Perceptions of Students' on 'Intelligent Tutoring System'

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ABSTRACT

The research in this thesis investigated how instructional technological based solutions, such as intelligent tutoring system, help students to increase their learning motivation and satisfaction after provided quality of information, system, and service. Intelligent tutoring system as an educational supplemental tool, which has been one of the major discussion topics about between educators and education theorist, is designed to assist students for their academic achievement. Although intelligent tutoring system has been successfully used in number of disciplines, it has not been exactly identified what affects students' perceptions and consequently what factor leads to success or failure of the program.

Therefore, this study implemented information system success model to ensure that all the dimensions are measured scientifically to carry out reliable and validated findings. This model proved that intelligent tutoring system helps to improve the desired learning performances significantly as students receive quality information, service and system. Another noteworthy finding was learning motivation, student satisfaction and task-technology fit were closely related with the learning performances.

Keywords: Tutoring, Intelligent Tutoring, Artificial Tutoring System

ÖZ

Bu tez araştırması, akıllı öğretim sistemi gibi eğitim amaçlı teknolojik temelli çözümlerin, verilen kaliteli bilgi, sistem ve hizmet sonrasında öğrencilerin öğrenme motivasyonlarının ve memnuniyetlerinin artmasına nasıl katkıda bulunduğunu incelemeye çalışmıştır. Eğitimciler ile eğitim kuramcıları arasındaki en önemli tartışma konularından birisi olan akıllı öğretim sistemi, eğitim/öğretimi destekleyici bir araç olarak, öğrencilerin akademik başarılarına yardımcı olması için tasarlanmıştır. Akıllı öğretim sistemi bir çok disiplinde başarıyla kullanılmış olsa da, öğrencilerin algılarını neyin etkilediği ve dolayısıyla programın başarısına veya başarısızlığına neden olan etkenler tam olarak tespit edilememiştir.

Bundan dolayı, güvenilir ve geçerliliği olan bulguları elde etmek için bu çalışma da tüm boyutların bilimsel olarak ölçüldüğüne emin olmak için 'bilişim sistemleri başarı modeli' uygulanmıştır. Bu model, öğrencilere kaliteli bilgi, hizmet ve sistem sunulduğunda, akıllı öğretim sisteminin öngörülen öğrenim performanslarını önemli ölçüde iyileştirdiğini göstermiştir. Dikkate değer bir başka bulgu ise öğrenme motivasyonu, öğrenci memnuniyeti ve görev-teknolojisi uyumunun öğrenme performanslarıyla yakından ilişkili olmasıydı.

Anahtar Kelimeler: Özel Ders, Akıllı Öğretim, Yapay Zeka Sistemleri

DEDICATION

This thesis is dedicated to the memory of my dearest daddy, Mustafa Yuce, who had impact on my life materially and spiritually from the moment I was born. Dad, you did not teach me only how to write, read and calculate basic arithmetical questions, but you also showed me love, respect, courage, perseverance, truthfulness and integrity ever since I remember myself. You were my inspiration and will remain so forever.

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LIST OF ABBREVIATIONS

CFA	Confirmatory Factor Analysis
CMV	Common Method Variance
D&M	Delone & McLean
EFA	Exploratory Factor Analysis
IQ	Information Quality
IS	Information System
ISS	Information System Success Model
LP	Learning Performance 63
SEM	Structural Equation Modelling
SEQ	Service Quality
SQ	System Quality
SST	Students Satisfaction
TAM	Technology Acceptance Model
TRNC	Turkish Republic of Northern Cyprus
TTF	Task-Technology Fit
UTAUT	Unified Theory of Acceptance and Use of Technology
ZPD	Zone of Proximal Development

Chapter 1

INTRODUCTION

Discoveries, inventions and innovations in modern ages opened tremendous opportunities that led, first, advanced technology then consequently digital age to be emerged and be part of our life. While technology advances in a rapid pace and spreads all over the world in a light speed, continuous and progressive developments resulted with cutting edge devices and software developments. Widespread of using these breakthrough tools have helped us communicate instantly, complete tasks easier, improve productivity, easy access to knowledge, and enhance our metacognitive skills. Advanced technology has also expanded our horizon and allowed us to have more creative insights to bring the new solutions to many fields from communication to transportation. In short, technology has been a major transformative factor/force behind social, environmental, financial, health and psychological developments.

Inevitably, education could not be isolated and deprived from this powerfully modernized progress, particularly; pervasiveness of technology has been taken place in every aspect of our lives. In particularly, as there are increasing demands for quality, reliable, open-minded and dynamic individuals who can meet with the requirements of challenging and competitive workforce after school. With this in mind, educational institutions have set goals to foster learners for the 21st century in which next generations are demanded to constitute and embrace newer ideas,

discoveries, inventions and explorations. Hence, most of those institutions have been transforming their instructional design, environment, methods and theories and train their educators/staff in order to meet with educational needs, requirements and purposes (Mohammadi, 2015). Therefore, these instructional technologies have been designed, developed and implemented in classroom environment to ensure that students have necessary skills that are compatible with unstoppable digital age which is expected to accelerate the transformation of social, cultural, behavioral, emotional and educational lives and methods more than one can imagine.

One of the major goals of this study is offering an alternative approach in order to contribute their academic success by identifying their learning style, providing necessary feedback and scaffolding to ensure that students are enthusiastically engaged and empowered while they actively interact with Intelligent Tutoring System (ITS). What is an intelligent tutoring system? There are number of definitions in literature and, in general, they all indicate the similar meanings. After reviewing some of these definitions in literature, ITS can be defined as 'a representation of a human tutor in computational format that aims to deliver adapting learning objectives on a digital platform by regarding students' individualistic differences, needs, learning styles, and goals (Crockett, Latham, & Whitton, 2017; Sani & Aris, 2014). ITS also provide opportunity to build a student centered learning environment in which they have control over.

On the other hand, this paper does neither aim nor claim to replace human teacher; instead, it supports teachers' efforts by reinforcing students' comprehensive learning, understanding and cognitive development. As a supplementary tool, ITS helps teachers use their limited time to design more efficiently and make necessary

interventions almost instantly, while they observe their students' development. Teachers, as a primary source, continue to introduce other important internal qualities in their students such as aspiration, dedication, determination and compassion, all of which are needed for the endeavors of students to attempt throughout their lives. ITS is not a miracle and most effective computerized based learning supplementary tool in learning and teaching efforts. But it helps to present some solutions and alternative methods to help students perform better in and out of the classroom.

1.1 Traditional Educational System

Lack of effectiveness and productivity of traditional education system has been one of the core topics among education theorists, researchers, and administrators. Within current traditional pedagogical epistemology students' capacity, intellectuality and abilities have been remained limited with given standardized information. The conservational education system also prevents students from getting efficient support from peers by not emphasizing the importance of interaction and promoting a personalized learning. Delivered information does not contain realistic, meaningful, scientific concept, and promoting creativity and collaboration involvement with a real-world relevant learning task. Lastly inability of giving students constructive feedback, providing lesson objectives based on their learning styles and pace of learning are another major drawbacks of conventional education system.

In conservative pedagogical system, the role of student has been assigned as the passive learners while teacher's role is determined as a direct knowledge transmitter. An effective learning and teaching activity that does not allow student's active participation by brain storming, questioning, reasoning, and investigating to

construct a body of knowledge creates low level achievement. Teachers who do not promote collaborative work, creativity and influence students by providing personalized based learning environment lays foundation for a certain failure in long term. Teacher based learning style without implanting the creative learning activities does not also enable productive information process as a result of giving abstract knowledge.

Despite all these concerns about education, common and stubborn problems such as need for assistance, active participation, more concreate knowledge than abstract, improving creativity and providing more personalized lesson continue to be major issues. Moreover, transforming classical schools into a student centered environment has not been more important than it is in this current digital age. Therefore assisting, coaching, and reinforcing students at a time when it is needed, allow them to build more concrete knowledge that is needed in 21st century than classical approach. One of the interventions that educators have been using to assist student to improving students' capacity and learning is called tutoring.

1.2 Critics on Technology

On the other hand, there is a bias for the effectiveness about latest technological developments and innovations. This misjudgment finds ground either because of financial concerns of marketing lobbies, or with the belief that all latest produced/innovated devices are cutting edge tools that add value in our life. Murray and Pérez (2015) indicated technological based instructions are not a remedy for all kind of drawbacks, negativities, and limitations that classic learning environment causes –at least at this time. It is expected that these 'innovative' tools magically improves students' success in a short period of time. However, a device, particularly,

if it is designed diligently for pedagogical purpose, then it can be considered for many aspects of learning and teaching goals. For example, how rewarding it is; is it reliable; how useful and easy to use and adapt it in learning; does it produce a quality information and user satisfaction (Jan & Contreras, 2016) instead of desired commercial benefits.

A learning environment, if it is not designed with useful technologies, may not only just look like a technological graveyard, but it may be a place where the hopes of future generations are laid to rest. Designing and developing technology based learning environment is an essential factor to increase educational standards, but the final decision demands to be made after a collective agreement of all parties who aim to enrich students learning outcomes. Therefore, it is noteworthy to state that there are some essential procedures, criteria and evaluation methods that must be considered before spending a remarkable amount of taxpayers' money and implementing them in a learning setting.

Technology has been using in multiple areas of study to support students learning and improve their development (Patchan & Puranik, 2016). According to many researches related to the effectiveness of using technology indicated that using carefully chosen students centered technology benefits students starting at early ages (Heflin, Shewmaker, & Nguyen, 2017; Patchan & Puranik, 2016). Selected technology based learning tools should be able to provide convenience of anytime, anywhere and pace options for learners. These instructional instruments are required to have functionalities to motivate and create attractiveness to achieve learning goals. Further, learners need to gain practical experiences for both individualistic and/or collaborative work environment to ensure the early adaptation. Therefore, it requires

a systematic and scientific approach to determine the effectiveness of a pedagogical instrument whether it increases educational outcome or not by considering all the variables that impact overall success.

In order to measure their effectiveness and impacts on learners' perceptions, there are several of models that have been using among researchers (Mohammadi, 2015). Some of these models are: "Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT) and the Unified Theory of Acceptance and Use of Technology (UTAUT), DeLone & McLean's model to explore e-learning users' behavioral patterns" (Mohammadi, 2015). A brand new technological tool should focus on how it improves teachers' teaching research arsenal; how it improves students' active engagement; how it allows students to explore and discover their potential, furthermore, how it raises the educational bar? Brusilovsky, Eklund, and Schwarz (1998) argues that designing, developing and implementing an online learning environment should be prepared carefully by taking consideration of the differences of students and ensure that environment is flexible for those who are freshmen.

Ossiannilsson and Landgren (2012) and Mohammadi (2015) also argues that despite more digitalized tools add a positive value in productivity of students' achievement by offering flexible, interactive, personalization learning environment; however, those components should be implemented based on learners' academic, cultural and structural backgrounds. Hence, whatever the online environment is named, it should have variety of learning tools, activities, and assessment strategies in order to capture the attention of diverse group of student included their learning style, previous knowledge and current skill (Brusilovsky et al., 1998)

Researches indicate that an electronic based learning have tremendous benefits for both teachers and students from gaining knowledge in a flexible environment to increasing students' motivation and satisfaction. As a matter of fact, students learn how to navigate and use an online learning environment to gain self-confidence, self-regulation, and being disciplined/responsible individuals for their own academic achievement before the teachers facilitate learning objectives. However, there is a potential danger that can alienate students' motivation to bond with their own learning. This danger is a technology which does not offer a quality learning material and consequently does not meet with teachers' and students' needs. As a result, dropout rates are skyrocketing significantly because of leaving students unattended with an expert assistance, disregarding their behavioral difference, learning environments and tools that are lack of offering collaborative based interaction.

Further, Mohammadi (2015) suggests that designing an online learning and teaching platform should allow students to discover the connection between theory and practices. For this, architecture and framework of the projected learning environment should provide lifelike learning activities and tasks to gain the knowledge that can be applicable for the real world environment. Therefore, before implementing a new educational technology into learning and teaching environment make sure that selected technology provides efficient lesson content based on students' identified learning style, needs and expectations that can create useful and meaningful remedies for their academic development.

Allowing students to have an active interaction with a computerized tool that reinforces and challenges his/her knowledge, improve comprehensive understanding, and improves their mastery of subject with keeping truck of their personalized

experience creates enthusiasm and ownership for their learning. This study does not design, develop and implement an ITS to prove this hypothesis since it is beyond this research's boundaries.

1.3 Tutoring

As it is aforementioned, Vygotsky, who is well known with his theory of 'Zone of Proximal Development' (ZPD) made suggestion that individuals learn more and improve their learning abilities if they are guided by experts and knowledgeable people (Luckin & du Boulay, 2016). In other words, working with a peer or expert of a subject improves students' learning outcomes, increase their engagement; make a positive change in their personal, professional and emotional development. Tutoring is one of the reinforcement tools to improve students' knowledge, skill and engagement to ensure that students are guided when they are seeking for help. Tutoring services aims to assist a learner in an area of where he/she needs to clarify and develop a better significant understanding that allows them to discover newer approaches, broader knowledge, improved motivation, socially active, self-regulation and engagement (Mulyadi, Basuki, & Rahardjo, 2016). Further, tutoring empowers students gain confidence that they need not only for academic achievement, but also in personal development such as being independent learner (Mulyadi et al., 2016).

On the other hand, tutors are those who have expertise in an area of study provide assisting and guiding to enhance students' learning. Tutors help students after a systematic approach such as collecting data about students' level of understanding, learning style, and then provide necessary hints that allow students to discover solution they are looking for. In some institutions tutors are selected among the students who have more comprehended understanding than other students. This is

called peer tutoring. Peer tutors are selected based on several criteria for example their school success and/or specialized training they need to develop professionalism and qualification for the area they convey the knowledge.

Despite great advantages of tutoring students, there are some barriers that need to be removed and improved. For instance, availability of time for assisting when students need help is an important factor that creates satisfaction and improves students' success in learning. However, human tutoring may not be possible at the time when students need assistance to solve the problems and gain specific skills they need due to time, budget and location limitations (Bloom, 1984). Next, forming a tutoring service for schools requires investing considerable amount of budget to be able to afford tutors' salary, facility and other expenses such as hardware and software needs. Providing a tutoring service also does not attract some students due to their emotional, attitude and learning problems. For example, some students are not feeling confident to express their weakness areas, while others are not socially active and/or comfortable with interacting with others. Therefore, a tutoring service should be designed and developed to meet with students' demands and needs with more computational based intelligent services that provides flexible, comfortable, and affordable service for all students.

1.4 Intelligent Tutoring System (ITS)

A well-designed Intelligent Tutoring System (ITS) is one of these tutoring services that aim to provide solutions to remove the obstacles that cause dissatisfaction, disengagement, resentfulness and low learning performance due to lack of learning reinforcement and assistance features of education systems. Freedman, Ali, and McRoy (2000) defines ITS as "a broad term, encompassing any computer program

that contains some intelligence and can be used in learning." Another one defines it as "ITS is computer software designed to simulate a human tutor's behavior and guidance" (Koedinger & Tanner, 2013). In other words, for the researcher, ITS is another digital based phenomena besides many computerized tools that helps to clear the paths from removable objects, hammers on the barriers to proceed and grasp further information, and unlock the most important treasure door, which is the mind, to discover newer horizons by being assisted towards a computerized program.

ITS is a bridge between a planned objectives and desired goals to ensure that learners enhance their learning as they across the bridge on their own. As an easily accessible functionality, ITS helps learners to clear the vague topics, supports their self-enrichment, and allows students adjust the pace of learning. ITS allows learners to have strong mind-set and skillsets they need to be able to survive in digital age. ITS also attracts, influence and engages students with learning objectives, stimulate their enthusiasm, and create a learning environment in which students receive computerized assistance besides real human, instant feedback, and customized learning approach that takes learner's individualistic abilities. ITS also helps students to build not only problem solving skills and construct knowledge, but also provides opportunity to eliminate their frustration that occurs as a result of being left alone in the shadow.

ITS is a highly progressive program which is available throughout all computerized components to support learners at the time they need and defined as a "computer-assisted learning or instruction" (Amaral, Meurers, & Ziai, 2011; Hrubik-Vulanovic, 2013) and/or "web-based intelligent tutoring system" (Amaral et al., 2011) to improve the teaching and learning outcomes beyond classroom settings. ITS as a

digitalized educational tool offers several major benefits; first and most, students improve their understanding of the course objectives with individualized and adapted learning environment based on the level of knowledge and learning styles; second, students receive a timely given feedback as a conversational interaction with a programmed tutor after assessing their progress; and lastly, flexibility which allows learners go beyond the classroom to reinforce their comprehensive learning (Annabel M Latham, Crockett, McLean, Edmonds, & O'Shea, 2010).

There are many additional benefits of using ITS in education besides being assisted and getting instant feedback. For instance, students discover newer ideas, alternative learning approaches, ownership of their learning, improve their creativity while they collaborate and communicate with their peers and teachers in group work. As ITS advanced and gets more intelligent, then it fascinates learners in a multiple areas of study because it offers information based on students' psychological state, attitude, and identifying the most weakness point of students by recognizing not only with the voice recognition but also face recognition. In general, ITS motivates and encourages students to advance their skill and knowledge throughout a systematic, pre-designed and adapted program. Then, it prompts necessary feedback such as hints, showing their missteps and guidance when it is needed and until they feel comfortable with their learning (Koedinger & Tanner, 2013). As a result of interaction with ITS, students have more self-confidence and self-esteem which increase their adaptation for their working place after school.

It is aimed to discover the impacts of ITS whether students are going to be engaged with the course objectives and have a solid understanding after receiving assistance and feedback or not. Collecting reliable and sufficient data by using the

questionnaires to assess students' and teachers' perception and effectiveness of the ITS are core elements of this study. In short, this research examines and argues intelligent tutoring system from the aspect of sustainability, productivity, and efficiency in higher educational level.

Next generations need alternative solutions, approaches, methods and practices in order to have ability, knowledge and skill that can be obtained using the state-of-art technologies effectively. More importantly, preparing and fostering our generations with latest innovative tools help them to improve their higher order thinking skills that allow them to use their minds, time and energy more effectively. As most of the reviewed articles, they indicate that ITS's impact on learning and teaching efforts which have been influencing all involvers' academic and personal development significantly; and its effect has been felt stronger as ITS gets smarter and performs better by imitating human attitudes and emotions. Additionally, this paper offers personalized and contextualized learning materials to boost instructional and educational outcomes for both teachers and students.

1.5 Aims of the Study

One to one instruction has proven that students with or without diverse background, level of their ability and capacity, they can achieve and improve their comprehensive learning outcome when they are assisted and instructed by a proficient tutor, well-designed learning setting in which students' learning style is taken in consideration (Bloom, 1984; Mulyadi et al., 2016). This study claims that students can maximize their performance, consequently their academic success, if an advanced computational intelligence tool that adapts the course material to engage them with their courses. Furthermore, researcher asserts that there are fundamental factors that

affect the consequences of an instructional technology's success. Some of these factors are quality of information, system, and service along with a task-technology fit, user satisfaction and motivation that lead both success or failure of the desired outcome. Study aims to prevail that these factors are critical for the success of a digital instrument to increase the learning/teaching productivity. Therefore, this study intents to collect reliable and sufficient data by using the questionnaire to assess students' perception of the ITS to indicate how strongly each of the aforementioned dimensions impacts the final outcome.

The study also presents an extensive and comprehensive assistance and support to both students to enhance ability to retain the course objectives, problem solving skills, advance their higher thinking skills, and motivation. An effective and advanced ITS motivates students by providing instant solutions for the problems they cannot figure out by themselves or to discover newer approaches for a higher level understanding (Sani & Aris, 2014). Lastly, ITS also gives an idea about each student's weakness and strength besides their learning styles and some other essential factors that allow all educators tailor an efficient model for them.

This study strives to explain that majority of students, regardless of their potential, skill and knowledge level, improve their learning performances as a result of increased satisfaction, motivation and with given meaningful task-technology fit using the web-based learning platform.

- ITS helps to influence students' motivation and satisfaction by providing quality information along with the system and service quality.
- ITS helps students' student satisfaction and performance by providing the

task-technology fit based learning activities.

- Students' desire to interact with ITS is promoted as their student satisfaction is increased.

1.6 Research Questions

There are several important questions that this research is seeking to respond. What factors of the research model have the positive impact on another variable, and then what factor constitutes to achieve the desired academic outcomes. Some of the most fundamental questions that laid the foundation for this research are listed in an order below.

1. Do information, system, and service quality have positive impact on student satisfaction?
2. Does ITS with task-technology fit and student satisfaction enhance learning performance?

1.7 Contributions of the Study

Many researches have been conducted to measure the impact of ITS in various fields. Although majority of the researches indicates that effectiveness of ITS is promising for educational outcomes with its current development, yet it still requires a comprehensive improvement to carry out more creative and leading educational conclusions for all involved in it. Each of them had distinguished method for the research they administered and implemented in multiple areas. These studies show that ITS as an intelligent computer program plays an essential role by allowing users interact based on their characteristic differences and it is expected to contribute more significant learning improvements as it gets smarter, sharper, and reflects human behavior.

ITS models that reviewed in the discipline are paradigms that implemented to discover the effect of ITS using the past technological approaches. However, technological development is a dynamic process that has been constantly evolved as newer innovations take place. Consequently, one can predict that this constant development of technology align with more sophisticated ITS increases productivity and efficiency of individuals' learning gains more profoundly in near future. Among many of the articles related to ITS, some of them are mentioned in literature review section.

1.8 Limitations

With bearing in mind that, to bring such an idealistic goal into life, there are essential components, elements, factors and dimensions, such as quality of given information, assigned task, provided service and system that are interwoven, to create satisfaction, motivation and enhancing learning performance. It is impractical and being naive to expect that each pupil succeeds and improves learning gains in an identical instructional environment without considering individual differences, their learning styles, giving them necessary feedback, support and assistance when they need it.

It is also foreseen/projected that developing such an intelligent tutor is not an easy task due to its complex architectural structure, high cost to develop and lack of human sensibility and emotion (Annabel M Latham et al., 2010). Another challenging issue is adaptation of learners to study with an artificial character that lacks of human emotion and attitudes (Annabel Marie Latham, 2011). Applying ITS just like any other instructional technology which does not have the ability of presenting guidance and assistance students when they are actively engaged, it

alienates them result with failure of the efforts (Annabel Marie Latham, 2011; Rus, D'Mello, Hu, & Graesser, 2013).

Designing ITS for multidisciplinary academic subjects may be intimidating because of the reasons as it is aforementioned. Current design and ability of intelligent technology needs time to be more effective to apply for multi-study areas. As it is mentioned, researcher is aware of that desired outcome of this study with its current design, scope, limited time, lack of expertise and budge cannot expose and reflect desired benefits that ITS can produce. An improved ITS is expected to predict more precise understanding of a user input, responds with empathy, emotionally and accurately focusing on the content of the topic which in return improves attractiveness of user participation, motivation and intention to engage with the program on their own. However, as technology advances, the role of ITS widens in multidiscipline of areas and provides more opportunities to improve students' engagement and success throughout their education. Therefore, developers try to develop a better ITS that reflects more humanistic emotion, attitude and mimic since current ITS models are far away from collecting accurate feedback from users (Beck, Chang, Mostow, & Corbett, 2008; Annabel M Latham et al., 2010).

1.9 Structure of the Study

This thesis is composed of five chapters. After giving an overview related ITS in abstract section, researcher moved to chapter 1 which included five sub-headers. Chapter one consists of research context which gives a broad information about what ITS is, the goals of using ITS, importance of ITS, limitations and what one should expect from using ITS in education level, research questions, purpose of this study, contributions of the study, finally structure of the study. Chapter 1 also indicates

how vital to design, develop, and implement a technological device in order to create enthusiasm, motivation and satisfaction as a result of providing quality of information, system, and service in all fields.

Chapter 2 is literature review section which is written after reviewed and examined more than 60 articles since fall semester of 2016-2017. Besides given a broad information about ITS from prior studies in literature, researcher also examined the motives and major concepts that influence students to be more motivated, engaged, and self-regulated not only to achieve their academic success, but also to ensure that students are prepared for the future technological revolutions and transformations. Researcher also introduced several models, theories and approaches to assure that chosen instructional technology is assessed with effective criteria to produce more accurate statistical data.

Chapter 3 and chapter 4 store the information about all methods, procedures, and tools that are used to collect data in a proper way to ensure the reliability and validity of this study. Furthermore, this chapter also explains how collected data is analysed using the statistical tools and techniques. Data analysis includes pre-test / pilot survey, construct validity of the researched variables, bivariate correlations and structural equation modeling. Lastly chapter 5 discusses the outcome, limitation and implication of this research.

Chapter 2

LITERATURE REVIEW

This chapter presents brief information that is reviewed from previously conducted studies. This helps to understand the progress, scope and feasibility of ITS and/or relevant to ITS that reflects the similar interest of this study. Most of these sources are encompassed with article, theses, conference papers and books.

2.1 Overview of ITS in Literature

Definition of Intelligent Tutoring System (ITS) varies from author to author in the field. Some of them "state that ITS ensures step by step individualistic instruction to engage, motivate and improve learners' knowledge building (Torras & Bellot, 2016) process by using the challenging inquiry type exercises and instructions" (Ma, Adesope, Nesbit, & Liu, 2014). ITS is also defined as a "self-paced, learner-led, highly adaptive, and interactive learning environments operated through computers (Steenbergen-Hu & Cooper, 2013). There are more definitions such as; ITS as a digitalized instructional design method which has positive impacts on students success, and increases teachers' effectiveness and obtains impressive outcome of the learning goals (Oliveira Neto & Nascimento, 2012). Despite all these different definitions, some authors agree that ITS make sure that student receive assistance to gain the desired educational goal by using highly influential computerized device that is available without time and location boundaries".

Demands and expectations of our constantly evolving world have been increasing and challenging so is our educational system. Current educational system has been experiencing these challenges more deeply since its accountability affects the future of individuals and societies directly. One of the most important problems they are facing is how to foster students for the 21st's digital age with more effective and meaningful learning activities that reflect the life like examples. Different approaches, methods and tools have been implementing to raise the standards and in return, improve the outcome of the educational efforts.

Some of these efforts are using smartboards in classroom, websites with discussion boards, practicing learning objectives in the labs and using computerized tools such as tablets and smart phones to support educational goals. However, these type simple and single changes do not achieve the desired goals in a long term. Even though it brings some success relatively, yet it does not provide permanent solutions that can be applicable and practicable in most circumstances. In order to generate better solutions for educational problems, radical changes are needed to be made. This type transformation of current school system is not an easy task since its foundation goes back to years ago and demands a huge commitment.

The major problem of conventional pedagogical system is promoting memorization based learning in which teachers play the start role. This type knowledge remains as an 'inert knowledge' which needs to be transformed into 'learning by doing' approach to improve learning standards (D. Wang et al., 2015). As it was stated above, learning process is a dynamic process that is evolved day by day and it demands more students centered in which students' actively participate in learning endeavor. In contrast to teacher centered approach, students who learn with more

realistic and meaningful learning materials make a better connection between a theory and its purpose in real life environment. This type of learning helps them to digest the knowledge and generate better learning improvements for their future oriented goals. Therefore, classical educational approach changes its operational method in order to meet with students' expectations, to enhance their motivation, self-regulation, metacognition and engagement to succeed in their learning experiences (McGarry, Theobald, Lewis, & Coyer, 2015; Olney & Cade, 2015; Peeters, De Backer, Kindekens, Triquet, & Lombaerts, 2016). This does not involve only technology based infrastructure change, but also requires an active participation of learners while teachers change their roles from anchoring to facilitating learning objectives.

One of the most effective factors to carry out the transformation of education is ability to select the right instructional component for both students and teachers. Regardless of what type of the educational centered approach is selected/used, a learning/teaching environment need to be enriched by implementing highly effective and innovative instructional tools to present more attractive and desirable place. How to select a useful supportive and supplemental educational tool that can create attractiveness and empowers both students and teachers to improve educational standards? Some may claim to use the latest and most creative educational tool to bring the success. But using the latest technology, algorithm and program as an innovative instructional tool does not automatically and necessarily helps students achieve their academic success. However, using a tool that has been tested considering students' learning style may give more realistic approach whether a desired product is efficient enough to add a significant impact on learning experiences, values and make any noticeable improvement in a learner's behavior.

Students in a physical learning setting where they interact with teachers are not only the ones who are having difficulties with current system. It has been observed that students who are involved with computer based learning environments also face challenges that cause disengagement with their courses. Majority of students who are taking online and distance learning courses having difficulties to be able to keep up with their course requirements (Brusilovsky et al., 1998). Lack of supportive tools, assistance and unfamiliarity of this learning environment are some of the top reasons for students to lose their enthusiasm and engagement for e-learning and mobile learning. Therefore, in 21st century, innovative tools are designed to transform the inexplicit knowledge into concrete and workable skill that prepares students for their professional career.

ITS is one of the most recent technological programs that support learners regardless of the location. ITS as a part of pedagogical supplemental component have an effective functionality which allow students' active engagement and participation for their learning. ITS like some effective instructional tools also increase students' satisfaction significantly since students have desire to be ready for highly demanded interactive work environment (Dziuban et al., 2015). ITS differs comparing to other instructional technologies because it manages and monitors students learning progress based on their personalized choice and learning style. ITS also provides self-regulated learning materials for students "educational experience entails the intersection between cognitive presences, social presence and teaching presence" (Torras & Bellot, 2016). Enabling opportunities to practice and create motivation for learning objectives are some of the most important elements of retaining the desired knowledge and skill in both short and long term memories (Robb, 2016). This is what ITS provides with its complex but effective features.

2.1.1 Historical Background of ITS

The use of computer for tutoring purpose goes back to a few decades. They all had different functionalities to be able to improve the standards of learning and teaching outcomes. As a result of birth of World Wide Web (WWW), a new window is opened to see different things; a newer path that leads to undiscovered destinations and countless opportunities from learning to making money as an internet phenomenon is presented to individuals all over the world.

Educators also involved in a series of attempting to create a learning environment to take education from buildings to the digital life where time, location and accessibility depended on users' finger tips (Weber & Brusilovsky, 2016). ELM-ART was a basis paradigm that fundamentally opened a new view for web-based learning/assisting/tutoring experiences. ELM-ART allowed users to gain and improve their knowledge with intelligent books which contained information that were relevant to lesson content and reinforced students' understanding with its interactive based problem solving features besides giving feedback (Brusilovsky et al., 1998; Weber & Brusilovsky, 2016).

Some of them attempt to aide students by producing "simulation-based learning" named SIMQUEST (Cabada, Estrada, & García, 2011; de Jong et al., 1999). Since SIMQUEST aims to help students by creating a learning environment in which students enhance their learning with simulated inquiry based learning (de Jong et al., 1999). InterBook is emerged with the idea of integrating traditional education system with technology by adapting learning materials; in this case, it is electronic textbooks, on web to allow broader population of learners, in particularly, those who are adults and/or graduate level students take advantage of using internet

(Brusilovsky et al., 1998; Cabada et al., 2011; de Jong et al., 1999). Educa is another Web-based tutoring system which mainly had three steps with five modules: Instructor module which basically contained course outline information included quizzes; second, knowledge base/module which held all the learning materials needed to carry out the lesson goal; and last step database/server/delivery engine (Cabada et al., 2011).

Oscar is one of the latest artificial intelligent program that provides personalized, independent and flexible assistance as a conversational agent tutor which tries to mimic human to create enthusiasm for their learning and leverage students' knowledge by determining their learning styles (Annabel Marie Latham, 2011; Annabel M Latham et al., 2010). Oscar communicates with users based on specific labelled words that are stored in database and has ability to ask questions and determine user's learning style, provide hints, and feedback functionality. Oscar's most important feature is storing a rich learning resources to offer appropriate learning materials based on students' learning style that is detected via a conversational based interaction with learner and ability to (Annabel Marie Latham, 2011). One of the most important benefits of providing conversational interaction with tutor is obtaining user's emotional pattern during a session.

2.1.2 Inquiry-Based Learning with ITS

Inquiry based learning essential factor that impacts students' long term memory development, academic success, professional development and improve students' metacognitive skills. Inquiry-based learning is one of the educational methods which requires students' proactive involvement for learning activities, ownership of their task, hypothesis generator, take the role of an investigator, advocator and scientist to

prove their cases, explorer for newer approaches, and socially active (Chiang, Yang, & Hwang, 2014). The goal of integrating inquiry-based learning with ITS helps learners to have ability to construct the knowledge by practicing it with meaningful learning activities that is relevant to real-life environment such as questioning, investigating, and articulating (Chiang et al., 2014; Schmoelz, Swertz, Forstner, & Barberi, 2014).

As it is stated above, there is a relation between supplemental computational tool that sparks curiosity and improved academic success effective. Chiang et al. (2014) state in their co-authored study that providing a learning framework in which inquiry-based learning strategies combined with digitalized components and placing students in the center while teacher's role is just a facilitator, has proven impact on learning success.

2.1.3 Architecture and Goal of Tutoring System

Designing an ITS requires high budget, a team of experts in relevant areas from computer scientists and instructional designers to pedagogues, and time (Zarandi, Khademian, & Minaei-Bidgoli, 2012). After revising and examining literature about ITS, it is seen that there is no a particular architectural model or prototype to determine the main framework and components of this tool. Despite an amazingly enhanced technological age, developers in both academic and commercial sectors experience highly serious challenges to present an intelligent device to capture users' attention in various areas, such as education and personal training areas, and prepare a lesson content that takes hours of development time (Zarandi et al., 2012). Developers included commercial companies also invest to build such an efficient product that attracts consumers to create a big market around the globe.

While development of ITS began with digitalized technology, currently fuzzy technology is considered as a major development tool (Zarandi et al., 2012). Fuzzy system is newer but promising technology that can, particularly, be adapted in ITS system to improve educational standards and enhance the quality of recognition human voice to perform their instructions with more productive way. According to Zarandi et al. (2012) four major components of ITS are used: Expert, student, pedagogical and communication models.

There are some essential factors that should be implemented and result should be measured carefully to determine students' experiences to increase the level of quality for a future design. Designers should pay attention to "students choices, timing intervals, student outcomes (predictions), classifiers, and types of help given" (Zhuhadar, Marklin, Thrasher, & Lytras, 2016). Zhuhadar and her coauthors (2016) proposed that an efficient ITS should target not only to improve students' academic success but also should contribute to develop better meta-cognitive abilities such as creative thinking, decision making, and problem solving. Zhuhadar et al. (2016) defined cognitive model "a set of predefined rules that influence the process of students problem solving tailored to provide helpful feedback and hints while increasing difficulty to improve student learning and knowledge." On the other hand, feedback feature is another important functionality that ITS aims to carry out.

There is a strong correlation between given a feedback and students' academic achievement because, first an effective feedback has positive impact students' learning, and second, it motivates students to improve their learning engagement (Oinas, Vainikainen, & Hotulainen, 2017; Patchan & Puranik, 2016). Feedback is not only a goal of letting a learner to know how he/she is doing in a particular course, but

also it is an important factor for families and administrations in order to adjust, modify and update learning materials as well as changing the behavior of students. Timely given feedback by an intelligent tutor is an important element in order to move forward for more challenging problems/topics while students are solving problems and/or engaged with learning objectives (Corbett & Anderson, 2001; Kefalidou, 2017).

Learning and teaching environment in which students are engaged increase educational outcomes and improves students' collaboration and consequently their collaborative success. Adelman and Taylor (2011) emphasized that "Student disengagement in schooling is a fundamental barrier to well-being". Hence, educators have been looking for a workable and meaningful intervention that increases students' engagement in their own learning goals. Engagement in an important factor that drives students' enthusiasm, desire and motivation to gain the skill and knowledge they need to achieve their academic success. Zhuhadar et al. (2016) argue that enabling students' active engagement with content adapted learning sessions allow learners to benefit and, profoundly impacts their productivity. Engagement also reduces alienation from learning activities and educational goals while it improves students' self-confidence and self-efficiency (Adelman & Taylor, 2011). ITS's design ensures that students are motivated and engaged more effectively comparing to classical educational system. ITS guides students with step by step approach to make sure that learners are engaged with their own learning progress.

Most educational systems promote a standardized educational content and approach that is solely depends on teachers. However, in this rapidly evolving digital age,

students are required to have more responsibility in order to keep up with tomorrow's technology on their own. Hence, ITS offers individual lesson content to ensure that learners are able to move forward with the decision they make as they continue to build knowledge puzzles together. Improved responsibility creates ownership not only for the academic success but also professional development. Allowing students take control on their own learning also motivates learners to be more responsible individuals. Obtaining self-efficiency is one of these inner skills that brings success in personal and professional development because it allows learners embark with any given task regardless of the level of difficulty (Kuiper, Murdock, & Grant, 2010; Robb, 2016). Lastly, an effective ownership allows learners to develop better decision making and risk taking skills.

Individuals who are encouraged to have ownership for their personal development, they are also empowered to be self-regulated after obtaining desired knowledge and skill. Zimmerman (2002) defines self-regulation as, "Self-regulation is not a mental ability or an academic performance skill; rather it is the self-directive process by which learners transform their mental abilities into academic skills." Moreover, Zimmerman (2002) argues that self-regulatory does not only allow gaining the knowledge that is needed for an academic success, but it also helps learners how to deal with the real life situation, especially to obtain the higher positions and promotions after graduation. On the other hand, Dörrenbächer and Perels (2016) asserts that students who feel disengagement with their learning and assistance, then they begin to learn self-regulated learning approaches for their academic success. This allows students to overcome the difficulties they face while other students achieve the same material without hassling (Zimmerman, 2002). Some also argues that presenting an autonomous learning environment to students who are used to be

fostered and educated in a classic education system, are experiencing adaptation issues and consequently it results with high rate of dropout rate (Dörrenbächer & Perels, 2016). Hence, any technology based intervention should have functionality to present the lesson content like a human teacher and then consist of collaboration platforms such as discussion board in order to keep them motivated.

Besides abovementioned factors that impact students learning significantly, there are a few more elements that are noteworthy to mention. Alli, Rajan, and Ratliff (2016) stated that "Students learn best when their education is targeted and tailored to them". Other researches indicate that students achieve desired goal and improve their skill sets significantly if they interact with personalized learning environment, when it is designed, adapted and developed effectively for personal learning style (Dziuban, Moskal, Johnson, & Evans, 2017; Annabel Marie Latham, 2011; Murray & Pérez, 2015).

As it is noted above, figuring out someone's learning skill is a complexed and difficult procedure due to some personal characteristics cannot be explained well with current scientific and technological tools. Moreover, collecting data using current tools included questionnaires accurately is a challenging task in terms of designing, developing and implementing an effective model for a particular learner (Crockett et al., 2017). Nevertheless, some of those predictable personal traits can give some hints about learners' current knowledge and learning style, thru standardized survey questions and constant behavior observation (Annabel Marie Latham, 2011).

Furthermore, constant, objective and personalized evaluation of students' development and achievement are also crucial step to keep them motivated in the pursuit of their educational and professional life. Students do not only improve their knowledge, but they also clarify the misconceptions points of course objectives by being instantly evaluated via a computerized learning device (Mohammadi, 2015; T.-H. Wang, 2014). The difference between traditional learning system's assessment processes versus computerized learning lays in different formats. For example; while memorization based education evaluates students learning at certain times with standardized testing approach, however, digitalized instructional method ensures that goal of the topics are retained during the learning experiences with more precise measurements such as offering objective relevant problem solving questions (Dziuban et al., 2017).

The major difference between ITS and other electronic based learning methods is ITS's dynamic and personalized structure versus CAI's static approach. ITS is student centered that transmit information based on students' need. Students have control over on their own learning and progress while CAI has one way approach that lacks of active interaction, feedback, assessment and motivation features of ITS. Students can enhance their learning gains with being one-on-one based tutoring options. Moreover, web based ITS have rich sources such as discussion board, file sharing options, chat rooms in which students can reflect their sincere emotions and thoughts.

As a conclusion, as it was mentioned earlier, a programmed based tutoring may not influence all students since it is lack of the sensitivity of human behavior, may not include everything students need to develop, and students may not like to be

controlled (Sani & Aris, 2014). With this in mind that, this disadvantage of ITS is actually an opportunity to modify and improve ITS's functionality and performance because ITS learns from the user input by keeping students responds and questions in its database. This functionality allows developers to identify and fix the issues for further development. ITS differs from other digitalized instructional supplemental tool with its intelligence. ITS creates attractiveness with its features such as collecting necessary data to present the learning activities based on students' needs; it motivates learners by ensuring challenging tasks; it creates ownership for learners' development by creating self-regulated learning environment; and it also ensures that students receive feedback, scaffolding and evaluation while they are engaged with their course activities.

2.2 Information Systems Success Model

A spider produces silk for several reasons such as creating a web as path to get its destination, to move around by climbing, builds a safe location while it uses the silk to lay a trap for hunting. This is how technology surrounded us by providing opportunity to create, on one hand, a comfortable, but on the other hand, useless and a dangerous environment for society.

Since the importance and role of technology has been growing significantly and impacts society's life in an addicted level, assessment of these fast pacing technological devices', programs' and applications' effectiveness, usefulness and reliability are getting more crucial for all. These concerns impose researchers and theorists to discover and investigate the best method that can measure the effectiveness and success of technological devices (Y.-S. Wang & Liao, 2008).

Information System Success Model (ISS) that is developed and presented by Delone and McLean (2003) is derived from Shannon and Weaver's work. Shannon and Weaver (1949) offered three major criteria: the 'technical level', 'the semantic level' and 'the effectiveness level' to investigate the 'three levels of communication problems' for a technological tool's accuracy, precise, and effectiveness for the 'purpose of communication'.

This model is updated and named to D&M IS Success Model (Delone & McLean, 2003). Shannon and Weaver's three scaling factors that measured the entire effectiveness of technology are converted into "six-factor IS success model as a taxonomy and framework" (Y.-S. Wang & Liao, 2008). These six factors are 'system quality', 'information quality' and 'use', 'user satisfaction', 'individual impacts',' and 'organizational impacts' (Delone & McLean, 2003; Y.-S. Wang & Liao, 2008). In D&M IS Success Model, '*system quality*' carries the characteristic and features of 'the technical level' in which the value and a quality of information is measured as a result of evaluating of communication (Delone & McLean, 2003). Further, Shannon and Weaver's term 'the semantic level' has the equivalent representation with D&M's '*information quality*' which aims to evaluate how accurately information is transmitted to the end user (Delone & McLean, 2003). Lastly, while 'the effectiveness level' in Shannon and Weaver study indicates the impacts of information on the receiver, in the D&M model, on the other and, the effectiveness of transmitted information is measured and called as a 'use', 'user satisfaction', 'individual impacts and 'organizational impacts' (Delone & McLean, 2003). It is noteworthy to state that all these D&M six factors or dimensions have a strong bond or correlation between them; one factor cannot be separated from another to measure

the entire impact of an information system success (Delone & McLean, 2003; Y.-S. Wang & Liao, 2008).

Lastly, Y.-S. Wang and Liao (2008) states that updated D&M model does not mandate and require an empirical validation in order to create a success/failure report. This study aims to propose to measure the effects of ITS with using the six factor/dimensional approach to get a clear statistics about ITS's information quality, the system quality, service quality, user satisfaction and its benefits for users.

2.3 Task-Technology Fit Model

Evaluating the effectiveness and success of an information technology requires a good model in which every aspect of system can be measured in terms of its impact for the desired performance and productivity it helped to achieve. Goodhue and Thompson (1995) as the pioneers of Task-Technology Fit Model (TTF), constructed a conceptual model to investigate the relationship between the dimensional of triad: task, technology and performance. Goodhue (1998) argues that TTF model's vitality lies in the fact that user is given an information system as a tool to complete a task(s), then TTF analyses users' evaluation as a result of reflecting their experiences/performances with the system.

Both D&M and TTF models aim to provide information for administrators to ensure that selected technology has positive impacts on users; fits in working environment, accomplish the desired goals; increase the performance of all participants and concludes with success (Gebauer, Shaw, & Gribbins, 2010; Goodhue & Thompson, 1995). TTF also ensures any technology which is not beneficial to the purpose of task and does not create any significant advantages must be dropped from the

inventory (Dishaw, Strong, & Bandy, 2002). There are two major differences that set apart TTF from D&M model.

For TTF model, utilization of technology, attitude and behavior of users are vital elements to get the best result out of preferred technology, designed task and user efforts. Goodhue and Thompson (1995) state that "an information technology to have a positive impact on individual performance, the technology must be a good fit with the tasks it supports." In other words, there is a growing positive outcome for both user satisfaction and performance improvement as system functionality and task requirements are met (Goodhue, 1998). If a technology does not produce such an impact on individuals for being far away from meeting their needs, purposes and demands of proposed goal and lack of efficient usability, then it creates dissatisfaction, disengagement, and degradation on user intention to involve with the process.

2.4 Hypotheses Development

Improving educational quality has been one of the most important measurements in an academic institute in order to keep up with highly demanding global economic world (Langstrand, Cronemyr, & Poksinska, 2015). The responsibilities of universities are becoming more important than ever to provide a quality education in which students are in need to receive more information in a shorter period of time (Duque, 2014; Langstrand et al., 2015). It is a fundamentally important to use "a well-defined outcome measure" to carry out a reliable research (Agourram, 2009; DeLone & McLean, 1992).

How to define quality in information system? For DeLone and McLean (1992), information success system is an approach which brings a clear and more practical results that enlighten what variable(s) has/have influence(s) on the effect of the tested system. Gorla, Somers, and Wong (2010) defines "information system (IS) quality as conformance denotes designing systems that conform to the end users' information requirements and adhere to industry standards". According to a conference paper a quality education has several aspects that need to be considered to determine whether a quality education is exist or not (UNICEF, 2000). Learners, environment, content, process and outcomes are major dimensions that have significant influence over a quality education.

First, learners need to be physically and mentally in a good condition besides being fostered and prepared to make a profound improvement (UNICEF, 2000). Second, environment is also another factor because learning activities require to be originated in a healthy, reliable, comfortable and protective place where learners have access all the necessary hardware and software tools to acquire desired skill and knowledge (UNICEF, 2000). Third, providing life-like lesson contents to make learning more meaningful, productive and efficient is essential factor for a quality education (UNICEF, 2000). Hence, developing curricula with real life content contributes to reflect the skill and knowledge to solve problems in a workplace environment (UNICEF, 2000). Next teaching methods, approaches, and models determine the processes to manage classrooms (UNICEF, 2000). Providing a skillful evaluation process to deliver learning objectives and provide fairness is also important element of a quality education (UNICEF, 2000). Lastly, what skill, knowledge and attitude are accomplished in terms of previously declared educational policies also helps to identify whether quality knowledge is gained or not (UNICEF, 2000). According to

the same study, involvement for the social activities is another vital measure for a quality education.

There are three pillars as IS measures to determine the information system quality: system quality, knowledge quality and service quality (Gorla et al., 2010).This study aims to highlight the impact of ITS on students learning performances by testing these multidimensional quality measures to identify the major impacts on learning progress. By doing this so, research wants to identify which aspect of this multidimensional variable has impacts on learning performances.

2.4.1 ITS Knowledge Quality, Task-technology fit and Satisfaction

Academic quality has been a major discussion topic from the point of epistemological science (Waheed & Kaur, 2016). Knowledge quality represents a big portion of academic quality, in particularly, when electronic learning is selected as an academic platform. Academic quality is defined by The Quality Assurance Agency for Higher Education (2014) as "a comprehensive term referring to how, and how well, higher education providers manage teaching and learning opportunities to help students progress and succeed." Information quality measures the "semantic success" in other words, the quality of the words that are delivered (Delone & McLean, 2003). Information quality is determined by the output that is processed through using information system based on its relevancy and clarity to be able to build knowledge (Gorla et al., 2010). Furthermore, Delone and McLean (2003) emphasizes that "accuracy, timeliness, completeness, relevance, and consistency" are the major elements that needed to be measured to provide an explicit explanation for the role of information quality.

Although it is essential to reach the information as quick as possible in this digital age, however, how healthy knowledge is provided also a vital subject of this research. As Waheed and Kaur (2016) states that easier and faster accessibility of information does not automatically and necessarily provide a quality knowledge. Therefore, knowledge quality is one of these variables that needs to be measured whether provided knowledge is reliable, robust, effective, accurate, relevant and/or permanent that are delivered via a digitalized platform (Delone & McLean, 2003; Gorla et al., 2010). Identifying knowledge quality in connection with the task-technology fit, which is explained above, helps to narrow down the differences between theoretical and practical knowledge. Lastly, this study argues that quality of knowledge increases satisfaction of learning with digitalized learning and teaching systems.

H1: ITS Information quality has a positive impact on ITS Task-technology fit

H2: ITS Information quality has a positive impact on Satisfaction with ITS

2.4.2 ITS System quality, Task-technology fit and Satisfaction

On the other hand, system quality is another important variable that affects the perception of raters. Gorla et al. (2010) defines system quality as, "system quality represents the quality of information processing itself, which is characterized by employment of state-of-the-art technology...". This definition is briefly explained as a measuring "technical success" in D&M IS Success Model (Delone & McLean, 2003). In order to produced desired information, the system needs to be user friendly, easy to learn and easily maintainable (Delone & McLean, 2003; Gorla et al., 2010). This pillar also need to be measured in terms of its role in designed environment whether it has positive or negative impact on the conclusion. A well-prepared system helps to accomplish the desired learning outcomes significantly. Thus, as it is noted

by Delone and McLean (2003), Y.-S. Wang and Liao (2008) and Gorla et al. (2010), it is vital to identify the role of system quality based on its functionality, flexibility, data quality, portability, integration, and importance.

H3: ITS System quality has a positive impact on ITS Task-technology fit

H4: ITS System quality has a positive impact on Satisfaction with ITS

2.4.3 ITS Service quality, Task-technology fit and Satisfaction

Lastly, service quality is another aspect of information system quality that has remarkable impact on the improvement of the learning performances align with task-technology fit and improved satisfaction. According to Y.-S. Wang and Liao (2008) some may claim that service and system qualities have the similar impacts over an information system. However, Y.-S. Wang and Liao (2008) professed that service quality is considered as an another factor because of the changes in information system (Delone & McLean, 2003). Service quality is defined by Gorla et al. (2010) as "the level of service delivered by IS service providers to business users (in our case, they are students) in terms of reliability, responsiveness, assurance and empathy".

As it is seen, learning and teaching product does not automatically generate satisfaction and improve learning outcomes by itself. There are additional factors/variables/measurers that need to be identified to determine what has significant impact on received perception, satisfaction and productivity. Hence, researcher aims to highlight that how a reliable, responsive and promising quality of service positively impacts the outcome.

H5: ITS Service quality has a positive impact on ITS Task-technology fit

H6: ITS Service quality has a positive impact on Satisfaction with ITS

2.4.4 ITS Task-Technology and Learning Performance

Despite all the aforementioned variables of IS success taxonomy to achieve and improve the information system success, it is also essential to identify the promising points and impact of the interrelationship between technology, satisfaction and learning performance (Gebauer et al., 2010; Y.-S. Wang & Liao, 2008). These are also considered as the vital determinants for both failure and success of the implemented system, to draw conclusion and provide conceptual framework for future researches (Gebauer et al., 2010; Snead Jr, Magal, Christensen, & Ndede-Amadi, 2015; Y.-S. Wang & Liao, 2008). Snead Jr et al. (2015) defines that "task characteristics refer to degree of structure". On the other hand, Goodhue and Thompson (1995) strongly emphasizes that there is an inseparable correlation between task and technology. Therefore they suggest that "technology must be utilized and must be good fit with the task it supports" (Goodhue & Thompson, 1995).

Furthermore, determining user satisfaction indicates the degree of effectiveness success level which is defined as the effect of information for the receiver, user acceptance, and perception of the end user (Davis, 1989; Delone & McLean, 2003; Whyte, Bytheway, & Edwards, 1997). Regardless of the quality, effectiveness and support level of information system, desired outcomes fails and degree of performances decreases when it is rejected by the end users (Whyte et al., 1997). However, as Delone and McLean (2003) states that a well-designed and prepared system improves better user satisfaction, creates positive impacts for both individual and organizational productivity when causal relationship is emerged between these variables.

H7: ITS Task-technology fit has a positive impact on learning performance

2.4.5 Satisfaction, Motivation to Use ITS and Learning Performance

Carrying out a positive attitude towards for the newest pedagogical digital instrument has been one of the most challenging aspects of implementing instructional technologies in teaching and learning settings. (Kangas, Siklander, Randolph, & Ruokamo, 2017; Rashid & Asghar, 2016). It has been pervasively indicated in literature that digital technology remarkably influences students learning performances and motivation which consequently improves learners' academic achievements (Cheng, Lin, & She, 2015; Fonseca, Martí, Redondo, Navarro, & Sánchez, 2014; Rashid & Asghar, 2016). The need of collecting satisfactory data between the variables of satisfaction, motivation and learning performances are key indicators for a product in order to determine to evaluate its characteristics and relevancy to the end user.

User satisfaction indicates what degree the expected satisfaction is achieved in terms of measuring the tested product's effectiveness that helped the end user to gain greater knowledge, efficiency, skill and improved productivity (de Sá, 2008; Delone & McLean, 2003). According to de Sá (2008) satisfaction is "Capability of the system to provide adequate response to user needs". Criteria for the user satisfaction has some common characteristics such as how easy to perform the task; how its functions create more effective skill and knowledge to make connection for the real life and how inter-operable it is for with other products (de Sá, 2008).

Motivation is another essential dimension that impacts the outcome of the instructional technology design. Rashid and Asghar (2016) argues that there is a strong bond between technology and student motivation which leads to academic achievement. Especially, providing a learning environment in which students

interactively participate with real world relevant learning activities enables learners' freedom, creativity and improves their motivation (Ozverir & Herrington, 2011). Identifying the weakness of the digital system that needs to be improved for the further novel learning environments in terms of student motivation and learning performances is also vital goal of the research (Kangas et al., 2017). There is also psychological aspect such as perceived unfairness, inequality, or mistrust that causes for the dissatisfaction and decreases in desired performances, which is beyond this study (Bordia, Hobman, Restubog, & Bordia, 2010; Dziuban et al., 2015).

On the other hand, integrating digitalized tools with pedagogical purposes do not automatically and necessarily help to motivate students and enhance learning performances (Rashid & Asghar, 2016). Discovering the connections, reasons, and facts between student satisfaction and learning performances -based on the information systems success approach- helps to determine the degree of success/failure of the research subject. Nevertheless, exploring the facts that leads students' satisfaction or dissatisfaction has been more dynamic and complex due to factors such as learner relevance, active learning, authentic learning, learner autonomy, and technology competence (Dziuban et al., 2015; Ke & Kwak, 2013; Ozverir & Herrington, 2011). Moreover, technology and a well-prepared learning environment trigger students' engagement and motivation to achieve their academic performances (Kangas et al., 2017).

H8: Satisfaction with ITS has a positive impact on Learning performance

H9: Satisfaction with ITS has a positive impact on motivation to use ITS

H10: Motivation to use ITS has a positive impact on Learning performance

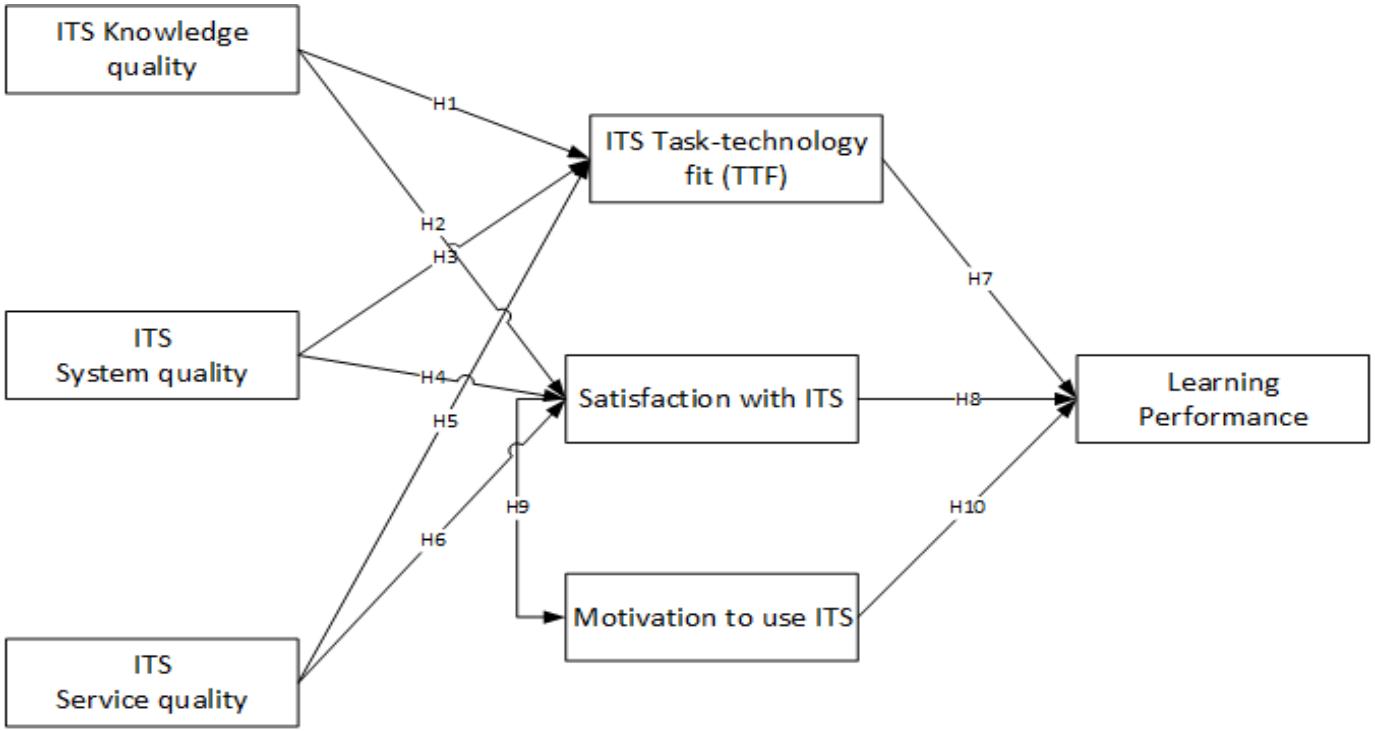

Figure 1: Conceptual Model

The conceptual model, above in Figure 1, illustrates all the variables that research aim to analyze in order to discover the correlation between each item. It also indicates the hypotheses that are being constructed.

2.5 The Context of ITS in Cyprus

Cyprus, home of the Greek goddess of love Aphrodite in mythology, is one of the three biggest islands (other two are: Sicily and Sardine islands of Italia) of the Mediterranean Sea and it is situated south of Turkey, west of Syria and Lebanon northwest of Israel and Palestine, north of Egypt and southeast of Greece. Cyprus gained its independence from Great Britain in 1960, and continued to administer itself interchangeably as living two nations: Turkish and Greek Cypriots which are supported by Turkish and Greek states besides a few minorities such as Armenians. However, they have been living as two different nations Turkish Republic of Northern Cyprus (TRNC) and The Republic of Cyprus since 1974 due to throwing the elected president from out of his office that was planned by Greek government and in return Turkey responded this with its military power to protect Turkish inhabitants in the island.

Cyprus has growing economy despite the 2013 recession that occurred as a result of the financial crisis in align with Greece's economy. Cyprus's most important economic locomotive sectors are tourism and education. The difference between two parts of the island is while Greek side, in general, is the destination for touristic visits, TRNC is the center of the attractiveness for the Study Abroad Destinations that is favored by international students around the world with its internationally accredited, quality, affordable education and accommodation costs. The number of students in TRNC is gradually increasing and recent numbers indicate that 93292

students included Turkish, Turkish Cypriots, and foreigners have registered to a higher educational institution. In order to meet with this growing number of students' educational, social and financial needs and demands, universities are evolving to present a better and more quality education with the most knowledgeable staff and innovative instructional tools. Fostering students with the most qualified instructors and technology not only enrich students' educational experience, but also make TRNC more educational destination place that impacts this isolated and small country' economy in a better way.

Chapter 3

METHODOLOGY

The core purpose of this research methodology was to illustrate how successfully Intelligent Tutoring System (ITS) impacts on students' academic success and why this efficient digital instrument is selected in learning and teaching efforts. This chapter provides information about the study context, the motives why the specific industry was chosen, the importance of the industry and why the author asserts that there is a need for such a study in the particular industry. The author provided concise information concerning the sampling approach and why it was chosen in this thesis. Subsequently, procedures and instruments used in data collection were discussed in depth and a succinct description of analytic methods and approach utilized were discussed. Prior research illustrated that "sound judgment, predictability and certainty are the shortcomings of qualitative methods compare to quantitative approach. Moreover, quantitative methods can help achieve sustainable stability on neutrality philosophy, low-downs as well as the determinateness of the research (Abubakar & Ilkan, 2014).

3.1 Sampling Technique and Description

The sampling in the research methodology is a statistical instrument in which researcher collecting sufficient amount of data such as people, animal, places and organizations, among a targeted sub-unit of relevant population to provide an accurate conclusion.

Sampling gives representable and generalized information about the population of interest and allows researcher to analyses and develop a theory as a result of collected data from the findings. Selecting a representable sample may also be considered as a subset which requires having similar characteristics and equal chance among other randomly selected variables in order to provide generalizable and validated conclusions. Probability sampling as one of the most reliable method helps to present the characteristics of the selected group for a larger population. On the other hand, simple random sampling technique is defined as an approach for selecting a subset/group/sample that are chosen under similar and equal conditions among a larger of a group/set/population to ensure nonbiased information for the research. Simple random sampling also ensures error free classification and easy to interpret data that can simplify the entire research outcome. Probability sampling approach is selected for this research study since it is more sophisticated instrument versus simple random sampling.

3.2 Common Method Variance (CMV)

Method biases emerged due to measurement error of selecting a single data gathering tool (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Common method variance (CMV) is defined by Bagozzi and Yi (1991) as the "variance that is attributable to the measurement method rather than to the construct of interest" in the referenced article of Eichhorn (2014). CMV, as an observational tool, clarifies the correlations between measurers by minimizing the measurement error because of using this single data gathering instrument such as using a questionnaire (Eichhorn, 2014). High probability of measurement error in researches produces inaccurate conclusions between determined correlations. This conclusion may be overstated or understated which occurs because of administering only one source of data gathering instrument

(Podsakoff et al., 2003). Hence, selecting a right method with an efficient measurement tool(s) for a research is an important step in terms of research's validity and reliability to avoid the potential method bias and measurement error. In order to provide a better validated conclusion for all predetermined dimensions of the measurers as a result of this study, common method variations are identified and controlled before and during the data gathering and measurement process (Eichhorn, 2014; Podsakoff et al., 2003).

According to the referenced articles about CMV, it requires researchers to consider the potential causes and sources of common method biases since they generate totally different meaning and conclusions for the research findings (Podsakoff et al., 2003). It is wise to understand how to avoid from potential measurement error, correlation between criteria and biases that undermine the research conclusion. There are several potential sources of common method biases. According to Podsakoff et al. (2003) and Eichhorn (2014), some of the potential sources of common method variance that causes serious method biases are as follow.

- The use of a common source or rater: this occurs because of generating a self-report bias using only one source with the same measurements, dimensions, items and criterions by the same respondent. Since participants of researches have tendency to be coherent between their thinking and acts, they try to respond the question to be consistent rather than what they really would like to express/respond. Ex: Survey. To minimize the side effect of these common issues, the referenced authors suggest designing and administering the questionnaire by considering all the critical aspects of survey such as confidentially, multiple sources, items, scaling and measurements.

- The way method instrument is designed such as scaling and the level of the difficulty of the questions has a significant impact on respondent's answer.

- The way questions are presented to the raters: allowing raters to answer the questions in an order that produces unrealistic outcomes in the observed relationships. Furthermore, since research participants have tendency not to involve and even if they are, they are willing to spend as little as time possible to answer the questions. Therefore, the number of the questions and correlation between the questions are the factors that also influence raters' attitudes and values to respond objectively.

- The survey's measurement context: it has been a challenging task for the researchers to compose a measurement context that measures both subjective and observable research phenomena in an explicit way reflects the raters' real view, idea and attitude.

Same references (Eichhorn, 2014; Podsakoff et al., 2003) also offer some solutions not to undermine the research outcomes and values because of the method biases. Some of these approaches are: paying special attention to participants' confidentiality and anonymity; using multiple sources for dependent and independent variables, presenting dependent variables on different page(s) from independent ones, and allowing participants to rate the questions with different versions of scaling.

This study is engaged with quantitative method and cross-sectional analysis in order to provide bias free or at least as little as possible from the potential common method variable biases. As a result of collecting data using the survey, researcher had necessary data that unveiled the success of the study by producing numerical values. This helped to receive more concrete evidence for a larger population relevant to this research's purpose. Study also implied the cross-sectional analysis/study which is based on collecting data throughout observational study. Cross-sectional study provided how strong/weak a factor had impact for the outcome of this research on a scientific ground.

On the other hand, privacy was a top concern for the researcher. Hence, participants of this research were assured that the information they provide is kept strictly private and their identities were kept confidential and anonymous. Further, they were not offered any true and false based questions; rather they were presented questions that gave chance to rate in a numbering range for a better scaling. Data gathering is administered one time to measure perception of the students about the system. To gather effective data that consequently carried out reliable findings, students were given the questionnaire in an environment where they felt comfortable and had sufficient time to ensure that they answered the questions sincerely and willingly.

Lastly, it is a fundamental need for constructing a research model to present a validated and reliable conclusion about the impact of each measurer. There are various methods which statistically help to calculate the possible measurement errors such as Harman's single test. According to Podsakoff et al. (2003), Harman's single-factor test is used to determine if there is any measurement error in the constructed model. Therefore, Harman's single factor test with CFA is applied to detect the CMV

effect in this study. Lastly, CFA is selected it offers numerical values based on chi-square to calculate the model fitness by detecting the single measurement error between the variables.

3.3 Participants

The study took place at school of computing at Eastern Mediterranean University during 2016-2017 summer sessions. A total of 140 undergraduate students participated in the survey; out of 66.4% are male and the rest female students as shown in Table 1. A majority 97.1 of the students are enrolled to a bachelor's degree program and the rest associate degrees as shown in Table 1. In regard to age, 89.3% of the participants are between 21 and 25 years, 5.7% of the students are less than 20 years, 4.3% are between 26 and 30 years, and the rest above 35 years as shown in Table 1.

The effects of the non-response bias were cross-checked through comparison analyses of the demographic characteristics of participating students' following suggestions laid by Collier and Bienstock (2007). As a result of the analyzing the demographics of participants, the features of them were not different from the entire students studying at Eastern Mediterranean University. Therein the population in this study seems to be a representative of the population of interest.

Table 1: Participant' Demographic Information

	Frequency	Valid Percent (%)
Gender		
Male	93	66.4
Female	47	33.6
Total	**140**	**100**
Age		
Under 21	8	5.7
21-25	125	89.3
26-30	6	4.3
31-35		
Over 35	1	0.7
Education		
Associate Degree	3	2.9
Bachelor's Degree	137	97.1
Higher Degree		0

3.4 Moodle

In originality, ITS is a digitalized tool that supports students with its novel and sophisticated program to assist learners around the clock. However, due to the limitations of this research and ITS's very complexed structure, researcher combined the online learning environment with the human tutor using the Moodle. There were four major domains of the Moodle. These are domain model, instructional model, student model, and expert model.

Domain model presents relevant examples, questions (Problems), hints, and explanations for students to have adequate practice to transform the theoretical information to more robust knowledge. Most of the current web-based learning platforms offer assistance based on the electronic sources. Although it has some advantages over the hardcopy based materials in terms of its ubiquity and easy to accessibility, nevertheless, it does not present activities that generate success with creativity or improvement in metacognitive traits such as critical thinking and decision making skills. Moodle aimed to provide pedagogical activities such as life like examples and games to convert inexplicit information into practicable knowledge. This feature of Moodle increased students' enthusiasm to engage and motivate learners with the course objectives. Students were given feedback and personalized support by instructors of the courses-when it was needed- ensured that students how they were doing and where they were heading. Therefore their activities, participations, posts, and tasks were being observed. Moreover, learners received evaluations via predetermined templates and as a result of communicating with the course instructor. Lastly, the system also generated graphical outputs to represent students overall progress.

Instructional domain of the Moodle is an important area of the system that allowed instructors to make necessary announcements, provide guidelines, and learning activities. The course instructor was posed both roles: teacher and tutor of the course. Teachers encouraged students to be self-regulated learners for their own development by requiring them to interact with the system actively at scheduled times. Allowing students take control on their own learning versus placing the teacher had significant outcomes for their academic and social skills. On the other hand, this allowed teachers to have more free time to provide individualized assistance, guidance and feedback when they needed.

This domain also determines how to interact with the learners accordingly using the predefined rules and approaches. Instructor designed and regulated the course in a pedagogical framework that composed of various learning activities based on the information gathered from the student domain. Instructor presented a specific topic using pdf files, presentations, and texts to ensure students have all the resources they need to complete the assigned tasks. Instructor administered and monitored the system between students through digital resources such as discussion board. Instructor evaluated students' participations, responds, and progress throughout the duration of the course. Lastly, evaluation was also major element of this model. Evaluation was not only considered as giving grade for completing the assigned work or taking the test, but also it also meant that how often the learner participated to the discussion board; how many he/she posted; was there any progress in terms of motivation, satisfaction, and learning improvement.

In student domain, those who took the courses had access to the online environment to gain the desired goal/objectives of the course. However, there was a significant

difference between accomplishing the course objectives in class and on Moodle environment. In addition to the common advantages such as flexibility, availability and ubiquity of digital sources, students were given opportunities to construct their own knowledge, improve social and technical skills, and finally to increase academic achievement. Another advantage using Moodle system was that students were forced to use their metacognition skills due to constant questioning, thrown pop-up hints and lesson oriented examples/games to generate solutions for the problems. Reinforcement was another important aspect of Moodle to assure that students improved their weak areas which were emerged after interacting with the learning materials. Lastly, students were encouraged to use discussion board in which they communicated directly with their peers, and teachers to share their opinions and ask any lesson related questions.

Expert domain is the assistance phase of the system. An expert of an area of study was available based on the predesigned scheduling using both: discussion board and email. Human tutor provided information based on student's learning style by providing customized information: Visual, Audio, or Text. Tutors did not solve the assigned homework; rather students were encouraged to complete their tasks by themselves. Tutor helped students to discover the novel approaches that will improved their learning autonomy, confidence, and independency to ensure that they moved forward from theoretical to practical approach. Tutors also had more responsibilities such as recording dates, times, durations of each interaction, progress of the learner. Lastly, tutors kept record due to the lack of participation, completing assigned task on deadlines, and obeying the rules.

3.5 Data Collection Procedure

The research questionnaire was collection of the previously conducted researches', (Cheng et al., 2015; Delone & McLean, 2003; Goodhue, 1998; Goodhue & Thompson, 1995; Liaw, Chen, & Huang, 2008; Liaw, Huang, & Chen, 2007; T. McGill & Klobas, 2008; Schmitt, Oswald, Friede, Imus, & Merritt, 2008; Staples & Seddon, 2004), in different areas of the study. There was no need to translate it since origins of the sources were written in English. However, all the items on the surveys were modified accordingly for the purpose of the study in terms of its validity and reliability. Next, simplified version of survey was conducted among students who have had experience using Moodle in order to investigate the difficulties, challenges, and vagueness of the questionnaire and system. Administering such a survey with 10 students is considered our non-formal pilot study. Researchers identified if students were encountering any difficulty for some areas included the meaning of the questions, willingness to respond the questions, reactions, and duration of filling out the questionnaire. Positive feedback was received from participants since the questions were prepared with straight forward sentences. Finally, this non-formal and minor pilot study indicated that participants had not any significant difficulties to understand the meaning of the questions and consequently they answered all the questions without any problem.

Students, who participated to this minor pilot study, have been enrolled to the courses for the school of the computing and technology for 2016 - 2017 summer semesters. The courses selected based on whether they would use the Moodle as a supplemental tool for learning, teaching, sharing, communicating, discussing and taking test within it. Each of these courses had between 10-45 students. The course

instructors besides the administrator of the department were informed to get necessary approval to conduct the survey throughout this short semester. However, it was taken into consideration that some teachers and/or students had tendency not to involve with this study due to time, feasibility and some other boundaries. As soon as the pilot study is completed, researcher contemplated over the pilot study in terms of its success, stability, applicability, difficulty and other elements that needed to be revised/updated/modified before the next step.

The study continued after giving all the relevant information about why their participation were important for this research, what were the goals of this research, and what they needed to know about this research. Nevertheless, researcher strictly emphasized on that participants were required to express their feelings by rating in a given range as a result of active involvement with the system. The plan was reaching out as many students as possible to eliminate potential method biases. On the other hand, taking precaution to avoid from social desirability bias was also vitally important in terms of participants' confidentiality and anonymity. Therefore, researcher also assured that no one but the participant and researcher were the only figures who viewed the answers to prevent any social desirability bias. All these biases are the side effect of research methods that were aforementioned earlier in common method variance or bias that occurs based on many factors, in particularly, using a single based data gathering sources.

3.6 Research Instruments

This study attempted to use several instruments to collect sufficient data that can give robust information to determine the significant relations between dimensions of the measurements. The data collection tool was designed from different sources in the

literature to minimize the potential bias and ensure that what factor has impact on the success or failure of the system. This study did not only measure the intelligent tutoring system's impact on students' by using a standard questionnaire that undermines some other factors' impact on raters' respond. Another major goal was to identify the elements which played an important role and positive impact in learning performances as a result of administrating this research.

One of the most important reasons to offer different categories of the questions to the learners was revealing the relations between each of the factors that impacts students' perception. One dimension of the categorized questionnaire was information/knowledge quality among other variables. Regardless of how great the content formed for the courses, it was concise enough to minimize the confusion and achieve the desired outcomes. Furthermore, as a research team during the preparation of the course contents, it was assured that delivered information was meaningful, productive and effective to improve students' attendance for lesson, participation for learning activities and motivated to complete given tasks. Although preparing the quality information took considerable amount of time, nevertheless, presented precise, sufficient, current, and reliable information was mandatory phase for the success/failure that impacted raters' perception.

Other categories such as system and service qualities were also important measurers that affected raters' responds. Questions, such as "is the system user friendly, easy to use; is there any problem solving mechanism" aimed to measure the critical aspects of the students' perception. Gathering data about these factors contributed to explain what affected the failure or success of the study. On the other hand, providing a supporting tool that improves learning and teaching objectives has a close relation

with given task and technology. Identifying motives that led success or failure of the study in the realm of the task and technology correlation, questionnaire contained a category to collect data directly from participants. Besides task-technology fit, other categories targeted to determine if the participants were satisfied with ITS; or if their learning motivation was increased and finally, if ITS contributed to improve learning and teaching performances. Following sections of the survey were adopted by reviewing the literature.

System quality (SQ), information quality (IQ) and service quality (SEQ) were measured using scale items adopted from previous studies i.e.,(Chiu, Chiu, & Chang, 2007; Delone & McLean, 2003; Urbach, Smolnik, & Riempp, 2010; Y.-S. Wang, Wang, & Shee, 2007). System quality, information quality and services quality factors were measured on a 1 to 5 scale, with higher scores indicating greater perceived system quality, information quality and service quality.

a) **ITS Task-technology fit (TTF)** was measured with items developed and used by prior studies (T. McGill & Klobas, 2008; T. J. McGill & Klobas, 2009; Schmitt et al., 2008). Task-technology fit was measured on a 1 to 5 scale, with higher scores indicating greater perceived task-technology fit.

b) **Students satisfaction (SST)** was adopted from (Liaw et al., 2008; Liaw et al., 2007). Students' satisfaction was measured on a 1 to 5 scale, with higher scores indicating greater perceived students/teachers satisfaction.

c) **ITS learning motivation** was adopted from (Hsia, Huang, & Hwang, 2016; Pintrich, 1991), including three items of intrinsic motivation and three of

extrinsic motivation. This scale has been used widely by researchers (e.g.,Hsia, Huang, & Hwang, 2016). ITS learning motivation was measured on a 1 to 5 scale, with higher scores indicating greater perceived learning motivation.

d) **Learning performance** was adopted from (Goodhue & Thompson, 1995; Staples & Seddon, 2004; Van Raaij & Schepers, 2008). Learning motivation was measured on a 1 to 5 scale, with higher scores indicating greater perceived learning/teaching performance.

3.7 Statistical and Analytical Approaches

Furthermore, "IBM-SPSS AMOS is used for additional analyses and also, to gauge the mediation effect, because neural network assumes that in any given model only input and output variables exist. Using Structural Equation Modelling (SEM) technique, a Confirmatory Factor Analysis (CFA) was carried out. This was because CFA is a statistical technique used to verify the structure of a set of observed variables" as noted by (Harrington, 2009).

According to Bagozzi and Yi (1988), "CFA assist scholars and researchers in identifying and determining construct validity" (i.e., convergent, discriminant, and nomological validity). Convergent validity "is the unison that exist between scale items of the same construct, this can be measured by evaluating the standardized factor loadings, and reliability of any given construct" (Hair, Anderson, Babin, & Black, 2010). Discriminant validity is the "absence of concord between the scale items of the same construct", and can be observed from the correlation coefficients between the proposed variables, if the value does not exceeds 0.85 then there is evidence of discriminant validity and vice versa" Kline (2015).

Next, Cronbach's alpha (α) is "used in assessing the scale reliability (Cronbach, 1951) as most researchers have done and are still doing. The research model is a complex one and such a model is best evaluated with SEM. Hair et al. (2010) suggested that the basal factor why SEM is important is because of its rigorous nature in comparison to linear regression methods. Moreover, SEM has the power to identify the multi-level mediation effects much more than the regression".

Chapter 4

RESULTS AND DISCUSSIONS

In this chapter, data gathering process and data analysis are presented by using the quantitative method as it is stated in chapter 3. Data collection tool is designed in a way to illustrate what dimensions of presented system yields satisfaction, better perception and improves learning performance. The researcher also indicates the relationship between measured elements of the research and what variables influence learning progress significantly. All the relations between these factors are measured with the employed criterion and instruments to ensure the reliability and validity for the future studies. As a result of the data collection and then interpretation process, some critical conclusions are drawn, such as the relationship of the target population with the population of the interest. Lastly, this chapter also presents the correlation and direct effect of the variables that resulted with the positive impacts on students' satisfaction, motivation and learning performance.

4.1 Findings

The tables and figures throughout this chapter reflect participants' perceptions for each measured variables. Findings that are obtained as a result of the selected measurement tools help to understand the correlation between multivariables with numerical values besides the graph. Furthermore, findings also reveal how research questions are being responded based on the participants' involvement with the research.

4.1.1 Information, system, and service quality impact on student satisfaction

The first question was seeking for the answer to determine if student satisfaction has been improved as a result of providing quality information, quality system, and quality service. The question was: “Do information, system, and service quality have positive impact on student satisfaction?” are supported by the research study. The study revealed that system and service quality are the top priority and significant factors in terms of the students’ satisfaction along with information quality. However, according to the factor loading on Table 2, two items were dropped because they were insignificant for the data fit and model structure. These two items were, “Intelligent Tutoring System provides up-to-date information and “intelligent tutoring system provides reliable and useful information”. Therefore, this finding indicates that information delivered via the system should be current, reliable and useful to improve students’ satisfaction. Nevertheless, from the larger point of view, inter-correlations and path correlations are concluded that independent variables; quality of information, quality of system and quality of service have positive impact on learning performances. On the other hand, mediator factors; students satisfaction, learning motivation and task-technology fit also have positive and significant impact on learning performances as a result analyzing the inter-correlations and path correlation coefficient path effects.

4.1.2 ITS with TTF and student satisfaction enhance learning performance

The second question for the research was “Does ITS with task-technology fit and student satisfaction enhance learning performance?”, that research indicated that there is significant and positive correlations between task-technology, student satisfaction and learning performances. All the items under these two variables, except one item in student satisfaction, present significant and positive values for the

factor loadings according to the Table 2. Further, Table 3 also indicated that there is a significant and positive correlation between these variables. However, hypothesis that were stated as "task-technology fit and student satisfaction have positive impact on learning performance" are rejected.

4.2 Data Purification of the Measurement Model

The relationships in the model were tested using Structural Equation Modelling (SEM) to evaluate model fit. First of all, the fit and construct validity of the research model was tested by carrying out a Confirmatory Factor Analysis (CFA). Results from the CFA indicated that the data fits the model satisfactorily: (Relative $\chi 2$ = 1.964, $\chi 2$ = 928.803, df = 473 $p < 0.01$; CFI = 0.859, IFI = 0.862, TLI = 0.843).

For Common Method Variance (CMV), one factor model in which all the items were forced to load on one factor as follows: (Relative $\chi 2$ = 2.851, $\chi 2$ = 1391.107, df = 488 $p < 0.01$; CFI = 0.721, IFI = 0.725, TLI = 0.698). The results yielded a poorer fit suggesting that CMV does not seem to be a problem (MacKenzie & Podsakoff, 2012). Moreover, change in chi-square, the $\Delta \chi 2$ was significant as well.

The standardized factor loadings were equal and/or exceeded the recommended value 0.50 (Bagozzi R.P & Baumgartner, 1994). The *t values* were also significant, except for three items that were discarded as a result of low factor loadings which were less than 0.50: two items from information quality and other one from student satisfaction scale. For the scales reliability, *Cronbach's alphas (α)* exceeded the recommended values 0.70 for all constructs (Numally, 1978), which indicated a high degree of internal consistency and strong association between scales. Furthermore, the test for discriminant validity applied correlation coefficients, which were all

below 0.80 (Kline, 2004). Overall, this provides evidence of construct, convergent and discriminant validity for the model.

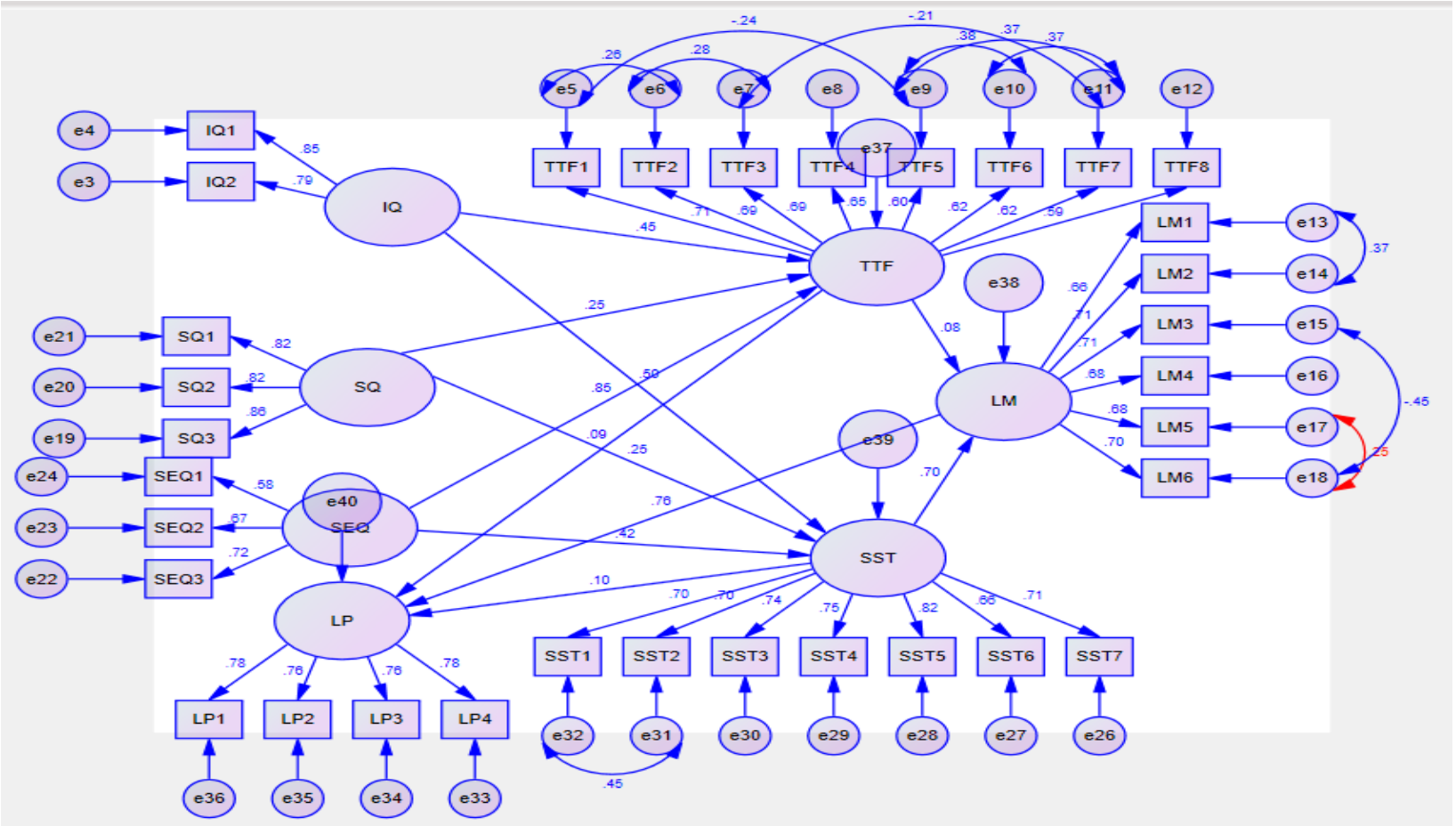

Figure 2: Structural Equation Modelling Results

Table 2: Factor Loadings

Scale Items	Standardized Loadings
Information quality (IQ)	
"Intelligent tutoring system provides the precise information you need".	.851
"Intelligent tutoring system provides sufficient information".	.786
"Intelligent tutoring system provides up-to-date information".	-*
"Intelligent tutoring system provides reliable and useful information".	-*
System quality (SQ)	
"Intelligent tutoring system is user friendly".	.819
"Intelligent tutoring system is easy to use".	.817
"Intelligent tutoring system is usable"	.863
Service quality (SEQ)	
"Intelligent tutoring system has a problem solving mechanism service".	.584
"You feel safe in your activities with intelligent tutoring system service".	.672
"The Intelligent tutoring system service gives you individual attention".	.724

Notes: -* dropped items during confirmatory factor analysis

Table 2: Factor Loadings (Cont.)

Scale Items	Standardized Loadings
Task-Technology Fit (TTF)	
"This intelligent tutoring system matches my interests"	.708
"This intelligent tutoring system is compatible (suits) with all aspects of my study"	.691
"I feel that my academic goals and needs are met by applying the intelligent tutoring system"	.694
"Do you think the output from the intelligent tutoring system is presented in a useful format?"	.650
"Is the information from this intelligent tutoring system accurate?"	.600
"Does this intelligent tutoring system provide you with up-to-date information?"	.621
"Do you get the information you need in time"	.623
"Does this intelligent tutoring system provide output that seems to be just about exactly you need?"	.588
Learning performance (LP)	
"Intelligent tutoring system has a large positive impact on my effectiveness and productivity as a student".	.779
"Intelligent tutoring system is an important and valuable aid to me in my studies".	.759
"I learn better with intelligent tutoring system than without it"	.765
"I can easily achieve the learning goals asserted by this course with intelligent tutoring system"	.776

Notes: -* dropped items during confirmatory factor analysis

Table 2: Factor Loadings (Cont.)

Scale Items	Standardized Loadings
Student satisfaction (SST)	
"I am satisfied with the intelligent tutoring system"	.696
"I am satisfied with the speed of the intelligent tutoring system"	.702
"I am satisfied with the functions provided by the intelligent tutoring system"	.741
"I am satisfied with the quality of information available on the intelligent tutoring system"	.755
"I am satisfied with the presentations methods of the intelligent tutoring system regarding the teaching material"	.821
"I can easily download the available teaching materials in the intelligent tutoring system"	.660
"I have no problem in viewing the posted information in the intelligent tutoring system"	.710
"I have encountered the problem in logging in the intelligent tutoring system"	_*
ITS Learning motivation (LM)	
"Intelligent tutoring system provide challenging tasks so I can learn new things"	.661
"Intelligent tutoring system provide programs that arouse my curiosity, even if it is difficult to learn"	.711
"Intelligent tutoring system provide me the opportunity to learn new things, even if they don't guarantee a good grade"	.711
"Getting a good grade in this class is the most satisfying thing for me right now"	.681
"If I can, I want to get better grades in this class than most of the other students".	.679
"I want to do well in this class because it is important to show my ability to my family, friends, employer, or others"	.702

Notes: -* dropped items during confirmatory factor analysis.

4.3 Correlation and Direct Effects

Variable means, standard deviations and inter-correlations are reported in Table 3. The path correlation coefficient from information quality, system quality and service quality to task-technology fit which is significant and positive (r = 0.643, p = 0.000), (r = 0.611, p = 0.000), (r = 0.745, p = 0.000). Next, evaluation of the path correlation coefficient from information quality, system quality, service quality and task-technology fit to student satisfaction which was significant and positive (r = 0.592, p = 0.000), (r = 0.534, p = 0.000), (r = 0.495, p = 0.000), and (r = .723, p = 0.000).

Similarly, the path correlation coefficient from information quality, system quality, service quality and student satisfaction to ITS learning motivation which is significant and positive (r = 0.501, p = 0.000), (r = 0.410, p = 0.000), (r = 0.530, p = 0.000), and (r = 0.714, p = 0.000). The path correlation coefficient from information quality, system quality, service quality, task-technology fit, student satisfaction and ITS learning motivation to learning performance is significant and positive (r = 0.627, p = 0.000), (r = 0.500, p = .000), (r = 0.509, p = .000), (r = 0.555, p = 0.000), (r = .707, p = 0.000) and (r = 0.802, p = 0.000). These results provide preliminary support for the proposed hypotheses above.

Table 3: Means, Standard Deviations (SD), and Correlations

Variables	Alpha	Mean (SD)	1	2	3	4	5	6	7
Information quality (IQ)	.809	3.76(.905)	-						
System quality (SQ)	.872	3.79(.923)	.519**	-					
Service quality (SEQ)	.725	3.69(.801)	.499**	.530**	-				
Task-Technology Fit (TTF)	.905	3.74(.769)	.643**	.611**	.745**	-			
Student satisfaction (SST)	.916	3.73(.823)	.592**	.534**	.495**	.723**	-		
ITS Learning motivation (LM)	.870	3.77(.769)	.501**	.410**	.530**	.580**	.714**	-	
Learning performance (LP)	.878	3.84(.871)	.627**	.500**	.509**	.555**	.707**	.802**	-

Note: Composite scores for each variable were computed by averaging respective item scores.
SD, standard deviation; ** Correlations are significant at the .01 level.

Lastly, Table 4 shows the standardized coefficients for each hypothesized path in the model. Eight of the 10 hypotheses were supported. Information quality had a significant positive effect on both task-technology fit student satisfaction, thus hypotheses H1 and H2 were supported. Similarly, system quality and service quality had a significant positive effect on both task-technology fit student satisfaction, thus hypotheses H3, H4, H5 and H6 were supported. Contrariwise to expectations, task-technology fit and student satisfaction did not influence learning performance; therefore hypotheses H7 and H8 were not supported. As hypothesized, student satisfaction had a significant positive influence on learning performance. Therefore hypothesis H9 was supported. Finally, ITS learning motivation also exerts significant impact on learning performance. Hence, hypothesis H10 was supported.

Table 4: Effect Summary

Hypotheses and Relationships		β	ρ	Decision
H1: Information quality (IQ)	Task-Technology Fit (TTF)	.446	**	Supported
H2: Information quality (IQ)	Student satisfaction (SST)	.498	**	Supported
H3: System quality (SQ)	Task-Technology Fit (TTF)	.248	**	Supported
H4: System quality (SQ)	Student satisfaction (SST)	.245	*	Supported
H5: Service quality (SEQ)	Task-Technology Fit (TTF)	.848	**	Supported
H6: Service quality (SEQ)	Student satisfaction (SST)	.420	**	Supported
H7: Task-Technology Fit (TTF)	Learning performance (LP)	.088	.317	Rejected
H8: Student satisfaction (SST)	Learning performance (LP)	.761	.443	Rejected
H9: Student satisfaction (SST)	ITS Learning motivation (LM)	.701	**	Supported
H10: Learning motivation (LM)	Learning performance (LP)	.761	**	Supported

Notes: *Significant at the $p < 0.05$ level (two-tailed); **significant at the $p < 0.01$ level (two-tailed)

Chapter 5

CONCLUSION AND FUTURE WORK

The major intention of this study was, first, to measure the impact of a web-based intelligent tutoring system's integration with in-class learning and teaching experiences in terms of its productivity. Second, determining the relationships between tested dimensions of the applied model in order to discover what constitutes to the acquired result. These dimensions are information quality, system quality, and service quality as independent variables; task-technology fit, satisfaction, and motivation as mediator; finally, learning performance took place as dependent variable. Lastly, some significant conclusions are drawn some as a result of implementing intelligent tutoring system into classroom environment. One of the most remarkable conclusion and contributions of this study is revealing each of the measured variable's impact on the obtained findings.

On the other hand, this chapter gives a brief summary of the thesis, highlights the essential points of the findings, and relates the outcomes with the previous studies that were investigated in literature review. Second part of this chapter identifies the factors that are deduced after examining the collected data to present as a contribution of this study for the future work.

5.1 Conclusion

Constant evolving in technology demands learners to access information quickly and build knowledge effectively and to generate solutions for the problems they face in a light speed as digital age influence every aspect of our lives. Therefore, providing a quality, efficient and productive system, service, information and relevant task have been a core purpose to meet with 21st century's global requirements. Integrating pre-evaluated technology with instructional technology has positive impact in myriad ways for all the stakeholders, in particularly, for students. Students, who gain, retain, and process knowledge and skill in a meaningful way are being prepared with today's challenging and competitive work environment.

This research, as it is intended, measured the different aspects of system success model to determine how a digitalized pedagogical component influences learning performances. Evaluation of the all the dimension of the system also proved that students' satisfaction and motivation increased using the online source. On the other hand, it is observed that accessing to the online source allowed raters to engage with the course objectives and improved their participation for the physical learning environment. Furthermore, learners also are benefited greatly accessing the course materials using internet at their own leisure. This allowed them to be prepared for the lesson on their own, collaboration with their peers, and assistance by the course instructor.

What factor leads to success or failure requires a reliable, workable and recognized system that measure all the variables effectively within the discipline. Therefore, information system success model is chosen to analyze the collected dataset from the

target group. Findings indicated that how a digitalized learning platform helps to improve the desired academic goals by measuring the conceptual framework of this study using the information success system model. This model exposed that a digitalized pedagogical tool does not automatically and necessarily generate the desired outcome unless it is formed by considering all the factors that influence the overall success. Data analysis section gives detailed information about how an element of the model significantly related with each other is shown in Figure 2 above. All the dimensions that are evaluated in terms of their interrelations with each other proved that one variable has impacts on another variable that leads to success or failure of the product. A system which contains quality of information, system and service enables significant improvement in learning performances.

As a result of this research, one can conclude that a technology should be evaluated based on the different criteria to measure its overall impact for the outcome. This research suggests that implementing an electronic supplemental tool for the instructional purposes needed to be done after administering a pilot evaluation test among all the population of interest. Measuring only one criterion such as learning performance may mislead to bias about the product that is tested. Instead, educators need to focus how cumulative success is achieved and how each variable is interwoven each other.

5.2 Future Work

Numbers of the questions have been arisen as a result of conducting the research in thesis. First of all, conducting such a research project requires a team work, time, plan and budget for an effective model to collect adequate dataset from the targeted population. Second, it requires when, where, and how to implement the selected ITS

model in learning platform. Lastly, there were insignificant t values for three scaling factors which were discarded from factor loading analysis. These factors needed to be investigated to explain what was/were the underlining possible issue(s) associated with the failure.

REFERENCES

Abubakar, A., & Ilkan, M. (2014). eWOM and the 3W's: Who, Why and What. *Morebooks, Germany*.

Adelman, H., & Taylor, L. (2011). School Engagement, Disengagement, Learning Supports, and School Climate. *Los Angeles: Center for Mental Health in Schools at UCLA.*

Agourram, H. (2009). Defining Information System Success in Germany. *International Journal of Information Management, 29*(2), 129-137.

Alli, N., Rajan, R., & Ratliff, G. (2016). How Personalized Learning Unlocks Student Success. *EDUCAUSE Review, 51(2)*.

Amaral, L., Meurers, D., & Ziai, R. (2011). Analyzing Learner Language: Towards a Flexible Natural Language Processing Architecture for Intelligent Language Tutors. *Computer Assisted Language Learning, 24*(1), 1-16.

Bagozzi R.P, B., & Baumgartner, P. (1994). H.(1994):"The Evaluation of Structural Equation Models and Hypothesis Testing". *Principles of Marketing Research*, 386-419.

Bagozzi, R. P., & Yi, Y. (1988). On the Evaluation of Structural Equation Models. *Journal of the academy of marketing science, 16*(1), 74-94.

Bagozzi, R. P., & Yi, Y. (1991). Multitrait-Multimethod Matrices in Consumer Research. *Journal of Consumer Research, 17*(4), 426-439.

Bloom, B. (1984). The Search for Methods of Group Instruction as Effective as One-to-One Instruction. *Educational Leadership*.

Bordia, S., Hobman, E. V., Restubog, S. L. D., & Bordia, P. (2010). Advisor–Student Relationship in Business Education Project Collaborations: A Psychological Contract Perspective. *Journal of Applied Social Psychology, 40*(9), 2360-2386.

Brusilovsky, P., Eklund, J., & Schwarz, E. (1998). Web-Based Education for All: A Tool for Development Adaptive Courseware. *Computer Networks and ISDN Systems, 30*(1-7), 291-300.

Cabada, R. Z., Estrada, M. L. B., & García, C. A. R. (2011). EDUCA: A Web 2.0 Authoring Tool for Developing Adaptive and Intelligent Tutoring Systems Using a Kohonen Network. *Expert Systems with Applications, 38*(8), 9522-9529.

Cheng, M.-T., Lin, Y.-W., & She, H.-C. (2015). Learning Through Playing Virtual Age: Exploring the Interactions Among Student Concept Learning, Gaming Performance, in-Game Behaviors, and the Use of in-Game Characters. *Computers & Education, 86,* 18-29.

Chiang, T. H., Yang, S. J., & Hwang, G.-J. (2014). An Augmented Reality-based Mobile Learning System to Improve Students' Learning Achievements and Motivations in Natural Science Inquiry Activities. *Educational Technology & Society*, *17*(4), 352-365.

Chiu, C. M., Chiu, C. S., & Chang, H. C. (2007). Examining the Integrated Influence of Fairness and Quality on Learners' Satisfaction and Web- Based Learning Continuance Intention. *Information systems journal*, *17*(3), 271-287.

Collier, J. E., & Bienstock, C. C. (2007). An Analysis of How Nonresponse Error is Assessed in Academic Marketing Research. *Marketing theory*, *7*(2), 163-183.

Corbett, A. T., & Anderson, J. R. (2001). *Locus of Feedback Control in Computer-Based Tutoring: Impact on Learning Rate, Achievement and Attitudes.* Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.

Crockett, K., Latham, A., & Whitton, N. (2017). On Predicting Learning Styles in Conversational Intelligent Tutoring Systems Using Fuzzy Decision Trees. *International Journal of human-computer studies*, *97*, 98-115.

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Tests. *psychometrika*, *16*(3), 297-334.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS quarterly*, 319-340.

de Jong, T., Limbach, R., Gellevij, M., Kuyper, M., Pieters, J., & Van Joolingen, W. (1999). Cognitive Tools to Support the Instructional Design of Simulation-Based Discovery Learning Environments: The SimQuest Authoring System *Design approaches and tools in education and training* (pp. 215-224): Springer.

de Sá, D. M. (2008). Improving User Satisfaction in VO through Systems Usability *Encyclopedia of Networked and Virtual Organizations* (pp. 694-699): IGI Global.

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information systems research, 3*(1), 60-95.

Delone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *Journal of management information systems, 19*(4), 9-30.

Dishaw, M., Strong, D., & Bandy, D. B. (2002). Extending the Task-Technology Fit Model with Self-Efficacy Constructs. *AMCIS 2002 Proceedings*, 143.

Dörrenbächer, L., & Perels, F. (2016). Self-Regulated Learning Profiles in College Students: Their Relationship to Achievement, Personality, and the Effectiveness of an Intervention to Foster Self-Regulated Learning. *Learning and Individual Differences, 51*, 229-241.

Duque, L. C. (2014). A Framework for Analysing Higher Education Performance: Students' Satisfaction, Perceived Learning Outcomes, and Dropout Intentions. *Total Quality Management & Business Excellence, 25*(1-2), 1-21.

Dziuban, C., Moskal, P., Johnson, C., & Evans, D. (2017). Adaptive Learning: A Tale of Two Contexts. *Current Issues in Emerging eLearning, 4*(1), 3.

Dziuban, C., Moskal, P., Thompson, J., Kramer, L., DeCantis, G., & Hermsdorfer, A. (2015). Student Satisfaction with Online Learning: Is It a Psychological Contract? *Online Learning, 19*(2), n2.

Eichhorn, B. R. (2014). Common Method Variance Techniques. *Cleveland State University, Department of Operations & Supply Chain Management. Cleveland, OH: SAS Institute Inc*.

Fonseca, D., Martí, N., Redondo, E., Navarro, I., & Sánchez, A. (2014). Relationship Between Student Profile, Tool Use, Participation, and Academic Performance with the Use of Augmented Reality Technology for Visualized Architecture Models. *Computers in Human Behavior, 31*, 434-445.

Freedman, R., Ali, S. S., & McRoy, S. (2000). Links: What is an Intelligent Tutoring System? *intelligence, 11*(3), 15-16.

Gebauer, J., Shaw, M. J., & Gribbins, M. L. (2010). Task-Technology Fit for Mobile Information Systems. *Journal of Information Technology, 25*(3), 259-272.

Goodhue, D. L. (1998). Development and Measurement Validity of a Task-Technology Fit instrument for User Evaluations of Information System. *Decision sciences*, *29*(1), 105-138.

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS quarterly*, 213-236.

Gorla, N., Somers, T. M., & Wong, B. (2010). Organizational Impact of System Quality, Information Quality, and Service Quality. *The Journal of Strategic Information Systems*, *19*(3), 207-228.

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). *Multivariate Data Analysis: A Global Perspective* (Vol. 7): Pearson Upper Saddle River, NJ.

Harrington, D. (2009). *Confirmatory Factor Analysis*: Oxford University Press.

Heflin, H., Shewmaker, J., & Nguyen, J. (2017). Impact of Mobile Technology on Student Attitudes, Engagement, and Learning. *Computers & Education*.

Hrubik-Vulanovic, T. (2013). *Effects of Intelligent Tutoring Systems in Basic Algebra Courses on Subsequent Mathematics Lecture Courses.* Kent State University.

Hsia, L.-H., Huang, I., & Hwang, G.-J. (2016). Effects of Different Online Peer-Feedback Approaches on Students' Performance Skills, Motivation and Self-Efficacy in a Dance Course. *Computers & Education*, *96*, 55-71.

Jan, A. U., & Contreras, V. (2016). Success Model for Knowledge Management Systems Used by Doctoral Researchers. *Computers in Human Behavior*, *59*, 258-264.

Kangas, M., Siklander, P., Randolph, J., & Ruokamo, H. (2017). Teachers' Engagement and Students' Satisfaction with a Playful Learning Environment. *Teaching and teacher education*, *63*, 274-284.

Ke, F., & Kwak, D. (2013). Constructs of Student-Centered Online Learning on Learning Satisfaction of a Diverse Online Student Body: A Structural Equation Modeling Approach. *Journal of Educational Computing Research*, *48*(1), 97-122.

Kefalidou, G. (2017). When immediate interactive Feedback Boosts Optimization Problem Solving: A 'Human-in-the-Loop'approach for solving Capacitated Vehicle Routing Problems. *Computers in Human Behavior*.

Kline, R. B. (2004). Principles and Practice of Structural Equation Modeling, (Methodology In The Social Sciences).

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling*: Guilford publications.

Koedinger, K., & Tanner, M. (2013, July 9). 7 Things You Should Know About Intelligent Tutoring Systems. from https://library.educause.edu/

resources/2013/7/7-things-you-should-know-about-intelligent-tutoring-systems

Kuiper, R., Murdock, N., & Grant, N. (2010). Thinking Strategies of Baccalaureate Nursing Students Prompted by Self-Regulated Learning Strategies. *Journal of Nursing Education, 49*(8), 429-436.

Langstrand, J., Cronemyr, P., & Poksinska, B. (2015). Practise What You Preach: Quality of Education in Education on Quality. *Total Quality Management & Business Excellence, 26*(11-12), 1202-1212.

Latham, A. M. (2011). *Personalising Learning with Dynamic Prediction and Adaptation to Learning Styles in a Conversational Intelligent Tutoring System.* Manchester Metropolitan University.

Latham, A. M., Crockett, K. A., McLean, D. A., Edmonds, B., & O'Shea, K. (2010). *Oscar: An Intelligent Conversational Agent Tutor to Estimate Learning Styles.* Paper presented at the Fuzzy Systems (FUZZ), 2010 IEEE International Conference on.

Liaw, S.-S., Chen, G.-D., & Huang, H.-M. (2008). Users' Attitudes toward Web-Based Collaborative Learning Systems for Knowledge Management. *Computers & Education, 50*(3), 950-961.

Liaw, S.-S., Huang, H.-M., & Chen, G.-D. (2007). Surveying Instructor and Learner Attitudes toward E-Learning. *Computers & Education, 49*(4), 1066-1080.

Luckin, R., & du Boulay, B. (2016). Reflections on the Ecolab and the Zone of Proximal Development. *International Journal of Artificial Intelligence in Education, 26*(1), 416-430.

Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (2014). Intelligent tutoring systems and learning outcomes: A meta-analysis. *Journal of Educational Psychology, 106*(4), 901.

MacKenzie, S. B., & Podsakoff, P. M. (2012). Common Method Bias in Marketing: Causes, Mechanisms, and Procedural Remedies. *Journal of Retailing, 88*(4), 542-555.

McGarry, B. J., Theobald, K., Lewis, P. A., & Coyer, F. (2015). Flexible Learning Design in Curriculum Delivery Promotes Student Engagement and Develops Metacognitive Learners: An Integrated Review: Elsevier.

McGill, T., & Klobas, J. (2008). User Developed Application Success: Sources and Effects of Involvement. *Behaviour & Information Technology, 27*(5), 407-422.

McGill, T. J., & Klobas, J. E. (2009). A Task–Technology Fit view of Learning Management System Impact. *Computers & Education, 52*(2), 496-508.

Mohammadi, H. (2015). Investigating Users' Perspectives on E-Learning: An Integration of TAM and IS Success Model. *Computers in Human Behavior, 45*, 359-374.

Mulyadi, S., Basuki, A. H., & Rahardjo, W. (2016). Student's Tutorial System Perception, Academic Self-Efficacy, and Creativity Effects on Self-Regulated Learning. *Procedia-Social and Behavioral Sciences, 217,* 598-602.

Murray, M. C., & Pérez, J. (2015). *Informing and Performing: A Study Comparing Adaptive Learning to Traditional Learning*: DigitalCommons@ Kennesaw State University.

Numally, J. C. (1978). Psychometric Theory. *NY: McGraw-Hill*.

Oinas, S., Vainikainen, M.-P., & Hotulainen, R. (2017). Technology-Enhanced Feedback for Pupils and Parents in Finnish Basic Education. *Computers & Education, 108,* 59-70.

Oliveira Neto, J. D. d., & Nascimento, E. V. (2012). Intelligent Tutoring System for Distance Education. *JISTEM-Journal of Information Systems and Technology Management, 9*(1), 109-122.

Olney, A. M., & Cade, W. L. (2015). *Authoring Intelligent Tutoring Systems Using Human Computation: Designing for Intrinsic Motivation.* Paper presented at the International Conference on Augmented Cognition.

Ossiannilsson, E., & Landgren, L. (2012). Quality in E- Learning–a Conceptual Framework Based on Experiences from Three International Benchmarking Projects. *Journal of Computer Assisted Learning, 28*(1), 42-51.

Ozverir, I., & Herrington, J. (2011). Authentic Activities in Language Learning: Bringing Real World Relevance to Classroom Activities.

Patchan, M. M., & Puranik, C. S. (2016). Using Tablet Computers to Teach Preschool Children to Write Letters: Exploring the Impact of Extrinsic and Intrinsic Feedback. *Computers & Education, 102*, 128-137.

Peeters, J., De Backer, F., Kindekens, A., Triquet, K., & Lombaerts, K. (2016). Teacher Differences in Promoting Students' Self-Regulated Learning: Exploring the Role of Student Characteristics. *Learning and Individual Differences, 52*, 88-96.

Pintrich, P. R. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of applied psychology, 88*(5), 879.

Rashid, T., & Asghar, H. M. (2016). Technology Use, Self-Directed Learning, Student Engagement and Academic Performance: Examining the Interrelations. *Computers in Human Behavior, 63*, 604-612.

Robb, M. K. (2016). Self-Regulated Learning: Examining the Baccalaureate Millennial Nursing Student's Approach. *Nursing Education Perspectives, 37*(3), 162-164.

Sani, S., & Aris, T. N. (2014). *Computational Intelligence Approaches for Student/Tutor Modelling: A Review*. Paper presented at the Intelligent Systems, Modelling and Simulation (ISMS), 2014 5th International Conference on.

Schmitt, N., Oswald, F. L., Friede, A., Imus, A., & Merritt, S. (2008). Perceived Fit with an Academic Environment: Attitudinal and Behavioral Outcomes. *Journal of Vocational Behavior, 72*(3), 317-335.

Schmoelz, A., Swertz, C., Forstner, A., & Barberi, A. (2014). Does Artificial Tutoring Foster Inquiry Based Learning? *Science Education International, 25*(1), 123-129.

Shannon, C., & Weaver, E. W. (1949). The Mathematical Theory of Communication. *Urbana: University of Illinois Press, 29*.

Snead Jr, K. C., Magal, S. R., Christensen, L. F., & Ndede-Amadi, A. A. (2015). Attribution Theory: A Theoretical Framework for Understanding Information Systems Success. *Systemic Practice and Action Research, 28*(3), 273.

Staples, D. S., & Seddon, P. (2004). Testing the Technology-to-Performance Chain Model. *Journal of Organizational and End User Computing (JOEUC), 16*(4), 17-36.

Steenbergen-Hu, S., & Cooper, H. (2013). A Meta-Analysis of the Effectiveness of Intelligent Tutoring Systems on K–12 Students' Mathematical Learning. *Journal of Educational Psychology, 105*(4), 970.

The Quality Assurance Agency for Higher Education, U. (2014). Glossary. Retrieved Jun 15, 2017, from http://libanswers.liverpool.ac.uk/faq/49511

Torras, E., & Bellot, A. (2016). Online Teaching and Learning Processes: Declarative and Procedural Knowledge. *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 10*(2), 601-604.

UNICEF, I. (2000). *Defining Quality in Education.* Paper presented at the A paper presented at the meeting of the International Working Group on Education, Florence, Italy.

Urbach, N., Smolnik, S., & Riempp, G. (2010). An Empirical Investigation of Employee Portal Success. *The Journal of Strategic Information Systems, 19*(3), 184-206.

Van Raaij, E. M., & Schepers, J. J. (2008). The Acceptance and Use of a Virtual Learning Environment in China. *Computers & Education, 50*(3), 838-852.

Waheed, M., & Kaur, K. (2016). Knowledge Quality: A Review and a Revised Conceptual Model. *Information Development, 32*(3), 271-284.

Wang, D., Han, H., Zhan, Z., Xu, J., Liu, Q., & Ren, G. (2015). A Problem Solving Oriented Intelligent Tutoring System to Improve Students' Acquisition of Basic Computer Skills. *Computers & Education, 81*, 102-112.

Wang, T.-H. (2014). Developing an Assessment-Centered e-Learning System for Improving Student Learning Effectiveness. *Computers & Education, 73*, 189-203.

Wang, Y.-S., & Liao, Y.-W. (2008). Assessing eGovernment Systems Success: A Validation of the DeLone and McLean Model of Information Systems Success. *Government Information Quarterly, 25*(4), 717-733.

Wang, Y.-S., Wang, H.-Y., & Shee, D. Y. (2007). Measuring E-Learning Systems Success in an Organizational Context: Scale Development and Validation. *Computers in Human Behavior, 23*(4), 1792-1808.

Weber, G., & Brusilovsky, P. (2016). ELM-ART–An Interactive and Intelligent Web-Based Electronic Textbook. *International Journal of Artificial Intelligence in Education, 26*(1), 72-81.

Whyte, G., Bytheway, A., & Edwards, C. (1997). Understanding User Perceptions of Information Systems Success. *The Journal of Strategic Information Systems, 6*(1), 35-68.

Zarandi, M. H. F., Khademian, M., & Minaei-Bidgoli, B. (2012). A Fuzzy Expert System Architecture for Intelligent Tutoring Systems: A Cognitive Mapping

Approach. *Journal of Intelligent Learning Systems and Applications, 4*(01), 29.

Zhuhadar, L., Marklin, S., Thrasher, E., & Lytras, M. D. (2016). Is there a Gender Difference in Interacting with Intelligent Tutoring System? Can Bayesian Knowledge Tracing and Learning Curve Analysis Models answer this question? *Computers in Human Behavior, 61*, 198-204.

Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory into practice, 41*(2), 64-70.

APPENDIX

Appendix A: Questionnaire

Dear student,

This survey is aimed at improving the services of intelligent tutoring system (ITS). Your responses are highly valuable and please note that there are no wrong or right answers. The information you provide will be kept strictly confidential. **Kindly answer the questions below according to the given scale.**

1= Strongly disagree	2= Disagree	3= Neither agree/disagree	4= Agree	5= Strongly agree

	Information quality (IQ)					
1	Intelligent tutoring system provides the precise information you need.	1	2	3	4	5
2	Intelligent tutoring system provides sufficient information.	1	2	3	4	5
3	Intelligent tutoring system provides up-to-date information.	1	2	3	4	5
4	Intelligent tutoring system provides reliable and useful information.	1	2	3	4	5

	System quality (SQ)					
1	Intelligent tutoring system is user friendly.	1	2	3	4	5
2	Intelligent tutoring system is easy to use.	1	2	3	4	5
3	Intelligent tutoring system is usable	1	2	3	4	5

	Service quality (SEQ)					
1	Intelligent tutoring system has a problem solving mechanism service.	1	2	3	4	5
2	You feel safe in your activities with intelligent tutoring system service.	1	2	3	4	5
3	The Intelligent tutoring system service gives you individual attention.	1	2	3	4	5

	Task-Technology Fit (TTF)					
1	This intelligent tutoring system matches my interests	1	2	3	4	5
2	This intelligent tutoring system is compatible (suits) with all aspects of my study	1	2	3	4	5
3	I feel that my academic goals and needs are met by applying the intelligent tutoring system	1	2	3	4	5
4	Do you think the output from the intelligent tutoring system is presented in a useful format?	1	2	3	4	5
5	Is the information from this intelligent tutoring system accurate?	1	2	3	4	5
6	Does this intelligent tutoring system provide you with up-to-date information?	1	2	3	4	5
7	Do you get the information you need in time?	1	2	3	4	5
8	Does this intelligent tutoring system provide output that seems to be just about exactly you need?	1	2	3	4	5

	Student satisfaction (SST)					
1	I am satisfied with the intelligent tutoring system	1	2	3	4	5
2	I am satisfied with the speed of the intelligent tutoring system	1	2	3	4	5
3	I am satisfied with the functions provided by the intelligent tutoring system	1	2	3	4	5
4	I am satisfied with the quality of information available on the intelligent tutoring system	1	2	3	4	5
5	I am satisfied with the presentations methods of the intelligent tutoring system regarding the teaching materials	1	2	3	4	5

6	I can easily download the available teaching materials in the intelligent tutoring system	1	2	3	4	5
7	I have no problem in viewing the posted information in the intelligent tutoring system	1	2	3	4	5
8	I have encountered the problem in logging in the intelligent tutoring system	1	2	3	4	5

	ITS Learning motivation(LM)					
1	Intelligent tutoring system provide challenging tasks so I can learn new things	1	2	3	4	5
2	Intelligent tutoring system provide programs that arouse my curiosity, even if it is difficult to learn	1	2	3	4	5
3	Intelligent tutoring system provide me the opportunity to learn new things, even if they don't guarantee a good grade	1	2	3	4	5
4	Getting a good grade in this class is the most satisfying thing for me right now	1	2	3	4	5
5	If I can, I want to get better grades in this class than most of the other students.	1	2	3	4	5
6	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others	1	2	3	4	5

	Learning performance (LP)					
1	Intelligent tutoring system has a large positive impact on my effectiveness and productivity as a student.	1	2	3	4	5
2	Intelligent tutoring system is an important and valuable aid to me in my studies.	1	2	3	4	5
3	I learn better with Intelligent tutoring system than without it	1	2	3	4	5
4	I can easily achieve the learning goals asserted by this course with intelligent tutoring system	1	2	3	4	5

Demographic Section

1. Your gender?
   Male [ ] Female [ ]
2. How old are you?
   Under 20 [ ] 21-25 [ ] 26-30 [ ] 31-35 [ ] Over 35 [ ]
3. Education?
   Associate Degree [ ] Bachelor's Degree [ ] Higher Degree [ ]

Thank you for your time