.332929		
Attitude (AT)	AT1	0.722	0.521284	0.804	0.58
	AT2	0.777	0.603729		
	AT3	0.784	0.614656		
Self-efficacy (SE)	SE1	0.66	0.4356	0.813	0.53
	SE2	0.755	0.570025		
	SE3	0.779	0.606841		
	SE4	0.706	0.498436		
Social interaction (SI)	SI1	0.718	0.515524	0.824	0.54
	SI2	0.781	0.609961		
	SI3	0.7	0.49		
	SI4	0.743	0.552049		
Perceived Satisfaction (PS)	PS1	0.771	0.594441	0.821	0.55
	PS2	0.798	0.636804		
	PS3	0.592	0.350464		
	PS4	0.794	0.630436		

4.3.2 Discriminant Validity of the Measurements

As indicated earlier in section 3.3.4.5 discriminant validity seeks to show how two construct that are not by definition supposed to be related are unrelated. Since each latent variable is defined by a set of observed variables, thus it implicitly saying that the observed variables define only the measure of the latent variable under which they are loaded and not another latent variable. Then analyzing the correlation of one latent variable with another and so on is necessary to understand how distinct they are from each other. Thereby the values of correlations among the latent variable

or the bivariate correlations that are higher than 0.700 indicates that they are not distinctly separated and required further investigation (Yalcin, 2017). The validation of the distinctiveness of the latent variable, in that case, was done through a chi-square (^{2}) difference test. This test has been performed for each bivariate correlation to compare the model in which those latent variables are two different constructs and the model in which those latent variables are combined to form one constructs. As part of this study, the table of construct correlation matrices (Table 4-14) shows 15 bivariable correlations with values above 0.7. (shown as bold font in table 4.1). Therefore, in order to improve the discriminant validity of this model we compared the model in which the two latent variables are distinct with the model in which the two latent variables are combined to form one variable. For example, the correlation between perceived usefulness (PU) and perceived ease of use (PEU) is 0.986. Therefore, to assert the distinctiveness between PU and PEU constructs we compared the basic model in which the PU and PEU are separated constructs and the model in which they are combined to form one construct. Since the chi-square goodness of fit of the basic model was (^{2}(303) = 816.8, < 0.01);and the chi-square goodness of fit for the model in which PU and PEU are combined was (^{2}(309) = 833.6, < 0.01); and the chi-square difference was (^{2} (6) = 16.8, < 0.01) Result shows there is a significant difference between these two model, and thus we conclude that perceived usefulness (PU) and perceived ease of use (PEU) are two distinct constructs. For the remaining 14 bivariable correlations we found that the chi-square difference tests that compared the basic measurement model with the corresponding combined factor models resulted in significant chi-square values:

1. combined Attitude-Perceived usefulness model (^{2} (6) = 111.2, < 0.01),
2. combined Attitude-Perceived ease of use model (^{2} (6) = 126.8, < 0.01),
3. combined Perceived usefulness- Self efficacy model (^{2} (6) = 271.4, < 0.01),
4. combined Perceived ease of use - Self efficacy model (^{2} (6) = 327.9, < 0.01),
5. combined Self efficacy- Attitude model (^{2} (6) = 73.9, < 0.01),
6. combined social interaction-perceived usefulness model (^{2} (6) = 420.1, < 0.01),
7. combined social interaction-perceived ease of use model (^{2} (6) = 467.1, < 0.01),
8. combined social interaction-attitude model (^{2} (6) = 163.9, < 0.01),
9. combined social interaction- Self efficacy model (^{2} (6) = 64, < 0.01),

- combined perceived satisfaction-perceived usefulness model (χ^2 (6) = 437.2, <0.01),
- combined perceived satisfaction-Perceived ease of use model (χ^2 (6) = 525.2, <0.01),
- combined perceived satisfaction-attitude model (χ^2 (6) = 178.9, < 0.01),
- combined perceived satisfaction- Self efficacy model (χ^2 (6) = 48.9, < 0.01),
- combined perceived satisfaction-social interaction model (χ^2 (6) = 48.1, < 0.01).

Therefore, despite the high correlation values between some constructs, the chi-square difference tests revealed that these constructs were distinct, and logically showed the strong evidence of the constructs' discriminant validity established for the basic measurement model.

Table 4-9 constructs correlation matrices

constructs	**PU**	**PEU**	**AX**	**AT**	**SE**	**SI**	**PS**
perceived_usefulness (PU)	1						
Perceived_easy_of_use (PEU)	**0.986**	1					
ANXIETY (AX)	-0.122	-0.119	1				
ATTITUDE (AT)	**0.928**	**0.884**	-0.056	1			
Self_efficacy (SE)	**0.84**	**0.851**	-0.061	**0.923**	1		
Social_interaction (SI)	**0.771**	**0.767**	-0.059	**0.86**	**0.915**	1	
Perceived_Satisfaction (PS)	**0.758**	**0.778**	-0.058	**0.866**	**0.941**	**0.92**	1

4.3.3 Model Fit Evaluation of the Measurement Model

The poor factor loadings of some indicators provided by AMOS prompted the removal from the initial model some items (AX2, AX3, and AX6) and then the overall fit model for the final measurement model was estimated to ensure a good data fit with the model. The model fit was evaluated as per the fit indices and their cut-off values proposed by Rainer and Miller (1996). These fit indices consist of $\chi 2$, the comparative fit index (CFI), the root mean squared residual (RMSR), the root mean square error of approximation (RMSEA), the normed fit index (NFI), the non-normed fit index or Tucker Lewis index (NNFI or TLI) and the parsimonious fit indices (PNFI). The table 4-15 shows the fit indices of both the initial model and the model after removing

AX1, AX3, and AX6 (modified measurement model). In the initial model, there were some model-fit indices with the values out of the requirements ranges, however, the obtained model after modification of the initial model show the optimum fit indices.

Table 4-10 model fit indices of initial model and model after removing AX2, AX3, and AX6

Fit indices	**Recommended value**	**initial measurement fit**	**measurement model after removing AX2, AX3, and AX6**
χ^2	….	1444.778	816.835
Degrees of freedom (df)	….	384	303
p	P-Value	0.001	0.001
χ^2/df	< 3.00	3.762	2.696
Comparative fit index (CFI)	>0.9	0.92	0.958
Root mean square residuals (RMSR)	<0.1	0.056	0.031
Root mean square error of approximation (RMSEA)	<0.08	0.057	0.045
Normed fit index (NFI)	>0.9	0.894	0.936
Non-normed fit index (NNFI or TLI)	>0.9	0.909	0.952
Parsimony normed fit index (PNFI)	> 0.60	0.789	0.808

4.4 Assessment of the Structural Model

A SEM analysis was used to develop a structural model that explains polytechnic students' perceived satisfaction and to delve into the relationships among the factors that affect polytechnic students' perceived satisfaction in the use of technology in their learning. As indicated by the two-step approach suggested by Anderson and Gerbing's (1988), the second step of structural equation modelling (SEM) consist of assessing the fit of the structural model by comparing it to the fit of the final measurement model and additionally, to scrutinize the mediating effect of Attitude and, the direct effects among the latent variable in order to test the research hypotheses.

4.4.1 Model fit of the structural model

Table 4-11 models fit indices of the structural model and measurement model after removing AX2, AX3, and AX6

Fit indices	**Recommended value**	**measurement model after removing AX2, AX3, and AX6**	**structural model**
χ^2	….	816.835	862.603
Degrees of freedom (df)	….	303	310
p	P-Value	0.001	0.001
χ^2/df	< 3.00	2.696	2.783
Comparative fit index (CFI)	>0.9	0.958	0.955
Root mean square residuals (RMSR)	<0.1	0.031	0.033
Root mean square error of approximation (RMSEA)	<0.08	0.045	0.046
Normed fit index (NFI)	>0.9	0.936	0.932
Non-normed fit index (NNFI or TLI)	>0.9	0.952	0.949
Parsimony normed fit index (PNFI)	> 0.60	0.808	0.823

After drawing and processing the structural model shown in figure 4.4 in AMOS software the estimated values of fit indices have proven the appropriate structural model fit to the data. Further, the values of fit indices for both structural and measurement model presented in table 4-16 are almost similar with a few insignificant differences.

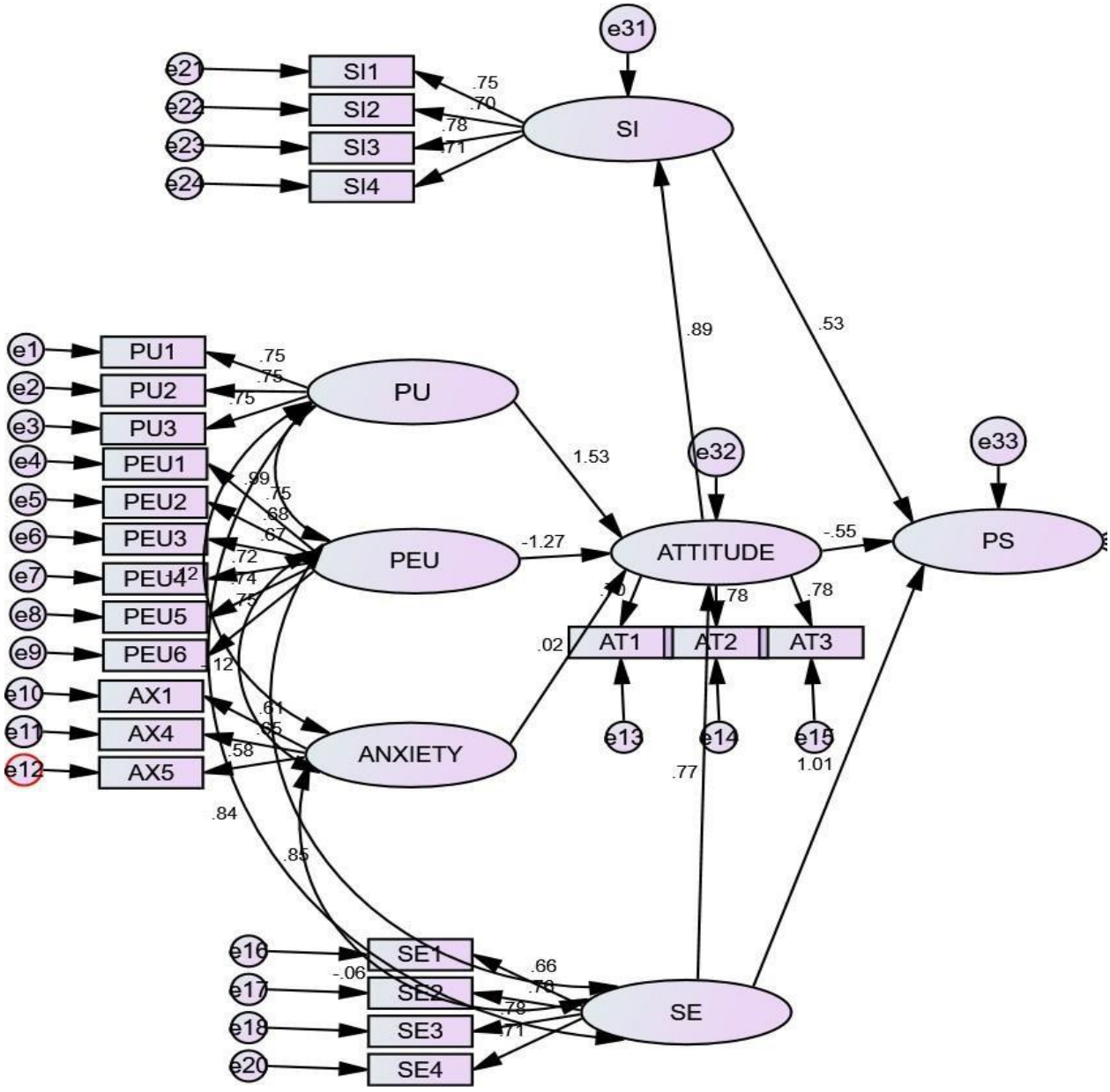

Figure 4-4 structural model in AMOS

4.4.2 Direct effects analysis

The structural model assessment implied investigating the direct effects among the latent variable aiming to test the research hypotheses thereof. Table 4-17 is a summary of the unstandardized and standardized coefficients for the direct effects, the probability (P) and the error variances (S.E.) of the endogenous variables. Information concerning the effect that a latent variable has effect on another latent variable is appreciable through the unstandardized or standardized coefficient given. For example, in the case of the direct effect of social interaction (SI) on perceived satisfaction (PS), the unstandardized coefficient (k = 0.563) represents the expected change in perceived satisfaction for each unit change in social interaction while maintaining all other variables constant. The standardized coefficient (*k** = 0.53), however, quantifies the extent of change occur in the standard deviation of perceived satisfaction caused by one standard deviation change in social interaction (SI) while maintaining all other variables constant. A negative value of either unstandardized or standardized coefficient points out the negative relationship that prevails between two variables which indicates that while one variable increases, the other variable decreases, or vice versa. In other words, this merely means that these variables have opposite directions of variation.

Table 4-12 Parameter Estimates of the Hypothesized Structural Model

	unstandardized coefficient (k)	S.E.	standardized coefficient(*k**)	P-value	hypothesis-testing
perceived_usefulness →ATTITUDE	1.587	1.265	1.526	0.21	not supported
Perceived_ease_of_use →ATTITUDE	-1.234	1.199	-1.274	0.303	not supported
ANXIETY →ATTITUDE	0.021	0.042	0.022	0.622	not supported
Self_efficacy → ATTITUDE	0.839	0.111	0.771	***	Supported
ATTITUDE → Social_interaction	0.881	0.045	0.892	***	Supported
ATTITUDE → Perceived_Satisfaction	-0.579	0.241	-0.552	*	supported
Self_efficacy → Perceived_Satisfaction	1.15	0.252	1.008	***	Supported
Social_interaction→Perceived_Satisfaction	0.563	0.087	0.53	***	Supported

* p <0.05; ***p < 0.001

As part of the direct effect analysis and in the overall study the critical value or the alpha level (alpha level which represents the probability to which the research hypothesis is true) was set at α = .05 for the hypothesis testing, therefore, a *p*-value that was lesser than 0.05 was accepted as statistically significant. The hypothesis testing unveiled the significance of some direct effects and also the insignificance of some other at either α = 0.05 or α = 0.001. in accordance with the parameters estimated and displayed in Table 4.17, Attitude was positively influenced by self-efficacy (k^* =0.771, $p < 0.001$), social interaction was positively influenced by attitude (k^* = 0.892, $p < .001$), and perceived satisfaction was influenced positively by self-efficacy (k^* = 1.008, $p <$
.001), social interaction (k^* = 0.53, $p < .001$), and influenced by Attitude (k^* = -0.552, $p < .01$). However, the influences of perceived usefulness, perceived ease of use and anxiety were found statistically no significant on Attitude. These results point out the importance of social interaction (which environmental factor), self-efficacy (a part of personal factor) and attitude (one of TAM factor considered) on polytechnic's student perceived satisfaction in learning through technology. Also since there was the lack of evidence to comfort the influences of Perceived Usefulness, Perceived Ease of Use and Anxiety it was not relevant to investigate the indirect effect of those constructs on perceived satisfaction by analysing the mediator role of Attitude.

4.4.3 Mediation effect analysis

A mediator is a variable that convey the influence of predictor variable on the criterion variable or dependent variable(Kenny & Baron, 1986). The proposed model displays the significant direct effect of AT and SI on PS and also the direct effects effect of SE on AT and the direct effect of AT on SI are significant. Therefore, the Sobel mediation analysis was conducted to scrutinize the role AT in the relationship between SE and PS (1) and the contribution of SI in the relationship between AT and PS (2). The level of significance alpha was set at α = .05 for the mediation analysis.

Unstandardised coefficient of indirect effect is computed by multiplying the direct effect from the predictor variable to the mediator variable and the direct effect from the mediator variable to the dependent variable. Further this value embody the unstandardized indirect effect that the predictor variable has on the dependent variable. For example the coefficient of the indirect effect of self-

efficacy on perceived satisfaction is -.48 and it is computed by multiplying the direct effect that self-efficacy has on attitude (i.e., *k* =.839) and the direct effect that attitude has on perceived satisfaction (i.e., *k* =-.579). Sobel test coefficient or Sobel critical ratio is obtained according to Kenny & Baron (1986) and Sobel (1982) program calculator by adding to calculator the values a (unstandardised coefficient of the direct effect of the predictor on the mediator), b the unstandardised coefficient of the direct effect of the mediator on the dependent variable), s_a(standard error corresponding to direct effect of the predictor on mediator) and S_b (standard error corresponding to direct effect of the mediator on the dependent variable). Then, the program calculated the critical ratio as a test of whether the indirect effect of the predictor on the dependent variable via the mediator is significantly different from zero.

Table 4-13 parameter estimates for indirect effect

	Sobel ratio	SE	Unstandardized coefficient	P value
SE→AT→PS	-2.3	0.212	-0.486	*
AT→SI→PS	6.14	0.08	0.496	*
* P<0.05				

According to the level of significance presented in table-13, there is no p-value greater than critical value alpha (0.05). Therefore, attitude significantly mediated the relationship between self-efficacy and perceived satisfaction (k=-0.486, p<0.05) and also, social interaction significantly mediated the relationship between attitude and perceived satisfaction (k=0.496, p<0.05)

4.5 The influence of demographic variables on the students' perceived satisfaction

In general, to objectively examine the influence of more than two levels of an independent variable on more than two dependent variables, two possibilities can be considered: - firstly we can consider a separate number of ANOVAs (Analysis of variance) test. The ANOVA is referred to as a univariate test since the analysis involves only one dependent variable despite allowing more than one independent variable. This analysis helps to scrutinize the differences among group means embodied in this case by the levels of the independent variable. it consists of verifying whether there is a significant difference between the means of groups considered on each dependent variable(Jackson, 2009). However, this approach due to the repeated ANOVA was shown as being likely to increase the likelihood of type I error (reject the null hypothesis when the null hypothesis

is true) and then subjected to numerous criticisms (Sthle & Wold, 1990). This approach thereby was not an optimal and convenient way to conduct this investigation. – secondly, rather than undertaking two or more separate ANOVAs we can undertake a single multivariate analysis of variance also termed as MANOVA (independent or repeated measures). The main point of a MANOVA is that it is essentially dedicated to examining in a single process the effect of the independent variables on two or more composite dependent variables. The advantage of the MANOVA over several separate ANOVAs is that it can keep the overall probability of a type I error fixed at a chosen level(Jackson, 2009). This advantage made this approach the most appropriate in investigating the influence of listed demography variables (gender, age, district, level of the academic year, living place and study time) on the constructs (AT, SE, SI and PS) that contributed in this study to structurally define the student perceived satisfaction of technology in their learning through technology. However, this approach is still subject to certain preconditions which determine the choice of the proper type of MANOVA as well as its effective implementation. As the preconditions, we have the clear definition of the variables (independents and dependents), the type of participants (independent or correlated participants), the assumptions on the data as well as the expected level of precision of the results.

4.5.1 The independent and dependent variables

We are interested in scrutinizing whether the demography variables (gender, age, district, level of the academic year, living place, and study time using technology) influence the constructs that structurally defined student satisfaction while learning through technology. Therefore, the independent variables here are represented by the demography variables and the dependents variables represented by the constructs (AT, SE, SI, and PS). However, all the independent variables have more than one variant, for example, the independent variable gender is made up to two variants (female and male) the tables 4-1, 4-2, 4-3, 4-4, and 4-5 show all the independent variables concerned and their respective variants (level of independent variable)

Also, the dependent variables evoked are latent variable (unobserved variable) defined by some items or observed variable. Thereby, in order to represent statistically the measure of the dependent variables, we consider the dependent variable as the composite variable which is a variable made up of two or more variables or measures that are conceptually or statistically related to one another. In the present case, the measure of each dependent variables was obtained by the mean of the measures of observed variables loaded under each construct for each participant. For example,PS

(perceived satisfaction) dependent variable have 847 measures corresponding to the participants entailed in the study ($_1 \ldots_{847}$ the measures of the participants).

$$\begin{pmatrix} 1 \\ 2 \\ \vdots \\ 847 \end{pmatrix} = \begin{pmatrix} \frac{1_1+2_1+3_1+4_1}{4} \\ \frac{1_2+2_2+3_2+4_2}{4} \\ \vdots \\ \frac{1_{847}+2_{847}+3_{847}+4_{847}}{4} \end{pmatrix}$$

Where $1\ 2, 3,\ 4$ represents respectively the measure of the first item (PS1: I am satisfied with using technology as a tool to help my study), second item (PS2: I am satisfied with using technology to solve my problems related to the study), third item (PS3: I am satisfied with the role the teachers play in my studies involving technology), fourth item (PS4: I am satisfied with the experience of using technology in my study) collected from the ^{h} participant. The same analogy has been applied for others dependent variables namely, Attitude (AT), self- efficacy (SE), and social interaction (SI).

- The composite variable of attitude

$$\begin{pmatrix} 1 \\ 2 \\ \vdots \\ 847 \end{pmatrix} = \begin{pmatrix} \frac{1_1+2_1+3_1}{3} \\ \frac{1_2+2_2+3_2}{3} \\ \vdots \\ \frac{1_{847}+2_{847}+3_{847}}{3} \end{pmatrix}$$

- The composite variable of self-efficacy (SE)

$$\begin{pmatrix} 1 \\ 2 \\ \vdots \\ 847 \end{pmatrix} = \begin{pmatrix} \frac{1_1+2_1+3_1+4_1}{4} \\ \frac{1_2+2_2+3_2+4_2}{4} \\ \vdots \\ \frac{1_{847}+2_{847}+3_{847}+4_{847}}{4} \end{pmatrix}$$

- The composite variable of social interaction (SI)

$$\begin{pmatrix} 1 \\ 2 \\ \vdots \\ 847 \end{pmatrix} = \begin{pmatrix} \frac{1_1+2_1+3_1+4_1}{4} \\ \frac{1_2+2_2+3_2+4_2}{4} \\ \vdots \\ \frac{1_{847}+2_{847}+3_{847}+4_{847}}{4} \end{pmatrix}$$

4.5.2 Type of participants

Participants could only choose one level of an independent variable, which implied that participants used for one level of an independent variable were distinct from those used in other levels of the same independent variable. The abovementioned precision makes it possible to appreciate the independent nature of the participants and leads to the obvious choice of Independent MANOVA test procedure. An independent MANOVA test procedure is one of the two variants of MANOVA analysis process where there are independent measures on the independent variable(s) (or levels of an independent variable).

4.5.3 Assumptions

The effective implementation of independent MANOVA test requires a prior verification of whether data satisfy some assumptions. The normal distribution of data, linearity, and homogeneity of Variances are the essential assumptions to satisfy (Sthle & Wold, 1990). -firstly, normal distribution of data requires that the dependent variables should be normally distributed within groups. – according to linearity there are linear relationships among all pairs of dependent variables, all pairs of covariates, and all dependent variable covariate pairs in each cell. – Then, homogeneity of variances assumes that the dependent variables exhibit equal levels of variance across the range of independent variables(Sthle & Wold, 1990). As part of this study, these assumptions have been tested and no major violation has been observed.

4.5.4 Independent MANOVA test procedure

We adopted the procedure described by Perry R.Hinto and Isabella McMurray (2014) to conduct the MANOVA test. Multivariate tests results shows the information required to examine the influence of the listed independent variables (gender, age, district, level of the academic year, living place, and study time using technology) on four dependent variables (AT, SE, SI, and PS) together. Within the Multivariate tests, the result indicates that overall whether there is a significant effect of the independent variable on the dependent variables or not. Also **Tests of Between-Subjects Effects** allow us to examine the effect on each of the dependent variables individually.

4.5.4.1 Statistic-test

We examined four different results in the MANOVA test- Pillai's Trace, Hotelling's T^2, Wilks' Lambda and Roy's Largest Root. Although, they have different formula they all attempt to assess the proportion of the variability in the dependent variables explained by the independent variable(s). Thus, the optimal choice of the appropriate statistical test is necessary and can be

subjected to two recommendations as proposed by (Perry R.Hinto, Isabella McMurray, 2014)- First, to check if all four statistics agree on the significance of the effect and, if they do, then we are confident that the result is valid. Second, to check whether the statistics do differ in their power depending on the type of data and the sample sizes. However, Wilks' lambda is neither the most powerful nor the least powerful of the tests, regardless of the data and it is thereby more or less a good 'middle' value to take.

4.5.5 The effect of gender on attitude (AT), self-efficacy (SE), social interaction (SI), perceived Satisfaction

The influence of gender on attitude (AT), self-efficacy, social interaction, and perceived satisfaction was observed descriptively and inferentially through the tables emanating from independent MANOVA test procedures. the effect of gender on AT, SE, SI and PS descriptive statistics (table 4-15) displays the mean value of evaluation for each gender (female and male) for their AT, SE, SI, and PS. Since the study was not aimed to compare the independent variables (female and male), these then appear in separate rows. However, we are interested in examining the means from the two genders (female and male) on each of the dependent variables. Thereby, observing successively the dependent variables, we can note that - the male has a slightly lesser attitude mean (5.7746) than female (5.9206), -the male has a slightly lesser self-efficacy mean (5.4981) than female mean (5.6317), - the male has a lesser social interaction mean (5.6179) than female mean (5.8730), and, - the male has a lesser perceived satisfaction mean (5.4569) than the female mean (5.7045). The Total refers to the overall mean score on each dependent variable across the gender groups (female and male). Then the Std. deviation shows the spread of values found in the scale of dependent variables.

Table 4-14 the effect of gender on AT, SE, SI, and PS multivariate tests

Effect		Value	F	df	Error df	Sig.
intercept	Wilks' Lambda	0.037	5507.260[b]	4	842	0
Gender	Wilks' Lambda	0.986	2.904[b]	4	842	0.021

b. Exact statistic

Within the Multivariate tests, we are looking to see if the Wilks' Lambda test statistic is significant, which would indicate that overall there is a significant effect of the gender on dependent variables (AT, SE, SI, and PS). Table 4-14 shows an F value of 2.904, with a Sig. value of .021. This is the

evidence of the significant effect of the gender on the combination of dependent variables: $F(4,842) = 2.904$, $p < .05$; Wilks's lambda = .986

Table 4-15 F test results gender variable on AT, SE, SI and PS

Dependent variables	gender	Mean	Std. Deviation	df	Error	F	P
AT	Male	5.7746	1.22174	1	845	2.975	0.085
	Female	5.9206	1.14466				
SE	Male	5.4981	1.1995	1	845	2.492	0.115
	Female	5.6317	1.18225				
SI	Male	5.6179	1.26258	1	845	8.515	0.004*
	Female	5.873	1.18226				
PS	Male	5.4569	1.28353	1	845	7.887	0.005*
	Female	5.7045	1.1739				

*significant at p <.05

Further, between subject effects tests table 4-15 show that gender has no significant effect on AT ($F(1,845) = 2.975$; $p > .05$) and SE ($F(1,845) = 2.492$; $p > .05$). but in opposition the gender has a significant impact of SI ($F(1,845) = 8.515$; $p < .05$) and PS ($F(1,845) = 7.887$; $p < .05$). thereby the effect of gender on combined AT, SE, SI, and PS were statistically significant. Also, the effect of gender on SI and PS each take lonely was found statistically significant. Additionally, PS and SI are significantly different for male and female.

4.5.6 The effect of age attitude (AT), self-efficacy (SE), social interaction (SI), perceived Satisfaction

The effect of age on attitude AT, SE, SI, and PS was observed similarly like in the case of the effect of gender through the tables resulting from independent MANOVA test procedures. The effect of gender on AT, SE, SI and PS descriptive statistics (table 4-17) displays the mean value of evaluation for each age range (less than 18 years, 18-22 years, 23-27 years, and above 27 years) for their AT, SE, SI, and PS. By observing table 4-16 we notice that: -the students with age range 23-27 Years have the highest AT (6.1852), SE (5.8056), SI (6.2361) and PS (5.6944) mean, meanwhile the students with the age additionally, Table 4-16 shows an F value of 1.061, at the significant of .389. which means that there is no significant effect of age on the combination of dependent variables: $F(7,837) = 1.061$, $p > .05$; Wilks's lambda = .985

Table 4-16 effects of age on AT, SE, SI, and PS Multivariate Tests

Effect		Value	F	df	Error df	P
Intercept	Wilks' Lambda	0.367	361.904b	4	840	0
Age	Wilks' Lambda	0.985	1.061	12	2222.723	0.389

b. Exact statistic

Table 4-17 F test results of age variable on AT, SE, SI and PS

dependent variables	Age	Mean	Std. Deviation	df	Error	F	P
AT	Less than 18 years	5.6245	1.37519	3	843	2.445	0.063
	18-22 Years	5.8715	1.14752				
	23-27 Years	6.1852	0.8419				
	Above 27 Years	5.8333	1.47824				
SE	Less than 18 years	5.3931	1.27277	3	843	1.376	0.249
	18-22 Years	5.58	1.1809				
	23-27 Years	5.8056	0.8294				
	Above 27 Years	5.625	1.12731				
SI	Less than 18 years	5.5602	1.3094	3	843	2.144	0.093
	18-22 Years	5.736	1.22865				
	23-27 Years	6.2361	0.74494				
	Above 27 Years	6.125	0.82916				
PS	Less than 18 years	5.4232	1.29324	3	843	0.762	0.515
	18-22 Years	5.5781	1.237				
	23-27 Years	5.6944	1.25895				
	Above 27 Years	5.5625	1.32877				

Further, we can highlight from the table 4-17 that age does not have a significant effect on AT($F(3,843)= 2.445$, $p>0.05$), SE ($F(3,843)= 1.376$, $p>0.05$), SI ($F(3,843)=2.144$, $p>0.05$), and PS ($F(3,843)=0.762$, $p>0.05$) for our dependent variables.

4.5.7 The effect of division on attitude (AT), self-efficacy (SE), social interaction (SI), perceived Satisfaction

The effects of division on SE, SI and PS descriptive statistics (table 4-19) displays the mean value quantifying for each division (Barishal, Chittagong, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, Sylhet) their AT, SE, SI, and PS. By observing table 4-18 we can see that: - the polytechnic students from Dhaka have the highest mean of AT (5.88), SE (5.6342), SI (5.8311), PS (5.6586). Also, we note a very slight difference between the mean of each division across the dependent variables. Additionally, Table 4-18 shows an F value of .982, at the significant value

of .510. which means that there is no significant effect of division on the combination of dependent variables: $F(7,837) = .982$, $p > .05$; Wilks's lambda = .944

Table 4-18 F test results of effects of division on AT, SE, SI and PS multivariate tests[a]

Effect		Value	F	df	Error df	P
Intercept	Wilks' Lambda	0.131	1381.218[b]	4	836	0
Division	Wilks' Lambda	0.967	1.003	28	3015.663	0.461

a. Design: Intercept + Division

Table 4-19 F test results of effects of division on AT, SE, SI and PS

dependent variables	Division	Mean	Std. Deviation	df	Error	F	P
AT	Barishal	5.9431	1.10117	7	839	1.21	0.3
	Chittagong	5.7549	1.25069				
	Dhaka	5.88	1.2046				
	Khulna	4.8571	0.76636				
	Mymensingh	5.737	1.2481				
	Rajshahi	5.6204	1.15512				
	Rangpur	5.7576	1.03377				
	Sylhet	5.8247	1.2077				
SE	Barishal	5.5264	1.19674	7	839	0.94	0.48
	Chittagong	5.4816	1.22727				
	Dhaka	5.6342	1.18001				
	Khulna	5.1071	0.77536				
	Mymensingh	5.4381	1.22151				
	Rajshahi	5.2361	1.25063				
	Rangpur	5.4545	0.95406				
	Sylhet	5.5844	1.20464				
SI	Barishal	5.6585	1.27205	7	839	1.34	0.23
	Chittagong	5.4669	1.35141				
	Dhaka	5.8311	1.21476				
	Khulna	5.5	0.76376				
	Mymensingh	5.5459	1.25008				
	Rajshahi	5.5556	1.33912				
	Rangpur	5.6136	1.39805				
	Sylhet	5.7825	1.1718				
PS	Barishal	5.5833	1.19796	7	839	1.09	0.37
	Chittagong	5.4154	1.31624				
	Dhaka	5.6586	1.17785				
	Khulna	5.2857	1.22838				

Mymensingh	5.406	1.36541
Rajshahi	5.2292	1.50994
Rangpur	5.4773	1.22196
Sylhet	5.539	1.2564

Further, we can highlight from the table 4-19 that division does not have a significant effect on AT($F(7,839)= 1.205, p>0.05$), SE ($F(7,839)= 0.937, p>0.05$), SI ($F(7,839)=1.337, p>0.05$), and PS ($F(7,839)=1.091, p>0.05$) for our dependent variables.

4.5.8 The effects of the year of study on AT, SE, SI, and PS

The effects of academic level on SE, SI and PS descriptive statistics (table 4-21) displays the mean value quantifying for each year of study (First Year, Second Year, Third Year, Fourth Year) their AT, SE, SI, and PS. By observing table 4-21 we can see that: - the polytechnic students from fourth year have the highest mean of AT (5.9303), SE (5.6692), SI (5.8004), PS (5.6540). -Meanwhile, polytechnic students from first-year have the lowest mean of AT (5.6561), SE (5.3988), SI (5.6091), and PS (5.4187). However, it is noteworthy that the difference between the mean values of each year of study across the dependent variables is slight. Additionally, Table 4-20 shows an F value of .656, with a Sig. value of .794. which means that there is no significant effect of year of study on the combination of dependent variables: $F(7,837) = . .656, p > .05$; Wilks's lambda = .991

Table 4-20 effects of academic level on AT, SE, SI, and PS Multivariate tests[a]

Effect		Value	F	df	Error df	P
Intercept	Wilks' Lambda	0.039	5224.097[b]	4	840	0
Year of Study	Wilks' Lambda	0.991	0.656	12	2222.723	0.794

a. Design: Intercept + YearofStudy

b. Exact statistic

Table 4-21 F test results of effects of year of study on AT, SE, SI, and PS

dependent variables	Year of study	Mean	Std. Deviation	df	Error	F	P
AT	First Year	5.6561	1.44403	3	843	1.83	0.14
	Second Year	5.8632	1.08164			2.06	0.1
	Third Year	5.755	1.24286				
	Fourth Year	5.9303	1.13348				

SE	First Year	5.3988	1.29506	3	843	2.06	0.1
	Second Year	5.5714	1.13149				
	Third Year	5.4446	1.30529				
	Fourth Year	5.6692	1.11563				
SI	First Year	5.6091	1.25877	3	843	1.1	0.35
	Second Year	5.7408	1.15956				
	Third Year	5.623	1.36362				
	Fourth Year	5.8004	1.21461				
PS	First Year	5.4187	1.26721	3	843	1.7	0.17
	Second Year	5.5897	1.18127				
	Third Year	5.4338	1.36085				
	Fourth Year	5.654	1.2195				

Further, we can highlight from the table 4-21 that year of study does not have a significant effect on AT(F(3,843) = 1.827, $p>0.05$), SE (F(3,843)= 2.064, $p>0.05$), SI (F(3,843)=1.104, $p>0.05$), and PS (F(3,843)=1.704, $p>0.05$) for our dependent variables.

4.5.9 he effects living place on AT, SE, SI, perceived Satisfaction

The effects of living place during the study on AT, SE, SI and PS descriptive statistics (table 4-23) displays the mean value quantifying for each place of living during study (Home, institutional halls, rental houses) AT, SE, SI, and PS. By observing table 4-23 we can see that: – the polytechnic students living in institutional halls have the highest mean of AT (6.0807), SE (5.7737), SI (6.0500), and PS (5.9289). – Meanwhile, the lowest mean values of AT(5.7711), SE (5.4762), SI (5.6429), and PS (5.3883) are experienced by polytechnic students living either in at home or in the rental house. Additionally, Table 4-22 shows an F value of 2.356, at a significant value of .002. which means that the effects of living place while studying, on the combination of dependent variables were statistically significant: F(7,838) = 3.083, p <.05; Wilks's lambda = .971

Table 4-22 effects of living place on AT, SE, SI, and PS multivariate tests[a]

Effect		Value	F	df	Error	P
Intercept	Wilks' Lambda	0.051	3893.737[b]	4	841	0
Living during Study	Wilks' Lambda	0.971	3.083[b]	8	1682	0.002*

a. Design: Intercept + Living_during_Study
b. Exact statistic
*significant at p <.05

Table 4-23 F test results of the effect of living place on AT, SE, SI, and PS

dependent variables	Place of living during study	Mean	Std. Deviation	df	Error	F	P
AT	Home	5.7711	1.21732	2	844	2.71	0.07
	Institutional Halls	6.0807	0.97087				
	Rental houses	5.8449	1.21704				
SE	Home	5.5449	1.21825	2	844	2.2	0.11
	Institutional Halls	5.7737	0.96486				
	Rental houses	5.4762	1.21736				
SI	Home	5.6879	1.27759	2	844	4.08	0.02*
	Institutional Halls	6.05	0.93299				
	Rental houses	5.6429	1.24713				
PS	Home	5.5673	1.2208	2	844	6.81	0.001*
	Institutional Halls	5.9289	0.99243				
	Rental houses	5.3883	1.34591				

*significant at p <.05

Moreover, we can draw out from the table 4-23 that living place during study does not have a significant effects on AT(F(2,844)= 2.707, $p>0.05$), and SE (F(2,844)= 2.198, $p>0.05$). However we reported from the same table the significant effects of polytechnics' students place of living during study on SI (F(2,844)= 4.083, $p>0.05$), and PS (F(2,844)= 6.805, $p>0.05$). Therefore, there are significant difference among living place with regard to SI and PS.

4.5.10 The effects of time of study AT, SE, SI, and PS.

Table 4-24 effects of time of study using technology on AT, SE, SI and PS multivariate tests[a]

Effect		Value	F	df	Error	P
Intercept	Wilks' Lambda	0.053	3781.931[b]	4	840	0.001*
Study_Time	Wilks' Lambda	0.949	3.689	12	2222.723	0.001*

a. Design: Intercept + Study_Time
b. Exact statistic
*significant at p <.05

The effects of time of study using technology on AT, SE, SI and PS descriptive statistics (table4-25) displays the mean value quantifying for each time range (Less than 1 hour, 1-2 hours, 2-5 hours, Above 5 hours) their AT, SE, SI, and PS. By having a comparative look in table 4-25 we can see that: The polytechnic students that spent 2-5 hours studying with technology had the highest mean of AT (5.9699), SE (5.7129), SI (5.8750), and PS (5.7177); Meanwhile, the

polytechnic students that spent Less than 1 hour of study using technology experienced the lowest mean of AT (5.4860), SE (5.0280), SI (5.1495), and PS (4.9650). Table 4-24 shows an F value of 3.689, with a Sig. value < .001. which is the expression of the significant effects of time of study using technology on the combination of dependent variables: $F(7,837) = 3.689$, $p < .05$; Wilks's lambda = .935

Table 4-25 F test results of the effect of daily time of study using technology on AT, SE, SI, and PS

dependent variables	Study time using technology	Mean	Std. Deviation	df	Error	F	P
AT	Less than 1 hour	5.486	1.36002	3	843	4.84	0.001*
	1-2 hours	5.7862	1.18907				
	2-5 hours	5.9699	1.10464				
	Above 5 hours	5.9498	1.23936				
	Total	5.8296	1.19471				
SE	Less than 1 hour	5.028	1.34073	3	843	9.4	0.001*
	1-2 hours	5.5315	1.17614				
	2-5 hours	5.7129	1.08379				
	Above 5 hours	5.6952	1.29787				
	Total	5.5484	1.19409				
SI	Less than 1 hour	5.1495	1.38509	3	843	9.52	0.001*
	1-2 hours	5.7465	1.23509				
	2-5 hours	5.875	1.10909				
	Above 5 hours	5.6986	1.33591				
	Total	5.714	1.23843				
PS	Less than 1 hour	4.965	1.34868	3	843	10.1	0.001*
	1-2 hours	5.5854	1.24312				
	2-5 hours	5.7177	1.14262				
	Above 5 hours	5.524	1.32495				
	Total	5.5502	1.24846				

*significant at p <.05

Additionally, we could appreciate through the table 4-25 the significant effects of daily time spent for learning on AT($F(3,843)= 4.844, p<0.05$), SE ($F(3,843)= 9.398, p<0.05$), SI ($F(3,843)= 9.521, p<0.05$)and PS ($F(3,843)= 10.121, p<0.05$). Therefore, the difference across times spent on technology for learning with regard to AT, SE, SI and PS is significant.

4.5.11 The effects type internet connection on AT, SE, SI and PS.

The effects of type of internet connection normally use while studying using technology on AT, SE, SI and PS descriptive statistics (table 4-27) displays the mean value quantifying for each type of internet connection (Broadband, Mobile data, Both, none of it) the polytechnic students' AT, SE, SI, and PS. By observing table 4-27 we can see that: –the polytechnic students who used both broadband and mobile internet connection presented the highest mean of AT(6.2763), SE(5.9257), SI(6.1149) and PS(5.8964).– Meanwhile, the polytechnic students that used neither broadband nor mobile internet connection showed the lowest mean AT (5.6667), SE (5.1563), SI (4.5625), and PS (5). Table 4-26 shows an F value of 3.616, with a Sig. value of .000. which means that there is the significant effects of internet connection type on the combination of dependent variables: $F(7,837) = 3.616$, $p < .05$; Wilks's lambda = .915

Table 4-26 effects of internet connection type on AT, SE, SI, and PS multivariate Tests[a]

Effect		Value	F	df	Error	P
Intercept	Wilks' Lambda	0.212	782.330[b]	4	840	**
Internet connection	Wilks' Lambda	0.958	3.042	12	2222.723	**

a. Design: Intercept + Internet_con

b. Exact statistic

**significant at p <.001

Table 4-27 F results of te effects of type of internet connection on AT, SE, SI, and PS

dependent variables	Study time using technology	Mean	Std. Deviation	df	Error	F	P
AT	Broadband	5.9306	1.12391	3	843	7.36	0.0001*
	Mobile data	5.7202	1.25015				
	Both	6.2763	0.85265				
	None	5.6667	0.9595				
SE	Broadband	5.6711	1.24427	3	843	5.92	0.001*
	Mobile data	5.4499	1.21146				
	Both	5.9257	0.88971				
	None	5.1563	1.55229				
SI	Broadband	5.7701	1.21349	3	843	7.15	0.0001*
	Mobile data	5.6386	1.27106				
	Both	6.1149	0.94254				
	None	4.5625	1.50446				
PS	Broadband	5.6762	1.20054	3	843	4.97	0.0002*
	Mobile data	5.459	1.29668				
	Both	5.8964	0.94536				

	None	5	1.32288

*significant at p <.05

Also, we could find out through table 4-26 the significant effects of type of internet connection use, on AT($F(3,843)= 7.357$, $p<0.05$), SE ($F(3,843)= 5.920$, $p<0.05$), SI ($F(3,843)= 7.152$, $p<0.05$)and PS ($F(3,843)= 4.968$, $p<0.05$). Then, the difference across types of internet connection used with regard to AT, SE, SI and PS is significant

4.6 Conclusion

This chapter aimed to scrutinize the measurement and structural models of the conceptual framework of perceived satisfaction defined as a part of this study and examined the effects of some demographic data on the constructs entailed in the model. Thus, after a descriptive presentation of the participants based on the demographic parameters selected in the framework of this study, Structural equation modelling (SEM) approach as per the procedure indicated in literature was used to ensure the validity and reliability of measurement model and subsequently to analyze the structural model. Thereafter multiple analysis of variance (MANOVA) contributed to scout about the effects of some demographic data on PU, PEU, AX, AT, SI, SE and PS. At the end of these analyzes, it emerged some points worthwhile to highlight. The measurement model initially made up of 30 observed variables loaded under 7 constructs, following reliability and validity calculation and then 3 items (AX2, AX3, and AX6) were deduced from the set of observed variables. The new measurement model thereby obtained, presented satisfactory features in term of validity (convergence and discriminant) and reliability of the entailed constructs and the model fit indices. The structural model analysis pointed out the non-significant effects of perceived usefulness, perceived ease of and anxiety on students' attitude towards the use of technology. However inherent from this analysis we noted the significant effect of attitude on perceived satisfaction at 0.05 level of significance and the significate effects of self-efficacy on attitude, and the significant effect of social interaction and self-efficacy on perceived satisfaction. Polytechnique students perceived satisfaction while learning through technology was thereby influenced by attitude, self-efficacy and social interaction. Also, polytechnic student attitude and social interaction were found significant in the mediation of the effects of self-efficacy, and attitude respectively on their perceived satisfaction. Further MANOVA unveiled the significant effect of gender, living place, time of study while using technology, and type of internet connection on both Polytechnique students' perceived satisfaction and likewise on their social interaction.

Additionally, the effects of study time and type of internet connection on attitude and self-efficacy were also found significant. Conversely, the effects of age, division and academic level were found non-significant on Polytechnique students' perceived satisfaction.

Chapter 5 Discussion and conclusion

The objectives of this study were revolved around the following two points: firstly, to investigate the structural relationships among the factors that affect polytechnic students' perceived satisfaction while using technology in the learning process and to develop a structural model that explains polytechnic students' perceived satisfaction. Secondly, to analyse the effects of some demographic data on the constructs entailed in the structural definition of Polytechnic student's perceived satisfaction. In line with the objectives mentioned above, we targeted to answer the following research questions:

1) To what extent the perceived ease of use (PEU), perceived usefulness (PU), anxiety (AX), attitude (AT), self-efficacy (SE), social interaction (SI), and perceived satisfaction (PS) are related to each other?
2) To what extent gender, age, district, level of the academic year, living place, and study time using technology influence the students' perceived satisfaction?

An online survey was carried out, the participants were asked to answer a demographics questionnaire and the scales measuring the constructs that were hypothesized to affect Polytechnic students' satisfaction while study via technology. The study used structural equation modelling to explore the causal relationships among the study variables. Additionally, independent MANOVA test procedure was used to assess the significant effect of some demographic data on the involved variables.

Initially, the assessment of the measurement model comprising 30 observed variables that has unveiled some value evaluating the model fit conceptual framework. Also, the inappropriate value of average variance extracted (AVE) of anxiety construct brought about some modifications. Therefore, three observed variables that did not load well under anxiety construct were removed from the observed variables set and the news model thus assessed in terms of construct reliability, discriminant validity, and model fit. The assessment of the new measurement model showed good constructs' reliability and discriminant validity. Additionally, the new measurement model showed a good fit to the data through the convenient fit indices recommended in the literature. The resulting measurement model with 27 observed variables was considered as the final model to explain the Polytechnic students' perceived satisfaction towards using the

technology in their learning. Further, independent MANOVA procedure was implemented to investigate the effect of some demographic parameters on the constructs entailed in the developed model. Thereby, the composite variables of each construct as a mean of the measure of all observed variable loaded under each construct were considered as part of the analysis procedure. The influence effects of gender, age, district, level of the academic year, living place, and study time using technology on the entailed constructs were observed via the F value and the corresponding probability when these constructs are combined and when they are taken singularly.

This chapter is made up of four main parts. Firstly, in the light of theory and past research, to interpret and to discuss the results obtained from the analysis as per the research questions. Secondly, the implications prompted by the research findings for practice are spotlighted. Thirdly, the limitations of the study are emphasized and their influence on the interpretation of the research results is discussed. Finally, for future research, some recommendations are included at the end of the chapter.

5.1 Interpretation and discussion of research results

This section is dedicated to interpretation and discussion of research outcomes following the chronological order of the research questions. The first research question concerned the structural relationships among the constructs entailed as part of this study, obviously as per the prior established model. Thereupon, eight relationships were hypothesized with the focus on the analyses of the direct effects of perceived usefulness, perceived ease of use, anxiety, and social interaction on the attitude, also the direct effect of attitude on social interaction and the direct effect of self-efficacy, attitude, social interaction on perceived satisfaction. The emanating results of hypothesis testing are interpreted and discussed in order of the research hypotheses. The mediator role of attitude and social interaction are also evoked in this section. The third research question addressed the effect of gender, age, district, level of the academic year, living place, study time using technology, and type of internet connection on the constructs considered in the structural definition of Polytechnic students perceived satisfaction while learning through technology. The outcomes obtained from the analyses of the influences of mentioned demographic parameters on the constructs are also interpreted and discussed in this section.

5.1.1 RQ1: Structural relationships among PU, PEU, AX, AT, SE, SI, and PS

5.1.1.1 A direct effect of perceived usefulness (PU), perceived ease of use (PEU), and anxiety (AX) on attitude (AT).

Yi-Cheng CHEN et al., (2013) indicated the essential character of PU and PEU in technology acceptance model (TAM), as well as their determinant impact on the students' use of technology in their learning activities. Thereby, PU was operationalized as the believes polytechnics students had about the catalyst role of technology in their performance and efficacy while leaning. And PEU was operationalized as the degree to which polytechnic students found the technology effortless to use in their learning. Hypothesis 1 suggested the direct effect of perceived usefulness on attitude and hypothesis 2 suggested the direct effect of perceived ease of use on attitude. These hypotheses were not supported as revealed by the structural equation modelling. Therefore, the effect PU and PEU were found non-significant on attitude. Several research studies reported findings that are in support of the direct effect of PU and PEU on attitude(Davis, 1989; Venkatesh, 2006). However, it is noteworthy to indicate the weak effect of PU and PEU on attitude reported by these research studies. Further, these weak effects of PEU and PU on AT have also resulted in an exclusion of AT in recent models considering TAM variables (Abdullah et al., 2016; Giovanis, Binioris, & Polychronopoulos, 2012; Hossien Zare, 2013) which in a way supports the obtained result.

Concerning, anxiety towards technology was operationalized as the condition or the state resulting from mental pressure while using technology for learning purposes. Hypothesis 3 suggested a negative effect of anxiety on Polytechnic student attitude. This hypothesis lacked the evidence to be supported, justifying thereby the non-significant effect of anxiety on polytechnic students' attitude towards using the technology. However, other findings have shown that technology anxiety caused negative attitudes (Conrad, 2008) that implicitly emphasized the direct effect of anxiety on Polytechnic students' attitude. However, a more recent study supported the findings of the current study (Jeong & Park, 2020).

5.1.1.2 Direct effect of self-efficacy (SE)on attitude (AT) and the direct effect of attitude (AT) on social interaction (SI)

Hypothesis 4 suggested a positive direct effect of self-efficacy on attitude. The self-efficacy construct scale used in this study highlighted the Polytechnic students' confidence in use technology and the confidence of improving learning through a technology learningenvironment.

In this study the effect of Polytechnic students' self-efficacy on their attitude was found to be significant. Bandura (2000) indicated that much of human motivation is cognitively generated. Therefore People's confidence in their abilities to cope with any discomfort situation when using common technology, or adopting recent technologies, would impact their motivation and behaviour, as well as their reactions to a situation (Bandura, 2000). Much of the research in the technology used for learning purpose has also shown that the self-efficacy construct has a significant impact on an individual's behaviour and attitudes (Beas & Salanova, 2006). And more recently Pan (2020) indicated that students' technological self-efficacy affected their attitude toward technology-based learning. The positive relationship between self-efficacy and attitude revealed by this study indicates the essential character of self-efficacy while engaging in learning through technology. Polytechnic students' confidence in the proper use of technology and their confidence in improving his learning through technology is highly needed for a positive attitude toward technology.

Hypothesis 5 suggested a positive direct effect of Polytechnic students' attitude on their social interaction. Under a broader spectrum, attitude toward technology is conceived as a form of belief prompting from both previous and current technology experiences, knowledge, habits and competencies of self, and impression on general technology usefulness and efficacy in terms of addressing learning needs and interests. The attitude construct in this study considers polytechnics students' cognitive, and affective aspects while participating in learning activities through technology. Also, social interaction construct reflected the students' feeling of communication and their confidence in the possibility of being able to interact with their instructors and with their peers during their learning activities through technology. The hypothesis was supported since the impact of Polytechnic students' attitude toward technology used for learning purpose was found significant on their social interaction through technology. Therefore, the Polytechnic students with positive knowledge, feeling and fondness for technology environment are more likely to feel easiness and confidence in interacting with their instructor and their colleagues through technology. Numerous studies indicated the significant impact of social interaction on attitude (Burkhardt, 1994; Hao, 2004; Zhu et al., 2020). But few studies emphasized on the reverse effect of attitude on social interaction. However, a recent study taking into account this relationship pointed out the significant effect of attitude toward technology on social interaction (İbrahim Hakki Bulut & IN, 2019).

5.1.1.3 The direct effects of attitude, social interaction, and self-efficacy on perceived satisfaction.

Perceived satisfaction was operationalized as the polytechnic students' feeling about technology use in learning at the individual level. Typically, user perceived satisfaction with technology is viewed as a feeling arising from their previous experience with technology (Yuen, Cheng, & Chan, 2019b). Hypothesis 6 suggested the direct effect of Polytechnic students' attitude toward technology on their perceived satisfaction of technology. The hypothesis was supported by the data collected as we noticed the significant effect of attitude on perceived satisfaction. Additionally, the result of the analysis reported a direct effect of attitude on Polytechnic students perceived satisfaction. According to this finding, Polytechnic students indicated that their feeling, affect or merely their perceived satisfaction while learning through technology was greater when their attitude toward technology was lower. However, this finding brings a sort of contradiction in many studies that highlight the positive relationship between attitude and perceived satisfaction. Backwards-looking, some researches indicated attitude as being a powerful predictor of satisfaction (Liaw, 2008; Liaw & Huang, 2013). Moreover in a recent study involving a total of 331 students indicated attitude as a positive indicator of perceived satisfaction (Divjak, Rupel, & Lešnik, 2018).

Hypothesis 7 suggested the direct effect of social interaction on satisfaction. The hypothesis was ascertained as the results demonstrated that social interaction had a significant direct effect on perceived satisfaction. Long before, Strachota (2003) examined in the University of Wisconsin Milwaukee and the Midwest Technical College about the effect of social interaction on perceived satisfaction. The findings indicated social interaction played an important role in predicting learner perceived satisfaction. Also, Lee and Jung-Wan Kim (2009) in their study considering the effect of social interaction on perceived satisfaction through data collected from 842 undergraduate students highlighted the significant direct effect of social interaction on students perceived satisfaction. Additionally, The deficiency of social interaction was pointed out as one of the hindrances of learning through technology (Muilenburg, Berge, Muilenburg, & Berge, 2007). Recently, some study in line with our finding suggested an improvement of interaction as the way to better student satisfaction of their learning through technology (Kuo, Walker, Schroder, & Belland, 2014; Zhang & Lin, 2020). Thereby, social interaction is a crucial parameter in learning settings mostly when the learning is held through technology. The direct

effect of social interaction on perceived satisfaction indicates that as Polytechnic students conceive the level of reciprocal exchange and support with their peers and instructors as important and worthwhile and have interest in learning through technology, they are more likely to perceive satisfaction.

In the end, hypothesis 8 tested the direct effect of self-efficacy on perceived satisfaction. The hypothesis was supported as Polytechnic student's self-efficacy influenced their perceived satisfaction while learning through technology. Self-efficacy was obtained from social cognitive theory, which provided an intelligible framework that showed how self-efficacy beliefs adjust human functioning through cognitive, motivational, affective and decision-making processes (Bandura, 1986, 1977, 1999). Several research studies reported findings that are in support of the direct effect of self-efficacy on perceived satisfaction in learning through technology. Yalcin (2017) reported a significant effect of self-efficacy on learner perceived satisfaction. Recently Rabin, Henderikx, Kalman, & Kalz (2020) found that learners' self-efficacy belief was a determinant predictor for their perceived satisfaction while learning through technology. Then the direct effect of Polytechnic students on self-efficacy on perceived satisfaction highlights the facts that personal confidence of their capabilities to access learning content, to perform their learning task and improve their learning through technology is a significant factor that lead to favourable perceived satisfaction.

5.1.1.4 The mediating role of attitude between perceived usefulness, perceived ease of use and anxiety, and perceived satisfaction

While the study revealed the non-significant direct effects of perceived usefulness, perceived ease of use and anxiety on attitude, a possible mediator role of attitude between these variables and perceived satisfaction was therefore compromised and far to address adequately the controversy around the mediating role of attitude in that case. However, the mediating effect of Polytechnic students' attitude between their self-efficacy and perceived satisfaction was found significant. Thus, implicitly indicating the indirect effect of Polytechnic students' self-efficacy on their perceived satisfaction through their attitude. These findings implied that the enhancement of polytechnic students' attitude by promoting polytechnic students' self-efficacy and higher would consequently improve polytechnic students perceived satisfaction of using technology in their learning. Also, the mediation role of social interaction was found significant in conveying the effect of polytechnic students' attitude on their perceived satisfaction in using technology in their

learning. Therefore, a double role of polytechnic students' social interaction as both mediator and predictor of polytechnic satisfaction attracts more attention to improving polytechnic satisfaction. thereby, the mechanism likely to improve significantly social interaction and attitude should be considered while thinking about polytechnic students' satisfaction in learning through technology. Despite a very scant literature on attitude mediation as well as social interaction mediation under perceived satisfaction perspective, it is essential to recognize that the results obtained on this subject contribute to forging avenues that should be used to beef up polytechnic students perceived satisfaction in the learning through technology.

5.1.2 The effect of demographic variables on Polytechnic students perceived satisfaction

Demographic parameters such as gender, age, and academic level are major factors in understanding and appreciating the constructs that support learning through technology (Binyamin, Rutter, & Smith, 2020; Islam, Abdul Rahim, Tan, & Momtaz, 2011). Therefore, the additional parameters like living place, study time using technology and type of internet connection widen the parameters leading to the comprehension of entailed constructs. Thereby beyond only traditional students' demographic factors taking into account some parameters concerning the student itself, student's environment, and material used while learning through technology is worthwhile in achieving better understanding and appreciating of the constructs and its relationship to perceived satisfaction. This study pointed out the significant effect of some Polytechnic students' demographic parameters like study time and type of internet connection on perceived usefulness, perceived ease of use, attitude, self-efficacy, social interaction, and perceived satisfaction. This is to say that the way Polytechnic students appreciate the usefulness, the flexibility of use of technology in their learning, their attitude, the way they interact through technology and their feeling of satisfaction are influenced by the amount of time spent fo study through technology and also by the nature of internet connection. The effect of gender was significant on anxiety, social interaction and perceived satisfaction while the effect of Polytechnic students age is significant only on anxiety. Additionally, the effect of the Polytechnic students' living place is significant on their social interaction and their perceived satisfaction. Also, the effect of divisions where Polytechnic are located are non-significant on the considered constructs. Further internet connection is found important for all the constructs (AT, SE, SI, and PS) since its effect is significant on it. Many studies found the influence of age, gender, and academic level significate on perceived satisfaction(Xu & Du, 2018), however, although these findings are in part

opposed to our findings, it is essential to note the impact of other factors that are often neglected, such as living place, study time and internet connection.

5.2 Implication of the study

The present research has several implications contributing to theory and practice of learning through technology to a general extent and particularly in the Polytechnic students learning satisfaction through technology literature. This study addressed the issue related to polytechnic students' perceived satisfaction and their attitude toward technology in their study. As knowing polytechnic's students perceived satisfaction of technology in their study and their attitude offer the frame for effective integration, contribute to improving ongoing use of technology, and increase the possibility to promote meaningful study. It provides a structural model of perceived satisfaction of learning through technology with the polytechnic students' perceived usefulness, perceived ease of use, anxiety, attitude, self-efficacy, and social interaction through technology. This study attempts to fill the void inherent to very limited literature regarding the polytechnic's students perceived satisfaction and attitude toward the role of technologies in Bangladesh.

Also, this study provides both teachers and administrations with a clear understanding of student's perception and the accurate insight on the influence to which it is subjected due to the impact generated by other parameters. Therefore, the polytechnics teacher and the administration in the context of Bangladesh can adapt respectively their teaching and institutional policy in such a way that students can draw out more satisfaction from using technology in their study. Moreover, teachers concerned with the successful integration of technology in their teaching will certainly find the opportunity to improve the learning experience of their students.

The study has several implications in understanding the Polytechnic students' perceived satisfaction of learning through technology. First, the study provides a conceptual framework allowing flexibility to manipulate and design other constructs rather than a theoretical framework that attempts to offer a single solution. This study allows extending the studies carried out by Abdullah-Al-Mamun (2015) and Habiba & Md. Maidul Islam (2015) by offering to observe from a conceptual and structural angle the perceived satisfaction of the Polytechnic students in Bangladesh. Thirdly, all the variables included in the model were identified and selected based on the fundamental variables of the technology acceptance model, social cognitive theory and macro model motivational and performance. In other words, it combines the TAM variables with the

fundamentals group of variables of Yalcin's model of satisfaction. Lastly, beyond traditional demographic parameters, the study shows the relevance of the effect of others demographic parameters (living place, study time, and time of internet connection) on the constructs entailed in this study. Therefore educators, instructional designers, and technology vendors can utilize for bettering perceived satisfaction experience while learning.

5.3 Study limitations

In a more general view, the current study addressed the factors affecting polytechnic students' satisfaction while studying through technology. While the study contributes to our understanding of polytechnic student satisfaction, there are, however, some limitations to consider when interpreting the results. Although the data were collected from Polytechnic students in 16 different Polytechnic institutes, the study employed a convenience sampling method, and the research setting was made up of the public polytechnic institutes in Bangladesh. Furthermore, demographic data such as ethnicity, religion, and socioeconomic status were not collected in the study due to the concerns regarding the length of the online survey. Therefore, care should be taken when generalizing the study findings to other contexts, especially those where the representation of special demographic groups such as minorities and low or high socioeconomic populations is high. Also, self-report surveys were the mean of data collection in this study, which may cope with biases in certain situations because respondents may inaccurately attribute their experiences and feelings to certain internal or external factors. The study was required to rely on an online self-report survey because it was a large-scale study involving many polytechnic institutes spread across the country also owing to the covid-19 pandemic with all the induced restrictions it was not thereby, appropriate for the researcher to collect data via other data collection methods. Also, one of the constructs (Anxiety) produced an average variance extracted value that is smaller than a cut-off value of .50 which is recommended in some research studies. Since the construct was an individual-based construct that can be difficult to remeasure, and few research studies investigated the relationship between anxiety and satisfaction mediated by attitude, the construct was retained in the model to provide contributions to the literature. Lastly, the assumptions on the data collected were merely claimed instead of being ascertained inferentially as the prior task in the implementation of multiple analysis of variance.

5.4 Recommendations for future research

Although it must be recognized that student perceived satisfaction of their learning through technology remains an elusive construct that requires many investigations aiming to increase the understanding of the effect other factors can have on it. However, this study is one more stone to the building that constitutes the plethora of existing knowledge regarding the factors that influence Polytechnic students' satisfaction of study through technology. furthermore, the results of this study revealed an unexpected finding regarding the non-significant effect in the relationship between polytechnic student's perceived usefulness, perceived ease of use, anxiety and their attitude through technology. This finding opposed the theoretical assumptions and the findings resulting from several past research studies interesting in the above-mentioned relationship.

These non-significant effects of polytechnic students perceived usefulness, perceived ease of use and anxiety on their attitude arise the interest in the particularity of Bangladeshi polytechnic students population that may be a possible explanation to these results which remains, to say the least, very particular with regard to literature. However, it is up to future research to investigate further the nature of the relationship between perceived usefulness, perceived ease of use, anxiety and attitude in order to better situate the understanding of this relationship with regard to Bangladesh polytechnic students specifically. Also, as this study was a cross-sectional research study, longitudinal research studies spanning a certain period (such as a year) can provide valuable results that will expand knowledge about the relationship of the aforementioned constructs on the one hand. And on the other hand, which can provide meaningful information on the relevance of the polytechnic's students perceived satisfaction model developed over time. Furthermore, it is auspicious for coming research to include more constructs such as polytechnic students expectations and their experience of studies through technology to further the understanding and reduce the uncertainties with the regard of the factors that affect polytechnic students perceived satisfaction. Finally, past research on polytechnic students perceived satisfaction mainly focused on the perceived satisfaction theory and description of polytechnic student perceived satisfaction of learning through technology. Future researchers should broaden the scope of research on the structural approach to polytechnic students perceived satisfaction of learning through technology. This study was among the firsts in investigating polytechnic students perceived satisfaction of their study through technology. The findings are promising as polytechnic students perceived satisfaction was predicted by his self-efficacy, attitude, social interaction while achieving their

learning process through technology. However as indicated earlier polytechnic students perceived satisfaction of study through technology is still an evolving research area and needs much work that will provide practical recommendations for instructional designers, remote instructors on how best to lead polytechnic students to satisfaction when learning through technology.

5.5 Conclusion

This study investigated polytechnic students' perceived satisfaction while study through technology with the focus on the structural relationships among the factors that affect polytechnic students perceived satisfaction of their study through technology. the structural equation modelling data analysis procedure was used to propose the structural model that explains polytechnic students perceived satisfaction based on the existing models and the research findings. Additionally, independent multiple analysis of variance (MANOVA) helped to appreciate the significance of the effect of some demographic data on the entailed constructs. The constructs that were retained as part of the study were perceived usefulness, perceived ease of use, attitude, anxiety, self-efficacy, social interaction, and perceived satisfaction. The findings pointed out the non-significant effect of perceived usefulness, perceived ease of use, and anxiety on attitude and the positive significant effect of self-efficacy on attitude. Also, the effect of attitude on social interaction was found significant. Further, the results revealed the positive significant effect of social interaction and self-efficacy on perceived satisfaction and the negative significant effect of attitude on perceived satisfaction. however, along with this, the mediating effect of attitude in the relationships between perceived usefulness, perceived ease of use, anxiety and satisfaction was improbable due to the lack of the significant effect of perceived usefulness, perceived ease of use and anxiety on attitude. The independent MANOVA analysis revealed the significant effect of gender on anxiety, social interaction and perceived satisfaction while the effect of age was found significant only on anxiety. Also, living place was a factor to consider for social interaction and perceived satisfaction, when the study time was found significant for perceived usefulness, perceived ease of use, attitude, self-efficacy, social interaction and perceived satisfaction. Additionally, the effect of the type of internet connection was significant on perceived satisfaction and the remaining constructs. The division or the geographical location of the polytechnic institutes and academic level were without significant effect on all the entailed constructs. The findings of the study were discussed under the light of the theoretical literature and the findings of past research. The implications of the findings were discussed both for designers and instructors. The model and other findings resulting from

this study can be used by the administration, and instructors to better Polytechnique students perceived satisfaction with the use of technology for their learning.

References

Abdullah-Al-Mamun, M. (2015). Technology in Educational Settings in the Government Polytechnic Institutes Technology in Educational Settings in the Government Polytechnic Institutes of Bangladesh : A Critical Analysis. *International Journal of Computer Applications (0975 – 8887)*, (September 2012). https://doi.org/10.5120/8628-2502

Abdullah, F., Ward, R., & Ahmed, E. (2016). *Investigating the influence of the most commonly used external variables of TAM on students ' Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of e-portfolios 1 Introduction*. 1–47.

Al-azawei, A., Parslow, P., & Lundqvist, K. (2017). *The Effect of Universal Design for Learning (UDL) Application on E-learning Acceptance : A Structural Equation Model*. *18*(6).

Amanortsu, G., & Dzandu, M. D. (2013). *Towards the Access to and Usage of Information and Communication Technology (ICT) in Polytechnic Education*. *66*(1), 23–33.

Anderson, J. C., & Gerbing, D. W. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin*, *103*(3), 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Anderson, T., & Elloumi, F. (2004). INTRODUCTION. In Terry Anderson & Fathi Elloumi (Ed.), *Theory and Practice of Online Learning* (online_boo, pp. xiii–xxiii). Retrieved from cde.athabascau.ca/online_book Athabasca

Arbaugh, J. B. (2014). *System , scholar or students ? Which most influences online MBA course effectiveness ?* 349–362. https://doi.org/10.1111/jcal.12048

Arenas, E. (2015). Affordances of learning technologies in higher education multicultural environments. *Electronic Journal of E-Learning*, *13*(4), 217–227.

Artino, A. R. (2008). Motivational beliefs and perceptions of instructional quality: Predicting satisfaction with online training. *Journal of Computer Assisted Learning*, *24*(3), 260–270. https://doi.org/10.1111/j.1365-2729.2007.00258.x

Artino, A. R. (2009). Think, feel, act: Motivational and emotional influences on military students' online academic success. *Journal of Computing in Higher Education*, *21*(2), 146–166. https://doi.org/10.1007/s12528-009-9020-9

Astin, A. (1993). *what matters in college?* Retrieved from http://search.epnet.com/login.aspx?direct=true&db=aph&an=9409260313

Bandura. (1986). Social fundations of thought and action: A social cognitive theory. Nueva Jersey. *Nueva Jersey: Prentice-Hall Englewood Cliffs*. Retrieved from https://books.google.com.bd/books?hl=en&lr=&id=PdY9o3l5vpYC&oi=fnd&pg=PA94&dq=Bandura,+A.+(1986).+Social+foundations+of+thought+and+action:+A+social+cognitive+theory.+Englewood+Cliffs,+NJ:+Prentice+Hall&ots=uFjWwW3l7P&sig=sBYiS6WQ_OaMgzZbC1dka4tLfeM&redir

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191-215. *Psychological Review*, *84*(2), 191–215.

Bandura, A. (1997). Self-efficacy: The exercise of control. *New York, NY: W. H. Freeman and Company*. Retrieved from https://psycnet.apa.org/record/1997-08589-000

Bandura, A. (1999). Social cognitive theory: An agentic. *Asian Journal of Social Psychology*, 21–41.

Bandura, A. (2000). Control of Human Behavior, Mental Processes, and Consciousness: Essays in honor of the 60th birthday of August Flammer - Google Books. In *(2000b). Self-efficacy: The foundation of agency. In A. W. J. E. G. Perrig (Ed.), Control of human behavior, mental processes and consciousness: Essays in honor of the 60th birthday of August Flammer (pp. 17-33). Mahwah, NJ: Lawrence Erlbaum Associates.* Retrieved from https://books.google.com.bd/books?hl=en&lr=&id=GjQik3MhmnMC&oi=fnd&pg=PA16&dq=Bandura,+A.+(2000b).+Self-efficacy:+The+foundation+of+agency.+In+A.+W.+J.+E.+G.+Perrig+(Ed.),+Control+of+human+be

havior,+mental+processes+and+consciousness:+Essays+in+honor+of+t
Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Asian Journal of Social Psychology*, *2*(1), 1–26. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=4369846&site=ehost-live
Beas, M. I., & Salanova, M. (2006). *Self-efficacy beliefs , computer training and psychological well-being among information and communication technology workers*. *22*, 1043–1058. https://doi.org/10.1016/j.chb.2004.03.027
Bernhardt, V. L. (1991). Assesing perceptions. Using education for the future questionnaires. *Education for the Future*, 1–14.
Binyamin, S. S., Rutter, M. J., & Smith, S. (2020). The moderating effect of gender and age on the students' acceptance of learning management systems in Saudi higher education. *Knowledge Management and E-Learning*, *12*(1), 30–62. https://doi.org/10.34105/j.kmel.2020.12.003
Bolliger, D. U., & Halupa, C. (2012). *Student perceptions of satisfaction and anxiety in an online doctoral program*. *33*(1), 81–98.
Bolliger, D. U., & Wasilik, O. (2009). *Factors influencing faculty satisfaction with online teaching and learning in higher education*. (June 2013), 37–41. https://doi.org/10.1080/01587910902845949
Bolliger, M. (2004). *Key Factors for Determining Student Satisfaction in online learning*. (March), 61–67.
Bradford, G. R. (2011). Internet and Higher Education A relationship study of student satisfaction with learning online and cognitive load : Initial results. *The Internet and Higher Education*, *14*(4), 217–226. https://doi.org/10.1016/j.iheduc.2011.05.001
Breckler, S. J. (1990). Applications of covariance structure modeling in psychology: Cause for concern? *Psychological Bulletin*, *107*(2), 260–273. https://doi.org/10.1037/0033-2909.107.2.260
Burke, J. (1985). *The Impact of Science on Society*.
Burkhardt, M. E. (1994). Social Interaction Effects Following a Technological Change: A Longitudinal Investigation. *Academy of Management Journal*, *37*(4), 869–898. https://doi.org/10.5465/256603
Chiang, I.-C. A., Jhangiani, R. S., & Price, P. C. (2015, October 13). *Reliability and Validity of Measurement*. BCcampus.
Cho, M. H., & Heron, M. L. (2015). Self-regulated learning: the role of motivation, emotion, and use of learning strategies in students' learning experiences in a self-paced online mathematics course. *Distance Education*, *36*(1), 80–99. https://doi.org/10.1080/01587919.2015.1019963
Chua, S. L., Chen, D. T., & Wong, A. F. L. (1999). Computer anxiety and its correlates: a meta-analysis. *Computers in Human Behavior*, *15*(5), 609–623. https://doi.org/10.1016/S0747-5632(99)00039-4
Coast, C. (2015). *Improving Teaching and Learning in Polytechnics with ICT Improving teaching and learning in Polytechnics with ICT*. (August).
Conrad, A. M. (2008). *RELATIONSHIPS BETWEEN COMPUTER SELF-EFFICACY , TECHNOLOGY , ATTITUDES AND ANXIETY: DEVELOPMENT OF THE COMPUTER TECHNOLOGY USE SCALE (CTUS)*. *39*(1), 51–73. https://doi.org/10.2190/EC.39.1.d
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319–339. https://doi.org/10.2307/249008
Dennen, V. P., Darabi, A. A., & Smith, L. J. (2007). Instructor-learner interaction in online courses: The relative perceived importance of particular instructor actions on performance and satisfaction. *Distance Education*, *28*(1), 65–79. https://doi.org/10.1080/01587910701305319
Dickson, P. P., Pendidikan, F., Malysia, U. K., Pendidikan, F., Perguruan, U., & Idris, S. (2010). *THE EFFECTS OF INTEGRATING MOBILE AND CAD TECHNOLOGY IN TEACHING DESIGN PROCESS FOR MALAYSIAN POLYTECHNIC*. *9*(4), 162–172.
Divjak, M., Rupel, V. P., & Lešnik, K. M. (2018). The impact of study attitudes and study behaviour on satisfaction of online students with the implementation of online study programmes. *Educational Media International*, *55*(3), 287–300. https://doi.org/10.1080/09523987.2018.1512450

Ekwunife-orakwue, K. C. V, & Teng, T. (2014). Computers & Education The impact of transactional distance dialogic interactions on student learning outcomes in online and blended environments. *Computers & Education*, *78*, 414–427. https://doi.org/10.1016/j.compedu.2014.06.011

Elkaseh, A. M., Wong, K. W., & Fung, C. C. (2016). *The Acceptance of E-learning as a Tool for Teaching and Learning in Libyan Higher*. (April 2015).

Entwlstle, N. J. (1991). *Approaches to learning and perceptions of the learning environment Introduction to the Special Issue*. (1987), 201–204.

Estriegana, R., Medina-merodio, J., & Barchino, R. (2019). Computers & Education Student acceptance of virtual laboratory and practical work: An extension of the technology acceptance model. *Computers & Education*, *135*(August 2018), 1–14. https://doi.org/10.1016/j.compedu.2019.02.010

Farrell, T., & Rushby, N. (2016). Assessment and learning technologies: An overview. *British Journal of Educational Technology*, *47*(1), 106–120. https://doi.org/10.1111/bjet.12348

Frey, B. B. (2018). Internal Consistency. *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*, 50–53. https://doi.org/10.4135/9781506326139.n340

Ga, D., Loughin, T. M., Kovanovi, V., & Hatala, M. (2015). *Computers & Education Learning at distance: Effects of interaction traces on academic achievement*. *87*, 204–217. https://doi.org/10.1016/j.compedu.2015.07.002

Gikas, J., & Grant, M. M. (2013). *Internet and Higher Education Mobile computing devices in higher education : Student perspectives on learning with cellphones , smartphones & social media*. *19*, 2007–2009.

Giovanis, A. N., Binioris, S., & Polychronopoulos, G. (2012). An extension of TAM model with IDT and security/privacy risk in the adoption of internet banking services in Greece. *EuroMed Journal of Business*, *7*(1), 24–53. https://doi.org/10.1108/14502191211225365

Glover, I., Hepplestone, S., Parkin, H. J., Rodger, H., & Irwin, B. (2016). Pedagogy first: Realising technology enhanced learning by focusing on teaching practice. *British Journal of Educational Technology*, *47*(5), 993–1002. https://doi.org/10.1111/bjet.12425

Goldstein, H., Bonnet, G., & Rocher, T. (2007). Multilevel structural equation models for the analysis of comparative data on educational performance. *Journal of Educational and Behavioral Statistics*, *32*(3), 252–286. https://doi.org/10.3102/1076998606298042

Gregory, A. (1999). *Technology Is The Tool , Teaching Is The Task : Student Satisfaction In Distance Learning*. 1–9.

Habiba, U., & Md. Maidul Islam. (2015). *Using Pattern of Internet and E-resources by the Students and Faculty Members of a Private University in Bangladesh*. (December). https://doi.org/10.12691/education-3-5-1

Hanover Research. (2017). *2017 Digital Study Trends Survey Results Prepared for McGraw-Hill Education by Hanover Research*. (October), 1–31. Retrieved from https://s3.amazonaws.com/ecommerce-prod.mheducation.com/unitas/highered/explore/sites/study-trends/2017-digital-trends-survey-results.pdf

Hao, Y.-W. (2004). Students' Attitudes toward Interaction in Online Learning: Exploring the Relationship between Attitudes, Learning Styles, and Course Satisfaction. *Lib.Utexas.Edu*, 1–136. Retrieved from http://www.lib.utexas.edu/etd/d/2004/haoy96662/haoy96662.pdf

Hodges. (2008). Self-Efficacy in the Context of Online Learning Environments A Review of the Literature and Directions for Research. *International Society for Performance Improvement*, *20*(3-4/2008), 7–25. https://doi.org/10.1002/piq

Holmberg. (1983). *Guided didactic conversation in distance education. In D. Sewart, D. Keegan, & B. Holmber (Eds.),*. 1–7. Retrieved from http://www.c3l.uni-oldenburg.de/cde/support/readings/holm83.pdf

Hong, K. (2002). *Relationships between students ' and instructional variables with satisfaction and learning from a Web-based course*. *5*, 267–281.

Horvat, A., Dobrota, M., & Krsmanovic, M. (2015). *Student perception of Moodle learning management system : a satisfaction and significance analysis*. (May 2015), 37–41.

https://doi.org/10.1080/10494820.2013.788033
Hossien Zare, S. Y. (2013). The causal Model of effective factors on Intention to use of information technology among payam noor and Traditional universities students. *66*, עלון הנוטע(1997), 39–37. Retrieved from http://www.lifesciencesite.com/lsj/life1002/008_B00896life1002_46_50.pdf
I, I. M., & Arif, C. R. A. (2013). Relationship between the Acceptance of Mobile Learning for AutoCAD Course and Learning Style in Polytechnic. *Procedia - Social and Behavioral Sciences*, *102*(Ifee 2012), 177–187. https://doi.org/10.1016/j.sbspro.2013.10.731
İbrahim Hakki Bulut, & IN. (2019). *CONSTRUCTION OF AN EDUCATIONAL TECHNOLOGY ENGAGEMENT MODEL FOR SOCIAL LEARNING PLATFORMS* (Vol. 34). Middle East Technical University.
Ifinedo, P. (2017). Examining students' intention to continue using blogs for learning: Perspectives from technology acceptance, motivational, and social-cognitive frameworks. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2016.12.049
Islam, M. A., Abdul Rahim, A., Tan, C. L., & Momtaz, H. (2011). Effect of demographic factors on e-learning effectiveness in a higher learning institution in Malaysia. *International Education Studies*, *4*(1). https://doi.org/10.5539/ies.v4n1p112
Jackson, S. L. (2009). *Research Methods and Statistics A Critical Thinking Approach*.
Jaggars, S. S., & Xu, D. (2016). How Do Online Course Design Features Influence Student Performance? AC. *Computers & Education*. https://doi.org/10.1016/j.compedu.2016.01.014
Jeong, S. W., & Park, J.-S. (2020). Impacts of technology anxiety and perceived productivity on attitude toward self-service technology. *The Research Journal of the Costume Culture*, *28*(4), 480–491. https://doi.org/10.29049/rjcc.2020.28.4.480
Jhurree, V. (2005). Technology integration in education in developing countries: Guidelines to policy makers. *International Education Journal*, *6*(4), 467–483.
Joo, Y. J., Lim, K. Y., & Kim, J. (2013). Locus of control, self-efficacy, and task value as predictors of learning outcome in an online university context. *Computers and Education*, *62*, 149–158. https://doi.org/10.1016/j.compedu.2012.10.027
Joon Lee, S., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011). Internet and Higher Education Examining the relationship among student perception of support , course satisfaction , and learning outcomes in online learning. *The Internet and Higher Education*, *14*(3), 158–163. https://doi.org/10.1016/j.iheduc.2011.04.001
Ju, Y., Yon, K., & Kyung, E. (2011). Computers & Education Online university students ' satisfaction and persistence : Examining perceived level of presence , usefulness and ease of use as predictors in a structural model. *Computers & Education*, *57*(2), 1654–1664. https://doi.org/10.1016/j.compedu.2011.02.008
Karvounidis, T., Chimos, K., Bersimis, S., & Douligeris, C. (2014). Evaluating Web 2.0 technologies in higher education using students' perceptions and performance. *Journal of Computer Assisted Learning*, *30*(6), 577–596. https://doi.org/10.1111/jcal.12069
Ke, F. (2013). *CONSTRUCTS OF STUDENT-CENTERED ONLINE LEARNING ON LEARNING SATISFACTION OF A DIVERSE ONLINE STUDENT BODY: A STRUCTURAL EQUATION MODELING APPROACH*. *48*(1), 97–122.
Keller, john M. (1983). Instructional-design Theories and Models: An overview of their current status - Google Books. Retrieved July 14, 2020, from https://books.google.com.bd/books?hl=en&lr=&id=N_MVUyHxnkcC&oi=fnd&pg=PA383&dq=Keller,+J.+M.+(1983).+Motivational+design+of+instruction.+In+C.+M.+Reigeluth+(Ed.),+Instructional+design+theories+and+models:+An+overview+of+their+current+status+(Vol.+1,+pp.+3
Keller, john M. (2010). Motivational Design for Learning and Performance: The ARCS Model Approach - John M. Keller - Google Books. Retrieved July 14, 2020, from https://books.google.com.bd/books?hl=en&lr=&id=HRCQlZzMwhsC&oi=fnd&pg=PR5&dq=Keller,+J.+M.+(2010).+Motivational+design+for+learning+and+performance:+The+ARCS+model+approach.+New+York,+NY:+Springer.&ots=RaKPTX327I&sig=jygoRZYaUcMGyfTn2LPTUN5J0MY

&redir_esc=
Keller, J. M. (1979). Motivation and instructional design: A theoretical perspective. *Journal of Instructional Development*, *2*(4), 26–34. https://doi.org/10.1007/BF02904345
Kemp, S. (2020). *Digital 2020 GLOBAL DIGITAL OVERVIEW*. Retrieved from https://datareportal.com/reports/digital-2020-brazil
Kennewell, S. (2006). *Using affordances and constraints to evaluate the use of information and communications technology in teaching and learning Using Affordances and Constraints to Evaluate*. https://doi.org/10.1080/14759390100200105
Kenny, & Baron, A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1007/BF02512353
Kline. (2011). Principles and Practice of Structural Equation Modeling. In T. D. Little (Ed.), *Thought* (third edit, Vol. 20). https://doi.org/10.5840/thought194520147
Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (2019). Studying user satisfaction with the MOOC platform interfaces using the example of coursera and open education platforms. *ACM International Conference Proceeding Series*, 26–30. https://doi.org/10.1145/3322134.3322139
Kumar, S., & Daniel, B. K. (2016). Integration of learning technologies into teaching within Fijian Polytechnic Institutions. *International Journal of Educational Technology in Higher Education*, *13*(1). https://doi.org/10.1186/s41239-016-0036-8
Kuo, Y. C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet and Higher Education*, *20*, 35–50. https://doi.org/10.1016/j.iheduc.2013.10.001
L. Smart, K., & J. Cappel, J. (2006). Students' Perceptions of Online Learning: A Comparative Study. *Journal of Information Technology Education: Research*, *5*, 201–219. https://doi.org/10.28945/243
Lane, M. (2014). *UNIVERSITY STAFF ADOPTION OF IPADS: AN EMPIRICAL STUDY USINGAN EXTENDED TECHNOLOGY ACCEPTANCE MODEL*. *18*(3), 53–74.
Lee, Jung-Wan Kim, Y.-E. (2009). Perceived Interaction in Online Classes and Technology Acceptance Model to Student Satisfaction. *Journal of Distribution Science*, *7*(3), 25–48. https://doi.org/10.15722/jds.7.3.200909.25
Lee, Y., Choi, J., & Kim, T. (2012). *Discriminating factors between completers of and dropouts from online learning courses _1306 1..10*. https://doi.org/10.1111/j.1467-8535.2012.01306.x
Liaw, S. (2008). *Investigating students ' perceived satisfaction , behavioral intention , and effectiveness of e-learning : A case study of the Blackboard system*. *51*, 864–873. https://doi.org/10.1016/j.compedu.2007.09.005
Liaw, S., & Huang, H. (2013). Computers & Education Perceived satisfaction , perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers & Education*, *60*(1), 14–24. https://doi.org/10.1016/j.compedu.2012.07.015
Lin, Y. M., Lin, G. Y., & Laffey, J. M. (2008). Building a social and motivational frameworkfor understanding satisfaction in online learning. *Journal of Educational Computing Research*, *38*(1), 1–27. https://doi.org/10.2190/EC.38.1.a
Malinowsky, C., Kottorp, A., Tanemura, R., Asaba, E., Nagao, T., Noda, K., … Nyga, L. (2015). *ScienceDirect Validation of the Everyday Technology Use Questionnaire in a Japanese context*. https://doi.org/10.1016/j.hkjot.2015.08.002
Mends-brew, E. (2012). *ENHACEMENT OF ICT IN POLYTECHNICS FOR ACCELERATED DEVELOPMENT*. *3*(3), 99–107.
Moore, M. G. (1989). *Editorial: Three types of interaction Editorial: Three Types of Interaction*. *3647*(October). https://doi.org/10.1080/08923648909526659
Mora, H., Signes-Pont, M. T., Fuster-Guilló, A., & Pertegal-Felices, M. L. (2020). A collaborative working model for enhancing the learning process of science & engineering students. *Computers in Human Behavior*, *103*(October 2018), 140–150. https://doi.org/10.1016/j.chb.2019.09.008
Muilenburg, L. Y., Berge, Z. L., Muilenburg, L. Y., & Berge, Z. L. (2007). *Student barriers to online*

learning : Afactoranalyticstudy Student Barriersto Online Learning : A. 7919. https://doi.org/10.1080/01587910500081269
Olanrewaju, O. S., & Ikuereye, E. P. (2019). *M-Learning in Developing Countries: Challenges , Remedies and Benefits in Instructional Activities*. *4*(1), 105–114.
Pan, X. (2020). Technology Acceptance, Technological Self-Efficacy, and Attitude Toward Technology-Based Self-Directed Learning: Learning Motivation as a Mediator. *Frontiers in Psychology*, *11*(October). https://doi.org/10.3389/fpsyg.2020.564294
Parai, M., Shenoy, P., & Loh, K. Y. (2015). Students ' perception of technology-assisted learning in undergraduate medical education – A survey. *The Social Science Journal*, *52*(1), 78–82. https://doi.org/10.1016/j.soscij.2014.08.007
Park, S. Y. (2014). *An Analysis of the Technology Acceptance Model in Understanding University Students ' Behavioral Intention to Use e-Learning*.
Peart, D. J., Rumbold, P. L. S., Keane, K. M., & Allin, L. (2017). Student use and perception of technology enhanced learning in a mass lecture knowledge-rich domain first year undergraduate module. *International Journal of Educational Technology in Higher Education*, *14*(1). https://doi.org/10.1186/s41239-017-0078-6
Perry R.Hinto, Isabella McMurray, C. B. (2014). SPSS Explained second edition. In *Sereal Untuk* (Vol. 51).
Prensky, M. (2009). H. Sapiens Digital: From Digital Immigrants and Digital Natives to Digital... *Innovate: Journal of Online Education*, *5*(3).
Rabin, E., Henderikx, M., Kalman, Y. M., & Kalz, M. (2020). What are the barriers to learners' satisfaction in MOOCs and what predicts them? The role of age, intention, self-regulation, self-efficacy and motivation. *Australasian Journal of Educational Technology*, *36*(3), 119–131. https://doi.org/10.14742/AJET.5919
Rainer, R. K., & Miller, M. D. (1996). An assessment of the psychometric properties of the computer attitude scale. *Computers in Human Behavior*, *12*(1), 93–105. https://doi.org/10.1016/0747-5632(95)00021-6
Rivers, J. K., & Rivers, P. A. (2015). Africa and Technology in Higher Education: Trends , Challenges , and Promise. *International Journal for Innovation*, *3*(5), 14–31. Retrieved from http://ijier.net/index.php/ijier/article/view/354
Rocci Luppicini. (2005). *International Forum of Educational Technology & Society A Systems Definition of Educational Technology in Society Author (s): Rocci Luppicini Published by: International Forum of Educational Technology & Society Linked references are available on JSTOR*. *8*(3), 103–109.
Rubin, B., Fernandes, R., & Avgerinou, M. D. (2013). Internet and Higher Education The effects of technology on the Community of Inquiry and satisfaction with online courses. *The Internet and Higher Education*, *17*, 48–57. https://doi.org/10.1016/j.iheduc.2012.09.006
S.A. Onasanya, R.A. Shehu, R. O. O. and L. A. S. (2010). *higher institution's lectures' attitude towards integration of ICT into teaching and research in nigeria*. https://doi.org/10.3923/rjit.2010.1.10
Santos, H., Batista, J., & Marques, R. P. (2019). Digital transformation in higher education: The use of communication technologies by students. *Procedia Computer Science*, *164*, 123–130. https://doi.org/10.1016/j.procs.2019.12.163
Segars, A. H. (1997). Assessing the unidimensionality of measurement: A paradigm and illustration within the context of information systems research. *Omega*, *25*(1), 107–121. https://doi.org/10.1016/S0305-0483(96)00051-5
Shahadat Khan, Mahbub, H., & C Clement. (2012). Barriers To the Introduction of Ict Into Education in Developing Countries: the Example of Bangladesh. *International Journal of Instruction*, *5*(2), 61–80.
Shelley, M. C. (2008). *Considering Students ' Perceptions : The Distance Education Student Satisfaction Model Considering Students ' Perceptions : The Distance Education Student*.
Smith, A. (2013). Smartphone Ownership Update. *Pew Research Center's Internet & American Life*

Project., 3–12.
Sobel, M. E. (1982). Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models. *Sociological Methodology*, *13*(1982), 290. https://doi.org/10.2307/270723
Sthle, L., & Wold, S. (1990). Multivariate analysis of variance (MANOVA). *Chemometrics and Intelligent Laboratory Systems*, *9*(2), 127–141. https://doi.org/10.1016/0169-7439(90)80094-M
Strachota, E. M. (2003). Student satisfaction in online courses: An analysis of the impact of learner-content, learner-instructor, learner-learner and learner-technology interaction. *Doctoral Dissertation, The University of WisconsinMilwaukee, Dissertati*(64(08)), 2746. Retrieved from http://dx.doi.org/10.1016/j.jaci.2012.05.050
Šumak, B., Hericko, M., Pušnik, M., & Polančič, G. (2011). Factors affecting university students' use of moodle: An empirical study based on TAM. *International Journal of Information and Communication Technology Education*, *13*(1), 14–26. https://doi.org/10.4018/IJICTE.2017010102
Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers and Education*, *50*(4), 1183–1202. https://doi.org/10.1016/j.compedu.2006.11.007
Sun, P., Tsai, R. J., Finger, G., & Chen, Y. (2008). *What drives a successful e-Learning ? An empirical investigation of the critical factors influencing learner satisfaction*. *50*, 1183–1202. https://doi.org/10.1016/j.compedu.2006.11.007
UNESCO, I. de statistique de. (2015). *TECHNOLOGIES DE L ' IN FORMATION ET DE LA COMMUNICATION (TIC) EN EDUCATION EN AFRIQUE SUBSAHARIENNE Analyse comparative du développement numérique dans les écoles*.
Venkatesh, V. . M. D. D. (2003). (2006). User Acceptance of Information Technology: Toward a Unified View. *International Encyclopedia of Ergonomics and Human Factors, Second Edition - 3 Volume Set*, *27*(3), 425–478. https://doi.org/10.1201/9780849375477.ch230
Venkatesh, V., Davis, F. D., Venkatesh, V., & Davis, F. D. (2000). *Studies Linked references are available on JSTOR for this article: A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies*. *46*(2), 186–204.
Villanti, A. C., Johnson, A. L., Ilakkuvan, V., Jacobs, M. A., Graham, A. L., & Rath, J. M. (2017). Social media use and access to digital technology in US Young Adults in 2016. *Journal of Medical Internet Research*, *19*(6), e196. https://doi.org/10.2196/jmir.7303
Xu, F., & Du, J. T. (2018). Factors influencing users' satisfaction and loyalty to digital libraries in Chinese universities. *Computers in Human Behavior*, *83*, 64–72. https://doi.org/10.1016/j.chb.2018.01.029
Xue, H., Sharma, P., & Wild, F. (2019). User Satisfaction in Augmented Reality-Based Training Using Microsoft HoloLens. *Computers*, *8*(1), 9. https://doi.org/10.3390/computers8010009
Yalcin, Y. (2017). *Florida State University Libraries Online Learners ' Satisfaction : Investigating the Structural Relationships among Self- Regulation , Self-Efficacy , Task Value ,*.
Yi-Cheng CHEN et al. (2013). Examining Factors Affecting College Students' Intention to Use Web-Based Instruction Systems: Towards an Integrated Model - University of Huddersfield. Retrieved November 30, 2020, from TOJET the Turkish online journal of educational technology 12.2 website: https://hud.alma.exlibrisgroup.com/discovery/openurl?institution=44HUD_INST&vid=44HUD_INST:Services&%3Fctx_ver=Z39.88-2004&ctx_enc=info:ofi%2Fenc:UTF-8&rfr_id=info:sid%2Fsummon.serialssolutions.com&rft_val_fmt=info:ofi%2Ffmt:kev:mtx:journal&rft.genre=article&rft.atitle=Examining Factors Affecting College Students%27 Intention to Use Web-Based Instruction Systems: Towards an Integrated Model&rft.jtitle=TOJET the Turkish online journal of educational technology&rft.au=Yi-Cheng CHEN&rft.au=Yi-Chien LIN&rft.au=Ron Chuen YEH&rft.au=Shi-Jer LOU&rft.date=2013-04-01&rft.eissn=1303-6521&rft.volume=12&rft.issue=2&rft.externalDocID=3031410981&paramdict=en-US
Yuen, A. H. K., Cheng, M., & Chan, F. H. F. (2019a). Student satisfaction with learning management systems: A growth model of belief and use. *British Journal of Educational Technology*, *50*(5),

2520–2535. https://doi.org/10.1111/bjet.12830
Yuen, A. H. K., Cheng, M., & Chan, F. H. F. (2019b). Student satisfaction with learning management systems: A growth model of belief and use. *British Journal of Educational Technology*, *50*(5), 2520–2535. https://doi.org/10.1111/bjet.12830
Zhang, Y., & Lin, C. H. (2020). Student interaction and the role of the teacher in a state virtual high school: what predicts online learning satisfaction? *Technology, Pedagogy and Education*, *29*(1), 57–71. https://doi.org/10.1080/1475939X.2019.1694061
Zhu, Y., Hua, J., Wing, Z., & Greg, A. (2020). University students ' online learning attitudes and continuous intention to undertake online courses : a self - regulated learning perspective. In *Educational Technology Research and Development*. https://doi.org/10.1007/s11423-020-09753-w

Appendix

questionnaire used to collect student and expert opinion

Part A: Demographic Data (please select the appropriate)

1. Gender: Male/ Female
2. Age: Less than 18 years/ 18 -22 years/ 23 -27 years/ Above 27 years
3. Division: Barisal/ Chittagong/ Dhaka/ Khulna/ Mymensingh/ Rajshahi/ Rangpur/ Sylhet
4. Department: Computer Science/ Mechanical/ Electrical and Electronic/ Civil/ Architecture/ environmental/ architecture and interior design/ Electromedical/ Power/ Mechatronics/ food/ chemical and food/ Construction/instrumentation and process control/ Tourism and hospitality
5. Year of Study: First Year/ Second Year/ Third Year/ Fourth Year
6. What devices have you used in your study? Laptop/ Desktop/ Tablet/ Mobile/ Others (Please specify …)
7. How much time have you spent every day for your study with technology? Less than 1 hour/ 1– 2 hours / 2–5 hours/ above 5 hours
8. Type of internet connection used: Broadband/ Mobile data/ Both/ None of the them/ Others (Please specify…)
9. Place of living during study: Home/ Institutional Halls/ Rental houses/ Others (Please specify …)
10. Where is your permanent home? City/ District town/ Thana town/ Village

Part B: Perceived Satisfaction Towards Technology

	Meaningful		Relevant		Clear	
Perception Towards Technology Perceived	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Usefulness						
1. Using technology would improve my learning performance						
2. Using technology would enhance my effectiveness in learning						
3. Using technology would help me finish my learning tasks more quickly						
Perceived ease of use						
4. I find technology is easy to use for learning						
5. I find technology user-friendly for learning						
6. The technology makes it easy for me to find the content I need easily						
7. I would find it easy to use technology to do what I want it to do						
8. I am quite relaxed when I use technology for my learning						
9. I feel comfortable when using technology in my learning						
Anxiety						
10. I feel mental stress with technology						
11. my technology skills make me insecure in learning. (R)						
12. I avoid using technology usually in my learning. I believe that working with Technology						
13. is very difficult (R)						
14. is very complicated (R)						
15. requires technical skills (R)						

Attitude/ Perception towards technology						
I believe-						
16. Technologies have many useful functions						
I believe that working with Technology -						
17. makes my study more interesting.						
18. makes my study pleasant.						
Self-efficacy						
I feel confident to ...						
19. start any application or software for my learning						
20. Complete assignments and exercises using technology						
21. Prepare for or give presentation using technology						
22. Finish complex learning tasks using technology						
Social interaction						
I feel-						
23. I can easily communicate to my classmates using email and social networking applications						
24. I can easily communicate to my teachers using email and social networking applications						
I am confident I can						
25. start discussions with my classmates using technology						
26. ask questions to my teachers using technology						
Perceived satisfaction						
27. I am satisfied with using technology as a study assist tool						
28. I am satisfied with using technology to solve my problems related to study						
29. I am satisfied with the role the teachers play in my studies involving technology						
30. I am satisfied with experiences technologies offer me						

Final questionnaire

I'm Souleman Sadam student in Islamic university of technology (IUT) in Dhaka. As part of my master's thesis in Technical and vocational education (TVE), I'm conducting research on polytechnic students' perceived satisfaction on technology use in their learning. Therefore, your answers to this questionnaire will help us in improving students learning experience with technology. The survey should only take 5 minutes, and your responses are completely anonymous Do you agree to the above terms? By clicking Yes, you consent that you are willing to answer the questions in this survey.

Part A: Demographic Data (please tick the appropriate)

1. Gender: Male/ Female
2. Age: Less than 18 years/ 18 -22 years/ 23 -27 years/ Above 27 years
3. Division: Barisal/ Chittagong/ Dhaka/ Khulna/ Mymensingh/ Rajshahi/ Rangpur/ Sylhet
4. Department: Computer Science/ Mechanical/ Electrical and Electronic/ Civil/ Architecture/ environmental/ architecture and interior design/ Electromedical/ Power/ Mechatronics/ food/ chemical and food/ Construction/instrumentation and process control/ Tourism and hospitality
5. Year of Study: First Year/ Second Year/ Third Year/ Fourth Year

6. What devices have you used in your study? Laptop/ Desktop/ Tablet/ Mobile/ Others (Please specify …) allow multiple selection
7. How much time do you spend every day for your study using technology? Less than 1 hour/ 1–2 hours / 2–5 hours/ above 5 hours
8. Type of internet connection while studying using technology: Broadband/ Mobile data/ Both/ None of them/ Others (Please specify…)
9. Place of living during study: Home/ Institutional Halls/ Rental houses/ Others (Please specify …)
10. Where is your permanent home? City/ District town/ Thana town/ Village

Part B: Perceived Satisfaction Towards Technology

Please rate the degree to which you agree or disagree with each of the following statements related to perceived satisfaction of technology:

[1] Strongly Disagree ,[2] Disagree [3] Somewhat Disagree [4] Neutral [5] Somewhat agree [6] Agree , [7] Strongly Agree

Perceived Usefulness

1. Using technology would improve my learning experience
2. Using technology would enhance my success in learning
3. Using technology would help me finish my learning tasks more quickly

Perceived ease of use

4. I find technology is easy to use for learning
5. I find technology is user-friendly for learning
6. I find technology gives me easier access to the learning materials I need
7. I would find it easy to use technology to do what I want it to do
8. I am quite relaxed when I use technology for my learning
9. I feel comfortable when using technology in my learning

Anxiety

10. I feel psychological stress while learning with technology (R)
11. I feel insecure about my technology skills in learning. (R)
12. I limit the use of technology in my learning.
13. I find difficulties in using technology in my learning (R)
14. I believe that learning with Technology is complicated
15. I believe that learning with technology requires technical skills

Attitude/ Perception towards technology

16. I believe Technology can be used to perform many useful functions in learning
17. I believe that learning with Technology makes my study more interesting.
18. I believe that Technology makes my learning more pleasant

Self-efficacy

19. I feel confident to use any application or software for my learning
20. I feel confident to complete assignments and exercises using technology
21. I feel confident to prepare any learning materials using technology for my study
22. I feel confident to complete the learning of complex subjects using technology

Social interaction

23. I feel I can easily communicate with my classmates using email and social networking applications
    (WhatsApp, Facebook…)
24. I feel I can easily communicate with my teachers using email and social networking applications
    (WhatsApp, Facebook…)
25. I am confident I can discuss my study with my classmates using technology
26. I am confident I can ask questions to my teachers using technology

Perceived satisfaction

27. I am satisfied with using technology as a tool to help my study
28. I am satisfied with using technology to solve my problems related to the study
29. I am satisfied with the role the teachers play in my studies involving technology
30. I am satisfied with the experience of using technology in my study