Understanding E-Learning Implementation Barriers: An Analysis of Individual, Technological, and Pedagogical Factors

HENLEY BUSINESS SCHOOL
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A thesis submitted to the University of Reading in fulfilment of the requirements for the degree of Doctor of Philosophy in Business Informatics and Systems Science

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Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

As part of this submission, Chapters 4, 5, and 6 are included, which have been published or submitted in journals as joint publications with Dr. Stephen Gulliver (my Ph.D. Supervisor) and Dr. Samnan Ali (my colleague). I have obtained written statements from each co-author, attesting to my contribution to these joint publications (signed below).

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I, Dr. Stephen Gulliver, hereby declare that the work presented in Chapters 4, 5, and 6, which are included in this submission, was predominantly carried out by Muhammad Basir. I also acknowledge Muhammad Basir was primarily responsible for the design, writeup, implementation, and analysis of the research presented in these chapters.

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I, Dr. Samnan Ali, hereby declare that the work presented in Chapters 4, 5, and 6, which are included in this submission, was predominantly carried out by Muhammad Basir. I also acknowledge Muhammad Basir was primarily responsible for the design, writeup, implementation, and analysis of the research presented in these chapters.

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Abstract

Technology has become an integral part of our daily lives and it has reshaped how we go about in our everyday life. Continuous advancement and innovation in information technology (IT) has, however, opened up new avenues and opportunities. The traditional way of doing business, interaction amongst people, and process used to support learning has changed a lot because of IT use. Traditionally, education dissemination has always been face-to-face or in-person, however, with the advent of the internet, new technologies and other associated information systems (IS), have offered new modes of delivery for teaching and learning. Utilisation of any technology-related component i.e., internet, software, hardware, device, and/or IT/IS based platforms to support the teaching and learning activity is also known as E-learning. As such, E-learning or technology-supported learning brings in many benefits (flexibility of time and space, cost-effective, interactive learning content, self-paced learning, wider reach, etc.). Despite the rooted benefits of the technology-assisted learning modules, failures of E-learning are well understood. E-learning-based IS projects still fail to deliver all functional objectives. Researchers, IT / IS implementors, and practitioners have all reported that these failures are due to underlying barriers / challenges / issues which hinder E-learning to deliver the promised benefits. Still, the educational institutes, employers, and students / learners have reservations about the E-learning systems. Many efforts have been made to highlight, understand, and remove the factors blocking the successful implementation of IT / IS learning systems. Still, however, the adoption of technology-based learning solutions was slow. The existence of hindering factors limits the usability and implementation of IT-based E-learning systems. Arguably this should not be the case since technology has indulged in every aspect of human society, the need to understand the E-learning implementation barriers is now more significant than ever. With this rhetoric, the identification of factors limiting the use of IT-based E-learning systems can assist the implementors, researchers, and institutes to understand the root causes of failures. Subsequently, strategic management for the removal of identified E-learning barriers can increase the likelihood of success and adoption.

The above-mentioned narrative led to the creation of this thesis topic, i.e., to design and validate tool(s) to assess and understand the existence of E-learning implementation barriers. Evidence from the existing body of research highlights the existence of three prominent domains of E-learning implementation challenges, i.e., i) technological components that need to be utilised

for delivering and / or receiving education, ii) user i.e., learner / student / end-consumer issues, and iii) methodological approaches i.e., pedagogy utilised to deliver education using E-learning components. The researcher thus outlined three objectives relating to the three identified domains (Technology, Individual & Pedagogy) of the IT / IS based learning challenges / barriers / issues.

Utilising the quantitative survey methodology, three sets of questionnaires regarding the Technology, User / Individual, and Pedagogy related barriers were formulated. The theoretical underpinning of the E-learning barriers is provided through a conceptual framework, developed by Ali et al. (2018), termed the TIPEC (Technological, Individual, Pedagogical, and Enabling Conditions) framework of E-learning implementation challenges. TIPEC framework consists of sixty-eight (68) E-learning barriers grouped into four (4) conceptual categories. Thematic nature of the TIPEC framework provided the ontological structure of the E-learning barriers which aided the researcher in the further development of questionnaire items. Through cross-sectional survey method, a total of 1166 responses were gathered from students of higher education institutes in Pakistan. Structural equation modeling was applied using SPSS and AMOS packages for factor analysis and instrument validation.

Validation of diagnostic instruments for Technological, Individual, and Pedagogical categories signified the existence of thirty-nine (39) challenges related to E-learning barriers. Specifically, 5 for technological, 16 for individual/user, and 17 for pedagogical related barriers were highlighted. Appreciating the three main aspects of E-learning related courses can help the experts and implementors to design a new and/or improve an existing E-learning system. The resulting system will be durable, intuitive, user-friendly, cross-device compatible, and versatile enough to meet the educational demands of a wide range of disciplines. Moreover, applying the developed survey instrument also aid in highlighting the user requirements, expectations, and constraints. Future research can be conducted by using the instruments developed in different regions and comparing the relevance and existence of barriers in a cross-contextual comparison. The scope of the research can be expanded further by involving other stakeholders and exploring different levels of education.

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Chapter 1

Introduction

This chapter gives an overview of the thesis, entitled “Understanding E-Learning Implementation Barriers: An Analysis of Individual, Technological, and Pedagogical Factors”. In the first section, the researcher presents a brief background to the research domain, followed by a high-level identification of the research gap and rationale of the study focus. After that, the researcher provides a brief discussion concerning the formulation of the research question, aim, and objectives. This is followed by a brief explanation of how the material presented in this thesis, which considers in detail how these questions are answered, is structured in the rest of the chapters.

1.1 Background

Information technology (IT) has advanced significantly during our time. The world as we know it has fundamentally transformed as a result of information technology (IT) and related elements. Every day new innovations are made, and the human ‘way of life’ is constantly evolving to incorporate these innovations. IT has transformed our outlook towards life and has impacted almost all aspects of business and education. Around the world, social, health, economic, and technological change is driving businesses, and education providers to question how they use technology to support their future education needs (Basak & Govender, 2015; Weiss & Eikemo, 2017). Use of information technology (IT) and information systems (IS), particularly in developing countries, has been a key factor in the growth and success of education dissemination. To service growing student numbers, education institutions have engaged in the use of technology-based teaching solutions, resulting in E-learning teaching and learning models that are no longer limited to the need for traditional classrooms. E-learning is defined as technology-based learning, i.e., where learning material is delivered electronically to remote learners via an internet browsing device (Seok, 2008). E-learning is also the delivery of instructional material using technological components. Since E-learning promises the potential of access, affordability, and knowledge without the traditional physical and temporal restrictions, a number of people are signing up for E-learning courses. Particularly in developing countries, it has increased exponentially. Since institutions using E-learning IS are able to reach a wider audience and are not bound by the traditional physical and temporal limitations for learners in remote locations, and/or with unsociable or unpredictable working hours, E-learning offers a possible solution to lifelong learning and effective through life education. In addition to the ubiquitous delivery of education, utilisation of the technological components in the traditional classroom setting can aid in making learning more interactive.

Learning and teaching have traditionally been in-person, i.e., face-to-face. Many stakeholders in education and business perceive E-learning as a cheap, low-quality alternative to traditional education methods. Employers globally perceive 'online courses' as being a low-quality alternative to face-to-face 'traditional' learning (Niemi & Kousa, 2020). Furthermore, enrolment and satisfaction rates on E-learning information systems are relatively low compared to face-to-face education; a trend that has resulted in a high dropout rate, 10-20% higher than on traditional courses (Ahmady et al., 2018). Such points discouraged policy makers and education providers from dependence on E-learning based programs. As our world increasingly moves online, with remote employment, commercial transactions, medical consultations, and now even the purchase of virtual real estate all conducted virtually, it's become clear that the mode of teaching and learning needs to match the pace of these transitions To ensure this need is to understand the underlying factors which are limiting the adoption of E-learning-based systems. Also, the 2019 pandemic has made it clearer than ever how much potential there is for E-learning, as E-learning emerged as the only practical solution to the effective provision of education material inside lockdown bubbles. Many institutions, however, had a poor experience with E-learning systems implementation and use, and not all institutions are prepared to continue this 'unprecedented educational disruption' longer than 'deemed necessary' (Thorat et al., 2022). The question then becomes, how to best utilise E-learning in the future for students, academics, and educational institutions?

Since the technology was first brought into education, researchers have been working hard to improve the use of E-learning. Voyler and Lord (2000) highlighted three key success foci: i) the students, ii) the instructors, and iii) the IT. Soong et al. (2001) empirically investigated critical success factors of E-learning and showed that the success and failure of online resources are dependent upon the existence / absence, and management of these determinants. Moreover, it is advised that for institutions invested in using IT / Information systems to gain benefits of usefulness, sustainability, and high returns, identification and assurance concerning consideration of students, instructors, and IT needs is key. Another study investigated this phenomenon, but from a different facet (Kwofie & Henten, 2011). Using theoretical approaches Kwofie and Henten (2011) have highlighted the possible challenges and issues faced during the implementation of IT based E-learning systems, specifically in the education sector of developing countries. They advised carrying out subsequent empirical studies using key stakeholder responses to validate the existence of these barriers, i.e., so policy makers can benefit from its findings in informed decision making, and researchers can reuse the study instrument to test in different contexts.

Voyler and Lord (2000) outlined the student as one of the key stakeholders of the E-learning system, his / her attitude, motivation, and satisfaction towards the IT / IS based learning solution will determine its success or failure (Basir et al., 2021). Hence it is important that the student perspective concerning E-learning barriers is understood (Ali et al., 2021). Failure to understand the student perspective risks a reduction in student engagement with the system, and either i) a reduction in student success and satisfaction (if system use is mandated), or ii) a lack of acceptance (if system use is not mandated); either way, reducing the value creation and/or return on investment of the E-learning system.

Much evidence can be found in the literature on issues / challenges / barriers hindering the usefulness of information system used in education. Miliszewska (2011) highlighted the need for researchers to investigate issues in E-learning in higher education to ensure the conformance of education via the use of technological components. Sadeghi (2016) mentioned four aspects of E-learning issues – i.e., pedagogy, culture, technology, and e-practice. Esterhuyse & Scholtz (2015) classified barriers to E-learning into 5 dimensions, i.e., lack of resources, infrastructure issues, technical issues, organisation management, and social interaction. Gutiérrez -Santiuste et al. (2016) presented four dimensions of barriers that E-learning students faced – Psychological Barriers, Sociological Barriers, Technical Barriers, and Cognitive issues. Andersson & Grönlund (2009) developed a framework, which proposed four dimensions of barriers as a result of reviewing 60 papers – Course related issues, Individuals related issues, Technological issues, and Context related issues. Finally, Ali et. al (2018) performed a comprehensive literature review (259 papers) and proposed a framework comprised of four categories (Technological, Individual, Pedagogical, and Enabling Conditions) and described a total of sixty-eight (68) E-learning implementation barriers (see Figure 1.1). Technological dimensions consisted of seven (7) barriers, Individual (user / student) dimensions consisted of twenty-six (26) barriers, Pedagogical (teaching methodology) dimension consisted of twenty-eight (28) barriers, and Enabling Conditions (barriers which are non-student facing issues, that potentially impact multiple students facing dimensions, i.e., T, I, and P) consist of seven (7) barriers (see figure 1.1). The TIPEC framework is a detailed and comprehensive framework consolidating 26 years of research (i.e., 1990-2016). Although the TIPEC framework is quite extensive and it has successfully structured the challenges / barriers / issues, however, it is purely based on literature. It has not been validated practically, and no instrument exists till-date to highlight the existence of barriers in a real-world context. The TIPEC framework, however, does assist in providing an ontological foundation for the design and/or development of a set of practical instruments (Ali et al., 2018).

It is evident that academics and implementation practitioners need strategic management of antecedents of E-learning system failure issues / challenges to resultantly increase the success of E-learning system. Studies considering categories of barriers have grouped failures into three such domains, i.e., barriers related to the component of technology, barriers related to the component of user / individual, and barriers related to the component of teaching methodology. Existing details also identified a lack of structured measuring instruments to identify and subsequent management of such challenges.

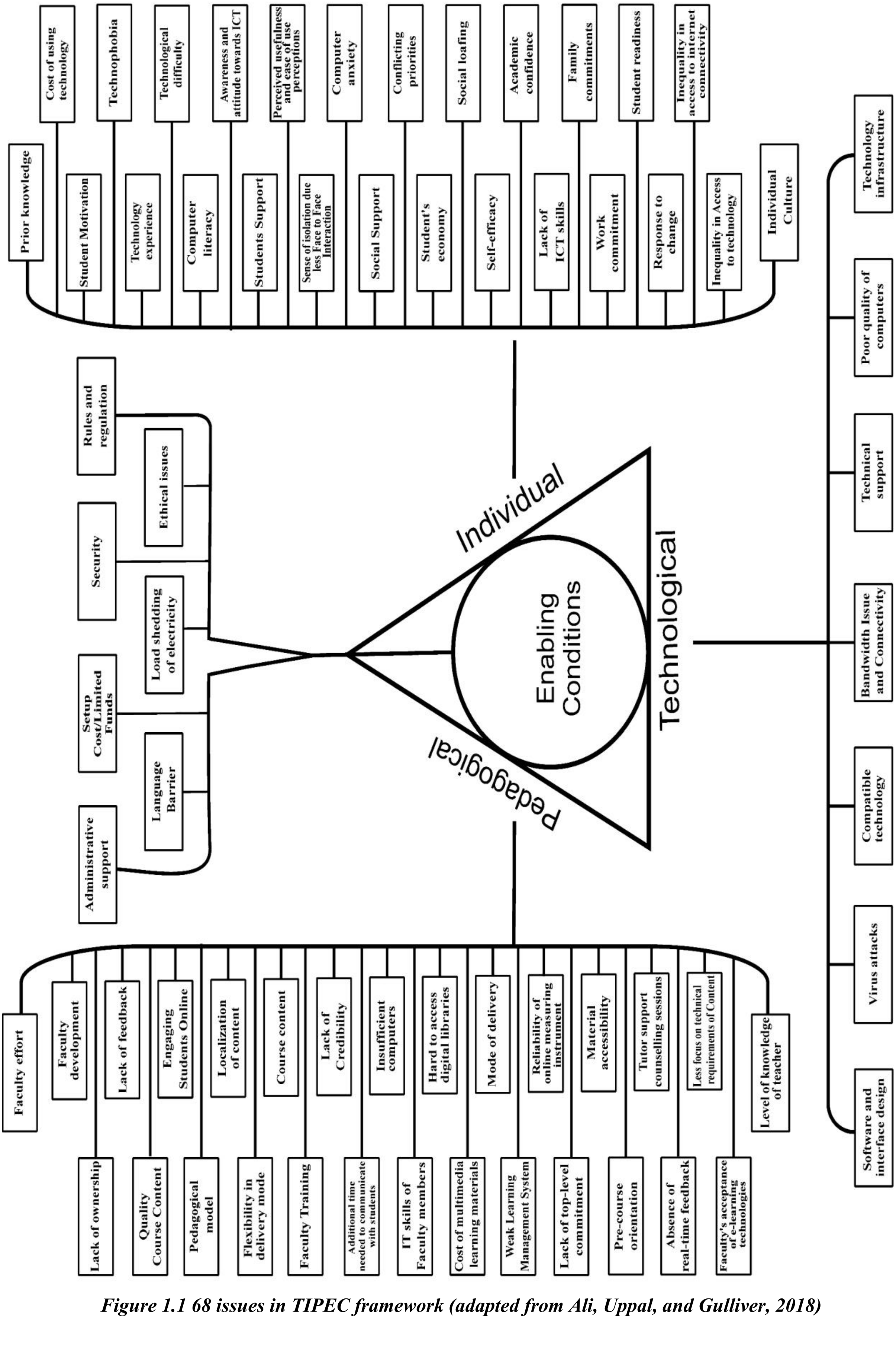

Figure 1.1 68 issues in TIPEC framework (adapted from Ali, Uppal, and Gulliver, 2018)

Development of such instruments would act as the diagnostic tools in the management of E-learning barriers / challenges / issues and increase the probability of making IT / IS based system work in a learning environment. If such an instrument could be quantitatively tested and validated, it would support implementation practitioners in the pre-emptive identification of problems potentially before implementation of system occurs (Ali, Uppal, & Gulliver, 2018). With this in mind, it is eminent that we need to be aware of the barriers / issues / challenges whilst planning, or at least during the implementation of E-learning systems.

1.2 Research Aim, Question, and Objectives

To define the question, a detailed review of the literature will be conducted (see Chapter 2). Within this review, the researcher aims to i) highlight and justify in more detail the importance of IT-based learning solutions, ii) the existence of numerous challenges / barriers / issues that have been identified in technology-based learning solutions, and iii) the need for an instrument to support the practical identification of barriers / challenges / issues as part of the information system-implementation process.

The importance and advantages of incorporating technology in learning are quite evident (see Chapter 2 – E-learning Benefits). Unfortunately, several problems and impediments impede the implementation of E-learning systems. Individuals' resistance to change, lack of familiarity with technology, teaching modules lacking in quality and depth, and technical issues (e.g., complex interface, internet access, etc.) are just a few of the impediments (for detail see Chapter 2 – Cases of E-learning). These challenges/barriers can have a detrimental impact on individuals (learning, performance, satisfaction, motivation, etc.) as well as on the institutions. The pandemic has also revealed the urgency and importance of removing the barriers to E-learning for educational and training institutes. They should act quickly and effectively to incorporate IT / IS support components into their courses, training modules, and/or degrees. Otherwise, they risk losing the satisfaction and trust of their students, who expect to have high-quality, interactive, and easy access to the learning materials and resources in the current situation. (Hassan, 2022).

Efforts have been made in the technology management context to increase the adoption of technology-based learning modules. A lot of research has been done to understand the antecedents of E-learning, which are the factors that affect how people adopt, use, and benefit from technology-based learning. These factors include technology adoption, service quality, and success factors. However, there is a gap in the literature on the identification of E-learning barriers, which are the factors that prevent or reduce the effectiveness of E-learning. Some researchers have proposed frameworks to conceptualise and categorise the barriers to E-learning, such as the challenges of the E-learning framework by Andersson and Grönlund (2009) and the TIPEC framework by Ali et al. (2018), among others (see Chapter 2 for a detailed review of these frameworks). However, these frameworks have some limitations, as they are mostly based on theoretical assumptions and/or qualitative data, which makes them difficult to test and validate in practice. Thus, the argument concludes that to increase the probability of technology-based solutions being successful, it is essential that the implementation team should investigate and include consideration of challenges / barriers / issues impacting the implementation. This can only be made possible if the implementors and practitioners are equipped with a diagnostic tool / instrument that can help them i) recognise the prominent challenges / barriers / issues, ii) devise strategies to remove the identified challenges / barriers / issues.

Based on the rationale presented above, the current study aims to provide a structured and quantitative instrument that will act as a tool to appreciate the challenges/barriers/issues in IT/IS based learning modules, projects, and/or institutes. As a result, the current study will answer the research question.:

How can E-learning practitioners identify, prioritise and manage the challenges / barriers / issues which hinder the implementation of IT based learning solutions? Furthermore, what are the possible challenges and their categorisation that hinder IT based learning?

1.2.1 Research Objectives

Pertaining to the research question and aim presented in the previous section, the following objectives are set to answer the postulated problem:

1. How to remove the factors causing hinderance in the implementation of IT / IS based learning solutions? To answer this, a systematic literature review of the existing studies and models of E-learning implementation barriers will be conducted. In doing so, it will help in the development of the background on the topic and appreciating the existing research on the barriers.
2. Consistent with the first objective, the second objective is to select a suitable framework for barriers to implementation. Much evidence in the literature exists on the challenges / barriers / issues related to technology-based solutions. Challenges related to i) technology (Quaicoe & Pata, 2020), ii) user / student (Jiang et al., 2021), and iii) pedagogy/teaching methodology (O'Donnell et al., 2015) in E-learning are the most important and emphasised domains. The framework will be selected based on the incorporation of these three sets of challenges.
   2.1. Development, quantitative validation, comparison, and finalisation of an instrument that will help the E-learning practitioners in the identification of barriers related to the technological component of E-learning (RO2,1).
   2.2. This sub-objective focuses on the user of the E-learning system. It will involve development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to user / student / learner / individual of E-learning (RO2.2).
   2.3. This includes the development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to the pedagogy of E-learning (RO2.3).
3. Subsequently, after the selection of a framework providing the theoretical underpinning for the research question, the next objective will be to design a questionnaire based on the conceptual framework that covers all the relevant aspects (T, I, P) of E-learning barriers and to test its reliability and validity using pilot testing.
4. After the pilot testing, the next objective is to administer the questionnaire to a large sample of E-learning users (e.g., students) from different educational institutions to analyse the data using Structural Equation Modeling (SEM).

5. The final objective will help us identify the existence of E-learning barriers in each Technological, Individual/User, and Pedagogical dimension.
   5.1. Investigation of technology related barriers will assist the policymakers / researchers / system implementors to have a yardstick to identify the technology related barriers. This will eventually help them to i) make a system that is easy to use, ii) compatible across platforms, and iii) allow the management to overcome shortcomings in IT / IS infrastructure. After drawing from a detailed review of the literature on student / learner related E-learning system barriers / challenges, a simplified list will be presented.
   5.2. Understanding individual / user barriers can help content providers focus on contextually relevant challenges / barriers / issues directly effecting the E-learning users / student experience. This will not only help them identify the user related problem but also assist in the management of psychological difficulties like peer-pressure, counselling needs, cultural issues, etc. students / users face. Eventually, the E-learning practitioners will be able to better address the user centric issues and create a user-friendly environment for learning.
   5.3. Barriers related to pedagogy will be considered in order to identify whether a list of question items can be formed that then can be applied in real-life projects. Empirical validation of these barriers will help the instructors, course developers, and institutes to design a module, enriched in terms of content quality as well as well-suited for any mode of teaching (i.e., face-to-face, virtual, or hybrid). This will not only aid in the successful implementation of IT / IS but also help ensure the conformance of quality teaching and learning.

1.3 Research Method

To test each of the objectives, an appropriate methodology is required to i) develop relevant constructs (with their measuring items), ii) operationalise the instrument, and iii) provide a demonstration of the instrument's reliability and validity. First, the relevant barriers need to be converted into measurable / testable instrument items, i.e., in order to employ empirical observation through a structured survey using a deductive approach (Petticrew et al., 2013). The aim is to aid the identification of the existence of IT related challenges / barriers / issues. Ideally, barriers will be identifiable, by having a structured set of questionnaire items.

Accordingly, item generation is considered to be a very crucial factor to develop a reliable structured survey research instrument (Glass & Arnkoff, 1997), which will be achieved in the following manner: i) a detailed thematic and literature review will be conducted to generate the items for each barrier related to the respective category, ii) each item statement will be developed after careful scrutiny of the recent literature relating to each of the barriers, and ii) the initial question items will be subjected to expert judgment for effective refinement, i.e. redundancy, content validity, clarity, and readability, and finally iv) the resultant set of items will be used as part of a survey questionnaire, which will be employed for data collection after preliminary validation.

1.4 Data Collection

The research was carried out in Pakistan, which is a developing country, so some of the findings and discussions may be incomparable to studies conducted in WEIRD (Western, Educated, Industrial, Rich, Democratic) nations; thus, impacting access to facilities, infrastructure, and/or people with specific cultural traits or skill behaviours, etc. The overall results, however, will be deemed reliable if an appropriate sample is applied, and the generalisability of the results, i.e., the implication and application of the question instruments are validated if the process is in compliance with rigorous statistical parameters.

1.5 Organisation of the Thesis

There are seven chapters in the current study, here is a brief discussion concerning what is discussed in each chapter.

Chapter 1: The current chapter presents a brief background to the study domain and the motivation for conducting the research. This chapter also presents the research, questions, aims and objectives, and – at an abstracted level – how the researcher believes that these objectives will be achieved. Finally, the structure and brief introduction of all chapters is mentioned.

Chapter 2: This chapter provides a detailed review of the literature. Moreover, chapter 2 explains and provides literature-based evidence to justify the research problem, aim, and objectives from the literature. The chapter covers literature concerning importance of education in the development of society, technologies in education, E-learning and higher education, benefits, and case studies (i.e., both failure and success), opportunities and challenges for E-learning, and consideration of E-learning implementation barriers. Moreover, chapter 2 includes a critical discussion concerning categorisation of barriers, which leads us to identify a need to develop an instrument for the E-learning barriers identification in real-life implementations, i.e., the formulated research question, aim, and objectives.

Chapter 3: In chapter 3, the researcher considers the research methodology, using Saunders' onion to provide a theoretical and critical justification of the selected research philosophy, approach, research design, strategy, construct development and measurement, sample selection, data collection, and data analysis techniques used in the thesis. The methodology chapter will be followed by the experiments for three outlined research aims and objectives. Results and findings for RO 1, 2, and 3 will be presented in Chapters 4, 5 and 6 respectively.

Chapter 4: This chapter will address research objective 2.1, which is to develop an instrument to critically test the barriers related to the technological component of E-learning systems. It presents the first paper submitted as a fulfilment of the current thesis. The paper begins with the background of technology in society, and its role in development, followed by a debate concerning the role of technologies in teaching and learning, and the opportunities that it offers Higher Educational Institutions (HEIs). Literature defines the advantages that if applied successfully, the use of relevant IT systems can provide to HEIs. Poor consideration, or application, however, can result in risks that if not managed, can result in failure. Accordingly, there is a need to evaluate and manage any existing technological barriers that hinder E-learning projects. As such, the paper presents the systematic development, implementation, and validation of an instrument to highlight Technological barriers; for practical identification and management of technology barriers by researchers / practitioners / implementors / project managers, etc.; thus, achieving the research objective 2.1.

Chapter 5: This chapter will address research objective 2.2, i.e., highlighting the need to assess the individual / student / user-related challenges / barriers / issues that one might face when implementing an E-learning project. Chapter 5 presents the second paper submitted as part of the current study. The paper starts with the debate on the impact of barriers on education delivery via technologies, and arguments that consideration of individual/student level issues is critical to student acceptance and engagement with online education and E-learning systems. Later sections layout the methodology to develop, test, and validate the need of user / individual related barriers / challenges / issues. Considering the student perspective, not only suggests a more simplified theming of Individual barriers but will also provide an empirically validated questionnaire that can be used as an instrument to highlight the individual barriers to students in any future and/or existing E-learning IS implementation. Thus, achieving the research objective 2.2. This paper is published in the International Journal of Educational Management (IJEM), volume 35, issue 6.

Chapter 6: This chapter will address research objective 2.3, which relates to developing and validating an instrument to identify challenges / barriers / issues related to teaching methodology (pedagogy) factors – i.e., concerning teaching and learning content and approaches. It contains the third, and final paper presented as part of this research. Like the previous two papers, this paper also starts by considering the importance of technologies in teaching and learning pedagogy. Entailing the significance of pedagogical factors like quality of e-teaching material, faculty expertise, interactivity of the materials, etc. if not aligned with user / student requirements will end-up in failure of learning and IT or information systems. Finally, research objective 2.3 will be attained by developing and validating constructs and statements for the twenty-eight (28) pedagogical barriers.

Chapter 7: This chapter will summarise the discussion, findings, and conclusions contained in the three papers presented in chapters 4, 5, and 6. It will also critically consider the theoretical, methodological, and practical contributions of the research, i.e., both implications and applications. Research recommendations based on the limitations of the present study are mentioned at the end.

Chapter 2
Literature Review

2.1 Introduction

To develop the reader's understanding of the research question, aim, and objectives, this section provides the reader with a summary of relevant background literature, i.e., in order to highlight the importance, challenges, and need to develop an understanding of E-learning implementation barriers as stated in chapter 1.

The researcher starts the chapter by introducing the primary role of education, followed by literature concerning different levels of education, and the difference with reference to countries. The importance of higher education and discussion concerning the modes of delivery of education is presented, which leads the reader to consideration of the benefits of technology in the higher education sector. Despite numerous E-learning challenges, to promote a culture of learning and innovation that can adjust to the shifting requirements and expectations of the global market, it is also vital to work on removing obstacles to E-learning. The last section of the chapter examines and considers how practitioners might be able to identify and manage E-learning barriers -forming the thesis research question and aim.

2.2 Education and Society

Mankind's insatiable appetite to understand the world around him has iteratively resulted in the most developed and civilised era in history. The wisdom and knowledge passed down, generation after generation ensures that advances in an increasing range of topics (e.g., ethos, medicine, geography, astronomy, engineering, etc.) are compounded with every passing generation. The bequeathing of knowledge and skills is core to the education of the recipient of knowledge. In 500 B.C., Socrates was among the first teachers/instructors to discover the principles of, and systematically implement, a structured approach to teaching and learning (Adler, 2000). Smith (1987) states that attaining wisdom, principles, skills, and habits through an organised method is referred to as Education. Haffenden, (1987) defines education as an "organized programme of learning experiences". Irrespective of the definition, the systematic transference in the wider population leads to prosperity and preparedness of individuals, and the society as a whole, towards a better and brighter future (Freedman. 2001). The opportunity and access to effective mentoring, education, teaching, and learning are recognised as a basic right of every human being (Susanti & Sari, 2021). Moreover, the character, values, and beliefs that society and its population hold dear are determined by the nature and level of literacy / knowledge / education acquired by the population (Beare et al., 2001). Due to this fact, human capital development and the economic, technological, and moral uplifting of a nation are closely linked with their education (Van Gameren & Hinojosa, 2004).

A higher percentage of educated persons in society also plays a very significant role in increasing moral values (Iipumbu, 2021) and socio-economic development (Chingono et al., 2015). Societies are made up of individuals, however, the collective well-being of the citizens or individuals contributes to the development of a nation and country. Well-being is not only related to financial prosperity, but education also augments the character and moral development alongside the economic wealth of the nations (Markley, 1990). Resultantly, high moral values nurture an environment, which aids in fostering personalities with strong character. A nation or country having individuals with a strong character is capable of producing leaders and visionaries capable of managing the resources for the benefit of citizens (Galston, 2004).

Evidently, the development of an individual is achieved through education, which leads to uplifting the economic condition of any nation. Adam Smith was the first person to emphasise the importance of human capital development in the development of economic growth (Smith, 1776). Vila (2000) explains the economic value of education by identifying the individual or group of beneficiaries of education. Students and their families are the groups of individuals, which are the direct proponents benefiting from the education system. Economists believe that investment in increasing the average individual's education level will result in an increase in the average earning, and therefore result in improvement in the general standard of living (Nadrag, & Mitran, 2011). As students complete each level of education, they tend to have better occupational opportunities. It opens new horizons for students and their families (Vila, 2000).

Thereupon, economists and educational researchers have reported a significant relationship between different stages of formal schooling and employability. Belfield et al. (2018) highlight the effect of educational attainment on the per capita income of developed and developing countries. Different stages of education have a significant role on the per capita income of the countries. Countries with higher per capita income were reported to have a high level of education (i.e., tertiary education) compared to countries at a lower stage of schooling (Belfield et al., 2018).

Considering the role of education in the uplifting of individuals, society, and nations, and that uplifting is key to long-term welfare and prosperity. Education level is commonly measured by the number of years spent in schooling or the highest level of education completed (Wheeler & Pappas, 2019). Dekker and Sibai (2001) explain three types, first type is primary education which is usually from the first grade of schooling till the eight (I-VIII). The second type is secondary education, which is from IX-XII, in some cases, it is also sub categorised into secondary school certificate (SSC) (IX-X) and higher secondary school certificate (HSSC). And the last type is "Tertiary education", also referred to as "Higher Education", which includes university education offering undergraduate and post-graduate programs. Every level of education plays a distinct role in elevating student education and/or supporting economic growth, however effective access to tertiary (i.e., higher) education is deemed to be most important in socio-economic growth (Tekgüç, et al., 2017); i.e., due to higher education institutions' ability to prepare an individual with the appropriate skills for future job requirements. Moreover, people having tertiary education have higher earnings, compare to those who do not (Belfield et al., 2018). In times of radical change in research, technology, and global competitiveness, there is a strong need to encourage the younger population to pursue higher education for economic success and elevation of human capital (Siriopoulos & Kassapi, 2019).

2.3 University Education

Traditionally, however, higher education has only been available to a selected few, due to issues of affordability and resource availability (Mills, 2012). Moreover, the formation of higher education institutions (HEIs), and the drive for knowledge acquisition, were pervasively linked to the understanding and/or spreading of spiritual / religious messages; and supported by a structure of Monasteries in the Middle Ages. In the 13^{th} century, however, the focus of

HEIs started to change with the development of several secular institutions dedicated to the teaching and learning of mathematics, geometry, astronomy, music theory, grammar, logic, and rhetoric (Dou & Knight, 2014). In the UK, for example, 2.28 million people are enrolled in higher education, studying at the 169 higher education institutions registered with the Higher Education Statistics Agency. Currently, there are over 30,000 universities worldwide, training over 250 million higher education students per year; yet this is expected to rise to 594 million worldwide by 2040. The increasing demand for higher education – particularly the training of medical specialists, engineers, administrators, scientists, instructors / teachers, and managers (Roberts & Ajai-Ajagbe, 2013), places a growing pressure on leading universities to provide an increasing number of graduates who possess the relevant skills and knowledge that allows them to contribute to business and society (Tinoco-Giraldo et al., 2020). Universities are being pushed to adapt to the ever-changing dynamics of the industry and society, i.e., by changing the focus of the content, use of infrastructure, and teaching methodologies (Bakhru, 2018; Aljabre, 2012). Furthermore, along with the structural and market need changes, HEIs need to expand or adapt in order to accommodate the increasing number of students requesting their service.

To respond to this demand, HEIs have been incorporating different modes, methods, and technologies, to deliver education to larger numbers (Hughes & Stanton, 2006). Modes of learning have been divided into three (3) types – i.e., face to face, online, and blended learning (Reid & Wilkes, 2016). Face-to-face learning is also known as traditional learning, as the name infers, in this mode of learning instructor and learner are present physically in one place. Since the beginning of education, traditional learning is the oldest and is adopted by most institutes around the world. Face-to-face mode of learning is the most familiar form of learning, however, it lacks the flexibility of time and space (Wu et al., 2013). In contrast to traditional learning, the second mode of learning allows the ubiquitous delivery of education without the constraints of physical presence. Online learning has many names, e.g., distance learning, digital learning, technology-based learning, or E-learning – in short use of technology to deliver education at student's doorstep. E-learning has many benefits as well as shortcomings which will be discussed in the coming sections. Third and last type of mode is blended or hybrid learning, which incorporates the components of technology in traditional form of learning. Use of technological components in hybrid education includes, but is not limited to projectors, tutorial videos and recorded lectures, etc.

Traditionally, dissemination of knowledge, skills, beliefs, and values was achieved via in-person face-to-face delivery, which is the most common and conventional method of instructor-led teaching. Although familiar and comfortable for both instructors and learners, such learning supports primarily passive learning for those physically able to gather students in classes / labs / seminars. Invention and development of supporting information technologies, provide HEIs with the opportunity to transfer courses 'online', however, the extent of use has varied between institutions depending on the institutions' strategic goals. Some HEIs have embraced the use of fully online learning / remote / distance learning models, some HEIs have used online technology solutions as part of a hybrid / blended learning model, and some institutions and / or academics refuse to engage with online solutions completely.

For example, the University of Namibia, which initially deployed an M-learning system in a Mathematics course. However, this resulted in a low student pass rate. University management responded by utilizing a blended platform and comparing its results to those of the M-learning system. The final comparison showed that the blended module had a higher pass rate than the M-learning system. (Ntinda et al., 2014). The Technical University of Madrid faced with the challenge of an increasing dropout rate and low grades, over the course of five (5) years (2003-2008). University management decided to experiment with blended and E-learning approaches. Students were given the option to choose between blended and E-learning modes of study. Results of the study showed a non-significant difference in the grade of students who opted for blended learning and those who opted for E-learning. However, mean grade of blended learning students was greater by 5.67 than the mean grade of traditional learning students (Alonso et al., 2010).

Another project in Thailand was undertaken to design an E-learning learning management system (LMS) module to increase the knowledge of farmers. Free open-source learning LMS was designed to educate the farmers. The results of the user feedback reported positive satisfaction, as the platforms enable self-paced learning (Chunwijitra et al., 2017). Schlenz et al., (2020) investigated the case of E-learning implementation in the Justus-Liebig-University Giessen (Germany) during the COVID-19 outbreak. Students and faculty members were found to have a positive perception towards the use of technology components in learning.

Researchers further pointed out the fact, that before the implementation of the technology-based learning, it was ensured that every student and faculty member have the required equipment and fast internet connection to receive and deliver education.

Higher education institutes have clearly been investing to use the information technology (IT) based solutions to teaching and learning. A mixed set of failure and success cases have been reported in the literature, which signifies the need for an in detail exploration of the use of technology in higher education.

2.4 Technology in Higher Education

A global transformation in education has been facilitated by the rapid advancement in science and technology and driven by demands to adapt market offerings to align with the needs of an increasingly diverse range of learners. Technological transformation has i) demanded a complete overhaul in the use of Higher Educational Institutions (HEIs) organisational structures and practices; i.e., to remain competitive in an increasingly customer driven market; ii) resulted in HEIs increased relying on the collection, processing, and analysis of student information to support strategic decision making, i.e. to achieve the current and future opportunities; iii) resulted in a change towards graduates gaining more hands-on experience instead of receiving didactic learning; and iv) supported changes in graduate employment expectations, i.e. graduates will increasingly make use of, and be comfortable with, the latest remote working online tools (Broadbridge et al., 2007). Ubiquitous mobile working facilitates flexible working, yet the resultant global employment marketplace has empowered employers to take an increasingly casual attitude toward employees (La Touche, 2016). Remote working, non-core outsourcing, and the use of short-term contracts have all compounded a shift in employee expectations, i.e., from a 'job for life' towards a 'series of jobs' for life. Employers are now seeking to employ the best person on offer, so there is an increasing need, in both developed and developing worlds, to engage in through-life-learning. Although graduates are aware of the demands and high expectations from them, yet educational institutions are struggling to adapt to this change (Lewin & Lundie, 2016).

Organisations are demanding that staff are increasingly adaptive, responsive to change, and willing to reshape and adapt dynamically as new technologies and tools present themselves.

Moreover, face-to-face learning might be ideal for full-time students, yet dependence on face-to-face is practically impossible for part-time, distance, and/or professional learners who have left full-time education (Saleem & Gouse, 2018). Technology / web-based E-learning is therefore increasingly being used as the platform for learning (Hainey, Kelly, & Green, 2017). E-learning offers itself as a solution to help mediate life-long learning (Gillet, 2013). The increasing use of information systems (IS) and technology (IT), especially via the world wide web, has been widely recognised as the future medium of choice for network-enabled transfer of skills, information, and knowledge in universities.

Information System (IS) / Information Technology (IT) based solution to learning has been termed as E-learning, distance learning, technology-based education, remote learning, virtual learning, blended learning, and/or web-based learning, was characterised by its usage of internet, in any form, to support teaching and learning activity. E-learning is the most used and considered more broader terminology whenever the use of technology in teaching or learning is considered (Lee et al., 2009). Despite the wide usage of concept, there seems to be no consensus over a single definition of E-learning (Beldagli & Adiguzel, 2010). Khamis, et al., (2002) proposed that E-learning was "the process of using electronic technology to map the traditional teaching and learning activities in an educational process where the instructor and the students are geographically separated. Lee and Lee (2006) define E-learning as "learning facilitated by the use of digital tools and content that involves some form of interactivity, which may include online interaction between the learner and their teacher or peers." Manochehr (2006) stated that E-learning related to "individualised instruction delivered over public (internet) or private (intranet) computer networks is E-learning". Balaji et al. stated that E-learning relates to "instructional content or learning experience delivered or enabled by electronic technologies" (Balaji et al., 2016). Igbokwe et al. (2020) state that E-learning is "a learning approach that is centred on the use of electronic technologies to teach, learn, and regulate educational activities in an online environment".

In summary, the use of any technological component in learning / teaching activity, be it of any type (hardware or software, internet) is considered a part of E-learning. However, E-learning is sub-categorised as being either asynchronous or synchronous (Dash, 2016). Asynchronous learning is often referred to as self-paced learning, since it uses E-learning technologies to disseminate learning material at distance and is not bound by the dimension of time (Picciano, 1998). Due to the 24/7 access to material, asynchronous learning courses have limited interaction with the instructor and/or other participants; since there is no guarantee that other individuals will be available at regular or specific times. Learners are provided with preprepared course material, which might use a range of recorded media and tools (e.g., video, online streaming platforms, emails, blogs, smartphones, databases, e-libraries, audio/video players, podcasts, etc.) Learners on asynchronous programmes have considerable flexibility, since students can set the pace of learning to match their schedules. One of the key disadvantages of asynchronous learning, however, if the programme has not been automated, is the delay that can exist in provision of feedback. Synchronous learning uses computer-based and/or E-learning technology solutions to support live but remote 'distance learning, i.e., where the instructor and learner are in different locations but are available and/or interacting simultaneously (Motycka, et al., 2013). Literature highlights, however, that asynchronous learners face issues including i) a sense of seclusion, and ii) frustration concerning limited support, feedback, and interaction. Synchronous learning is increasingly being conducted using videoconferencing software, audio calls, learning management systems (LMS), web conferencing etc. Synchronous learning takes place without any physical interaction between instructor, learner, and other participants. Use of virtual classrooms removes the problem of owning and maintaining an increasing number of dedicated teaching spaces, as all teaching is done virtually. Moreover, unlike asynchronous learning, synchronous learning allows significant interaction, personalisation of content delivery, and prompt feedback. Video-conferencing and other interactive platforms are used to support synchronous learning support interaction for both instructor and peers in case a problem occurs.

In addition to flexibility of learning and teaching methodology, use of technology has also helped reduce the reliance on live face-to-face human involvement in administrative processes. Due to the availability of online technology, there is a reduction in the temporal and/or workload complexities faced by HEIs in administrative processes like registration, fee submission, timetable etc. E-learning programs pupils reported positive: higher peer-to-peer and instructor-learner engagement (Brook & Beauchamp, 2015; Lawn et al., 2017), higher quality learning content (Ince, 2022; Mtebe & Raisamo, 2014), access to more reference materials (Balkan, 2001), greater satisfaction (Salem & Salem, 2015), and more affordable (per head) delivery (Goyal, 2012). This poses the understanding of the benefits that E-learning instils.

2.5 E-learning Benefits

Web-based technological advancement has led to a revolution of change in numerous aspects of human life, including, but not limited to manufacturing activities, medicine, construction, communication, travel, and education (Siddegowda & Devi, 2021). E-learning offers HEIs many opportunities and benefits to the teaching and learning domain (Traxler, 2018). Previously, the influence of traditional / face-to-face / physical education was limited by the physical location of the HEI. Incorporation of technological components into teaching and learning is thus essential to the achievement of learning goals (Middleton, 2010). With the introduction of E-learning technologies, HEIs are now able to provide learners with the following benefits:

- Instructor led and classroom-based programs cost more (per head) when compared to E-learning programs (Gill, 2003). The cost is often linked to the fact that face-to-face learners require access to a physical infrastructure that can accommodate the maximum number of students. Physical room sizes, and timetabling, are the significant factors limiting the number of students that can register on a single programme. Dependence on a physical campus requires a significant upfront investment of resources, e.g., building and/or maintenance of new buildings, classroom equipment, support staff, etc., which results in a considerable cost overhead for each learner (Ali, 2017). Although E-learning programmes have a potentially upfront cost, E-learning programmes allow i) the institution to reach a global market of learners, resulting in ii) a much larger number of students per cohort – resulting in a deduction of the cost of per-student delivery (Furukawa & Shi, 2011).
- Accessibility of students to learning materials is one of the main advantages of E-learning. For example, a shift to e-resources and repositories has brought instant access to most library materials, i.e., into the palm of the hands of reader/learner anywhere at any time (Sackstein et al., 2019). Not needing to go to university, or public library, to get the reading material in order to do the assignment or project has really helped the learners and positive perception of online learning (Jhaveri & Pareek, 2020).
- Reach of information and education, especially in remote areas, helps to overcome traditional geographical constraints. This point is enforced by the compatibility of E-learning platforms with smartphones. Almost anyone anywhere, with access to a smart

mobile device and a reasonable internet connection, can now access higher education material.

- E-learning also offers a great opportunity for those in work looking to i) enrol in higher education programmes or ii) undertake life-long career progression or personal development. Particularly asynchronous E-learning based programs offer the flexibility (both time and place) to support continued studying whilst working.
- Online counselling is cost effective, helps graduates to remotely gain support and provide the learner expert support without the physical constraints. Online counselling sessions can also be arranged with engaging expert support in case of special needs e.g., related to career (Pulist, et al., 2020) or psychological issues (Dimri, 2021).
- Online social media forums and platforms support learners who wish to interact with a wide range of learners with the same interests, levels and areas of study, irrespective of the physical location of the users. Furthermore, online forums, unlike face-to-face learning, do not just restrict the size of the learning cohort. Accordingly, students get to interact with potentially, if designed appropriately, a wider range of people with similar interests working in all parts of the world.
- This limitless network of peers also give learners the opportunity to share their art, work, and projects, thus helping them to showcase and get feedback from a wider worldwide audience.
- E-learning brings education to the learner’s doorstep. Whilst reducing the cost of transportation and parking, and reducing the carbon footprint of travel, some might argue that this is offset by the cost of purchasing and running appropriate computer-based devices.
- Learners unable to attend face-to-face programs, e.g., due to health conditions and or special needs, benefit from access equity within E-learning programmes.
- IT based solutions assist institutions and instructors to overcome the language barrier in the course material. The technological component has allowed the real-time translation of the content materials in any language (Kim, 2020).
- Using technological components allow the instructors to develop interactive course material. Interactive material can be developed in the form of text, video, animations, and call to action elements. This form of content increases learner engagement and helps effective delivery of knowledge (Shukla & Pal, 2015). Support of interactive content also supports creation of quality material for students with special needs.

- Many institutions' E-learning based systems are used to support face-to-face learning, e.g., use of a learning management system (LMS), which is a system used to deliver and manage instructional content, identify, and assess individual and organisational learning or training goals (Salem & Salem, 2015). Moreover, E-learning solutions have been used to track the progress of students toward the achievement of goals, collect and present data for the supervision of the learning process of an organisation as a whole (Salem & Salem, 2015).

Summarising the benefits and usefulness, E-learning solutions involve either a single or a combination of hardware, devices, software, applications, management systems and/or platforms (Ali et al., 2021), which are used to support the capture, storage, processing, and editing, sharing, presentation and personalised dissemination of information to student and staff users. Technology has enabled higher education institutes to compete internationally, improve the smooth running of administrative functions, improve faculty skillsets, and prepare and support remote graduates with ongoing lifelong training to meet industry changing needs (Sadeghi, 2019).

Despite many advantages and opportunities that IS / IT based solutions bring to the higher education, E-learning solutions failed to deliver the expected results (Ahmad, 2021), technology-based learning was traditionally not the first preference of the institutes, employers, and the students (Parlakkilic, 2013). Lack of confidence of different stakeholders towards E-learning was due to the content quality (Carter & Salyers, 2015), data security (Arkorful & Abaidoo, 2015), lack of motivation among students (Price, 2009), and low employability (Phutela & Dwivedi, 2020), to mention a few.

2.6 Cases of E-learning

Since the very beginning, efforts have been made to assess the efficacy, impediment, and/or acceptability of technology in learning and teaching, for example: i) Muyinda, et al. (2010) conducted a study investigating the effectiveness of using a mobile learning (i.e., m-learning) platform at the Makerere University. The result of the study states that there was positive attitude toward the use of M-learning platform for research supervision and lecture delivery. However, a lack of proper infrastructure, supply of airtime credit, and limited prior knowledge of the instructor and other students are issues that need to be addressed to make m-learning gain its promised benefits (Muyinda, et al., 2010); ii) Bhalalusesa et al., (2013) stated that, despite the efforts, resources and support provided by the Open University of Tanzania (OUT) to make E-learning management system (ELMS) successful, there are many factors that hindered their implementation success. Factors included; attitude of academic and non-academic staff, lack of training, slow response of LMS outside campus, internet access, and compatible learning materials were the most reported issues related to ELMS. iii) Lai et al., (2012) carried out research at Hong Kong University, and highlighted that the ultimate usage of an E-learning system is dependent upon a) compatible technology, b) teaching and learning style, and c) support from instructor and peers; iv) Munyangeyo (2009) conducted a survey-based study to understand problems in web-based learning programs in a UK university. Findings show that structure of programs, learners' perception, time allocated to develop technology compatible material, poor delivery, and appropriate access to resources are the major challenges to project success (Munyangeyo, 2009); v) Shemahonge & Mtebe (2018) showed that, in Africa, the enrolment rate in E-learning based programmes is very low when compared to traditional learning programs. 75% of institutes used E-learning to support their taught programmes, yet less than 7% of universities in sub-Saharan Africa pre-covid had invested in such solutions (Shemahonge & Mtebe, 2018) suggesting that facilitating conditions, particularly linked to budget limitations, play a significant role in E-learning solution adoption; vi) existence of poor infrastructure was highlighted by Ali (2017). The Pakistani administration decided to use E-learning solutions to make education accessible to the entire population. However, the adoption of the E-learning project was significantly impacted by several factors, including: (a) low confidence of learners and employers, (b) poor access to appropriate technology devices, (c) inconsistent internet and bandwidth, (d) social constraints, and (e) power shortages (Ali, 2017).

Notwithstanding COVID-19's growing usage of the IT/IS-based learning system, research conducted in recent years has revealed the challenges' persistence: i) Al-Fraihat et al. (2020) conducted a quantitative assessment of 563 respondents to determine student satisfaction of E-learning systems in the UK universities. Al-Fraihat et al. observed that HEI usage of E-learning was often mandatory, however, that system satisfaction was determined by the quality of E-learning Information System (IS) provision, support related to IS in learning, and social factors (e.g. instructor and learner quality); ii) Marinoni, et al. (2020) showed that, despite increased usage of E-learning based solutions worldwide, there were significant disruptions due to the lack of financial resources, lack of internet access to students, lack of learning material, lack of instructor preparedness, management challenges, practical / technical requirements of course / programs (e.g., laboratories, group practice for art/music). Factors resulted in the interruption in the lecture delivery, with some HEI temporarily putting a complete halt to teaching activities; iii) Mseleku (2020) conducted a meta-analysis of the research COVID-19 concerning E-learning system implementation. Results highlight that, despite the effort of institutes and administrations, a shift towards virtual learning, especially in developing countries, further increased the current gap in societal and educational / literacy, i.e., due to the inequality in the resource availability that exists between rich and poor. Mseleku (2020) pointed out that E-learning solutions are not really suitable for use in science programs, which elevates the dropout rates. Moreover, readiness and a need to train both the instructor and learner are essential, irrespective of field of study. For institutes that already had well-established infrastructures and / or access to the resources required to develop such an infrastructure, no major problems were identified; suggesting that infrastructure and resource provision was critical to E-learning issues; iv) Zapata-Cuervo et al. (2022) collected data from universities in Colombia, South Korea and the United States, in order to examine the factors that positively support learner engagement with E-learning courses. Results show that student level of engagement in E-learning based courses was lower than face-to-face courses. Students also reported that the E-learning programme content was not rigorous enough (Zapata-Cuervo et al., 2022); Finally, Ali (2020) used online conferencing software and LMS (Learning Management System) during the transition between face-to-face and remote learning activities; receiving positive results and feedback. Ali stated that the success was only achieved because students had had pre-covid experience with E-learning systems, which was decisive in attitude formation when E-learning was enforced.

It is quite evident that many of the obstacles and difficulties that were encountered during the deployment of E-learning systems twenty years ago still exist. Technological platforms and information system-based solutions played a significant role in developing countries. Furthermore, during pandemic, E-learning became the sole option for the continuation of learning activities, and overnight educational institutes had to set opinions and policies regarding the use of E-learning programmes (Zapata-Cuervo et al., 2022). As compared to the problems, the potential and opportunities of IT/IS-based solutions cannot be overlooked; thus, they require strategic management and elimination to maximise their potential.

2.7 Frameworks of E-learning Barriers

Literature highlights that E-learning system implementation contains inherit challenges / barriers / themes, regardless of whether the implementation is driven by voluntary or involuntary conditions. These challenges / barriers / themes seemingly remain consistent and continue to recur in cases of failures of IS based E-learning systems, thus an in-depth analysis of the barriers / factors / themes is required. Numerous studies explained the factors that hinder the implementation or the post-implementation success of E-learning systems.

A model of E-learning barriers was proposed by Rubenson (1986) categorised into three (3) barriers / challenges (Situational, Institutional, and Dispositional). Later Garland (1992) extended the model by adding the Epistemological barrier to understand the challenges and perceptions related to the course contents and delivery. Moreover, Garland categorised these four barriers into three focus areas – i.e., Student (including Situational and Dispositional barriers), Institution (including Institutional barriers excluding barriers related to teaching methodology) and Content (including Epistemological and Institutional barriers i.e., related to teaching methodology) for better investigation. Further adding to the work of Rubenson (1986) and Garland (1992), Schilke (2001) added one more category making it a five dimensions E-learning barriers model (see Figure 2.1).

i) Situational (learner/student personal limitations, causing hinderance),

ii) Institutional (problems related to the institutional structure and process e.g., technical support),

iii) Dispositional (personality and behavioural positioning of student/learner),

iv) Epistemological (challenges related to teaching methodologies, learning material, enrolment requirements etc.),

v) Technological (technology related problems like connection, availability of devices, down time, or lack of access to platform).

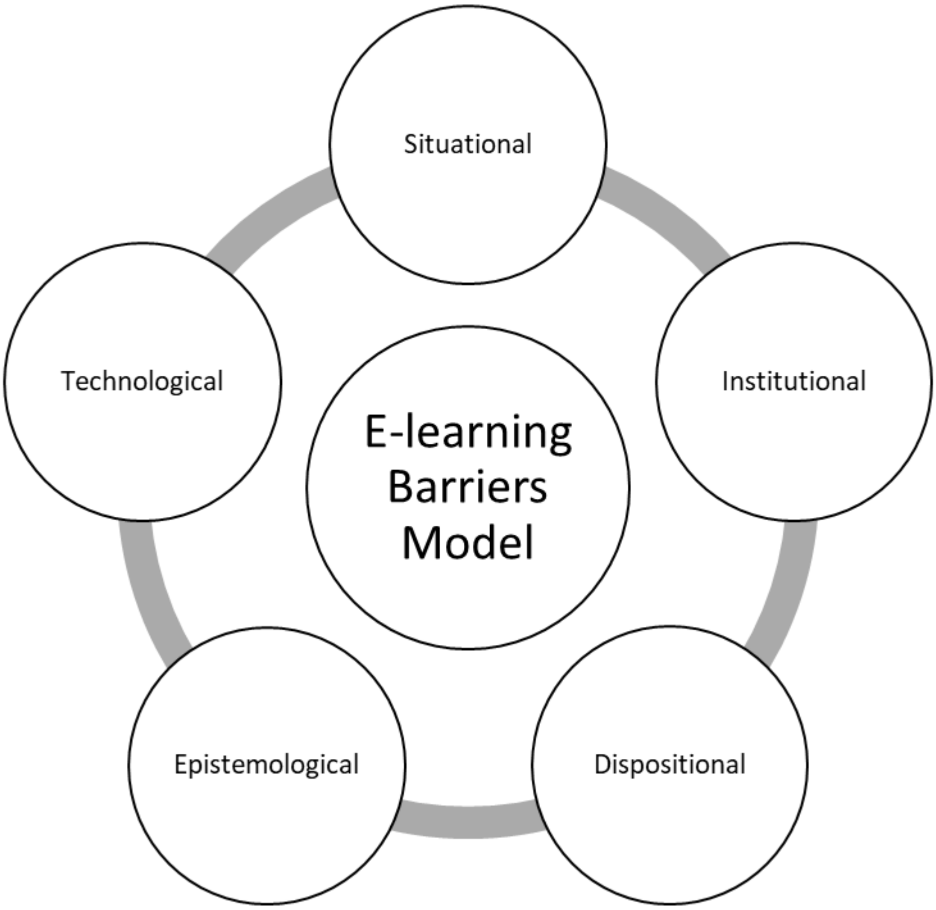

Figure 2.1 Model of E-learning Barriers (Rubenson, 1986; Garland, 1992; Schilke, 2001)

E-learning, being a learner centred approach relies heavily on learner's readiness in IT / IS based learning solutions. Shilke (2001) highlighted the significance of teaching methodology and learner's attitude in E-learning modules is of outmost importance. High quality content provides learner with the right information, and better teaching methodology, ensuring the transference of knowledge. E-learning content and teaching methodology should be improved according to the needs of the learners. Since instructors are the first and only point of contact in learning process. Institutions have bestowed instructors with the responsibility to create the quality, interesting and interactive teaching material. Failing to do leads to the hinderance in learning conformance and negative attitude of learners (Su et al., 2005). And learner's lack of ability, skill, and negative attitude consequently effect the student's overall perception and / or resultant-learning system success (Martínez-Caro et al., 2015).

Ali (2004) covers the argument, i.e., whilst discussing the challenges faced in E-learning system in Open University of Malaysia. By doing so, Ali (2004) was able to categorise seven

E-learning challenges: i) "low adoption (overall acceptance challenges resulting in low adoption), ii) computer literacy and digital divide (lack of IT literacy in remote areas), iii) bandwidth and connectivity (slow or faulty internet connections), iv) awareness (lack of awareness in majority population), v) quality e-content (lack of expertise to develop IS based content), vi) difficulty in engaging students online (lack of self-motivation in students to convert to E-learning based programs), and vii) language barriers (English not the first language)" (Ali, 2004).

Ali (2004) recommended the strategic management of the identified barriers, to fully realise the advantages of technology in learning. Exploitation of the IT components is ensured by appreciating the expectations of the individual (students / users) and ensures that teachers and learners have access to relevant technologies. Author further suggests that the student / user expectation can be managed using individualised learning. Whereas access to required technology is achieved by developing infrastructure, i.e., ensuring that learners and instructors both have the required tools.

Kohn et al. (2010) investigated knowledge transfer among the students, via E-learning in developing countries. As a result of literature analysis of E-learning case studies, Kohn et al. identified three (3) categories of challenges – i.e., Technology, Culture, and Previous Knowledge – consisting of thirteen (13) sub-barriers that are of hinderance in successful transfer of knowledge via E-learning.

The technology dimension relates to barriers linked to hardware or software through which E-learning knowledge content is made possible. Its subdimensions include: a) Infrastructure barriers – old and outdated infrastructure for the E-learning system; b) Technology access barriers – which occur as a result of lack or limited access to the technological device to use E-learning system; c) Internet access barriers – where there is little or no access of internet; d) Maintenance barriers – where there is difficult and high cost of installation or maintenance of technological systems, and includes the lack of support provided for the troubleshooting or debugging; e) Usability barriers – which surface when users face problems in using devices, programs or systems – as complex and less user-friendly interface are the major causes of these usability barriers.

The culture dimension relates to a combination of customs, religious beliefs / religions, traditions, societal norms, beliefs and language of groups, individuals and / or organisations (Kohn et al., 2010), which includes: a) Language barriers – Difference in language of the content or E-learning system results in the language related challenges for implementors; b) Local Context barriers – i.e., challenges faced whilst there is change in certain procedure with which E-learning stakeholders are familiar and accustomed to are local context barriers; c) Social context barriers – Societal, contextual or regional traditions and norms causing barriers in the technological implementation in learning; d) Interaction barriers – which erupt due to interaction with instructors, classmates and administration; e) Religious barriers – Conflicting alignment of E-learning technology with the religious beliefs of the individual; f) Didactical barriers – Barriers that arise among instructor and teacher due to comfort with previous methodologies and / or technologies, which results in resistance from both teachers and students to adopt new E-learning technologies. The previous knowledge dimension relates to barriers dimension refers to the characteristics of user including computer literacy and competence (Kohn et al., 2010), which includes: a) Computer Literacy barriers – which refers to the lack of skills in faculty and students to use the technologies; and b) Competence barriers – which relates to existing or previous knowledge necessary for using, receiving, delivering, and understanding knowledge via E-learning technologies.

Kohn et al. (2010) carefully analysed the case-study based literature to categorise barriers that are reported to cause hinderance in E-learning. The careful categorisation and consideration of actual project results is a noteworthy contribution of the study, however certain elements have been left unaddressed i.e., personality, attitude, pedagogy etc.

Around the same time, Andersson and Grönlund (2009) conducted a literature review-based analysis of E-learning challenges to develop a conceptual framework to define and categorise the key E-learning challenges. The literature review, based on studies published in context of developing nations, considered 278 published articles, however only sixty (60) articles were selected for inclusion in the categorisation of E-learning barriers; i.e. into four (4) parent categories (i.e., Course Challenges, Individual Challenges, Technological Challenges, and Contextual Challenges). Each of the four categories will be expanded below:

Course Challenges relates to curriculum related barriers, which are the most discussed in the literature (Andersson & Grönlund, 2009). Review of forty (40) papers reported eight course related challenges that arise because of issues with taught content and/or support to learner from faculty. These eight (8) barrier definitions are: a) Curriculum, i.e. challenges faced with the need to update and/or develop new curriculum compatible for E-learning; b) Pedagogical model which relates to inappropriate use of pedagogical approaches, and barriers due to shift to learner-centred from instructor-centred approach; c) Subject content, which refers to barriers caused by use of irrelevant, inaccurate, and/or outdated content material that is not in line with latest market needs, which creates challenges in implementing E-learning systems; d) Teaching and learning activities, i.e. E-learning programs that encourages self-study but can leads to problems, as activities incorporated in E-learning programs often offers less/or no interaction with other participants and instructor; e) Localization, which relates to issues caused by E-learning content lacking local, religious, language, and contextual relevance and examples leads to problems; f) Flexibility, which relates to a lack of concern whether or not the learner is able to customise, personalise, and set their own pace to complete the course; g) Students expected level of faculty support, which reflects that E-learning programme student support demands are very different when compared to those in the classroom setting. E-learning learners often demand prompt / timely support from the institution and faculty. Lack of support, or a delayed response, seems to increase stress and ultimate impact on the satisfaction. Support challenges are not limited to students only, it is of equal importance to the faculty as well.

Individual Challenges impact whether a specific individual can connect with the programme. Andersson and Grönlund (2009) analysed 32 papers and identified eight (8) student / learner challenges and four (4) teacher/instructor challenges. These were: a) Motivation – where a learner with low or no motivation at all tend to dropout in an E-learning based programs. This challenge suggests that it is an important to keep students motivated – i.e. due to their remote / isolated setting; b) Conflicting Priorities, which relates to the learner's committing to other things, e.g., family, work, and friends result in the conflict with course activities; c) Economy relates to the learner's access to finances, which is one of the reasons of low enrolment and high dropout in education and E-learning programs; d) Academic confidence, which relates to the self-efficacy and confidence on his/her skills and knowledge. Previous knowledge and academic qualifications also play a role in confidence level; e) Technological confidence depends on learner's background and skills concerning use of technology; f) Social support, which relates to the learner gaining an appropriate level of support from parents and/or employers; g) Gender includes challenges related to gender difference; h) Age, which was found to be a significant factor causing problems; i) Technological confidence relates to the instructor's confidence to use new technology in lectures; j) Motivation and commitment relate to the level of motivation and/or effort that the teacher makes in order to use E-learning systems in his/her lectures; k) Qualification and competence relate to the experience and skill of the instructor in using and incorporating new technologies; l) Time relates to challenges faced due to lack of time for the instructor to develop appropriate E-learning based content.

Technological Challenges refer to challenges related to technology components in E-learning. This third category of barriers, identified using twenty-five (25) papers, were categorised into three (4) categories, which were: i) Access, which relates to student availability to devices, ii) hardware, iii)internet bandwidth, and iv) other resources needed to access the E-learning content, which includes: a) Cost, which refers to the price of using the E-learning material and the price of technological hardware; b) Software and interface design relates to the learning tool interface, e.g. LMS, website, portal, application cause issues in the usage of E-learning system; and c) Localization, which arises when there is a difference in adaptability of the technology used for E-learning with the context and local norms, language, traditions.

Contextual Challenges relate to issues linked to implementation context. Twenty-three (23) papers identified context of organisation and societal issues. The six (6) subcategories related to contextual challenges are: a) Knowledge management, which is related to the data management and repository creation for sharing, storing and faculty inclination to build and contribute; b) Economy and funding, which includes issues related to the progression and development of physical and human resources; c) Training of teachers and staff, which relates to a lack of focus of the institutes to train the faculty and support staff in existing and new E-learning technologies; d) Role of teacher and student, i.e., where students and teachers are not fulfilling their required responsibilities to make the E-learning system work. This is reported to be due to cultural, behavioural and personality differences; e) Attitudes on E-learning and IT relates to a lack of commitment and importance of decision makers to implement the E-learning system in an institute is discussed in many studies; f) Rules and regulations relate to issues where government regulations and laws cause educational institutes to adopt new technologies into teaching and learning.

Andersson and Grönlund's framework was a positive step forward – particularly with the definition of technical, Individual, and Course related categories – however, there were arguably numerous limitations. Firstly, Andersson and Grönlund (2009) considered only a small proportion of related academic papers, restricting consideration to developing countries. Accordingly, Andersson and Grönlund (2009) failed to cover the full range of implementation barriers discussed in wider literature. Secondly, Andersson and Grönlund's category "Course related Issues", which was defined as relating to issues pertaining to the material provided for learning, did not appear to relate to only materials provision (e.g., teaching and learning activities / practice, the pedagogical model, support provided for students, and support provided for faculty). Finally, the Andersson and Grönlund framework relied primarily on literature from 1998 to 2008, and therefore ignores the lessons learned using recent solutions.

As a response to the above weaknesses, Ali et al. (2018) developed a more extensive Technological, Individual, Pedagogical & Enabling Conditions (TIPEC) E-learning barrier framework (see Figure 2.2). The TIPEC framework was based on 26 years of published literature, i.e., from 1990 – 2016, which included 259 E-learning related papers. In total Ali et al. identified 68 theoretical E-learning barriers, conceptually divided into four (4) major categories – similar to Andersson and Grönlund (2009) – i.e., three student facing categories, i.e. Technological (T), Individual (I), Pedagogical (P), and an internal support category entitled Enabling Conditions (EC) which relates to factors that need to be in place in order to support TIP categories. To date the TIPEC framework is arguably the most comprehensive framework in literature considering E-learning implementation barriers (Basir, et al., 2021), as it provides an extensive list of barriers that may occur whilst implementing an E-learning system.

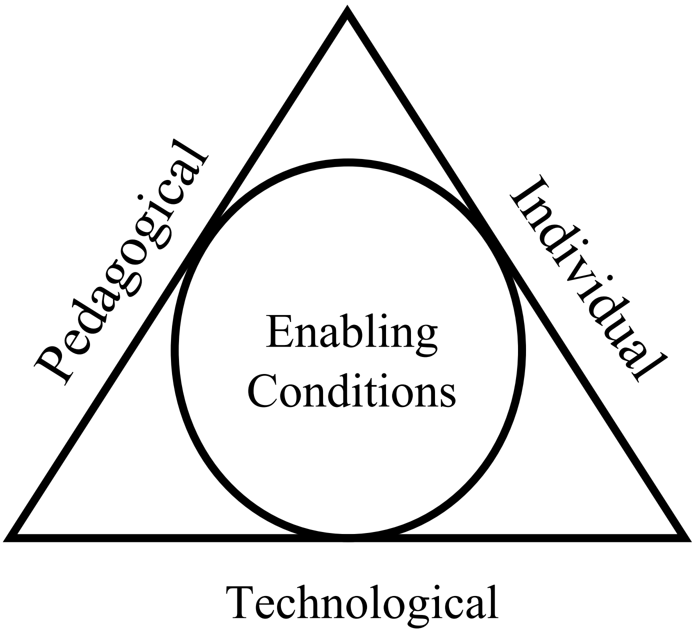

Figure 2.2 TIPEC framework – Ali et al. 2018

2.8 Dimensions of TIPEC Framework

The TIPEC framework describes sixty-eight (68) barriers grouped into four (4) categories (i.e., Technological, Individual, Pedagogical, and Enabling Conditions).

Technological issues include barriers related to the "E" in E-learning. Challenges related to the E-learning technologies include seven (7) barriers shown in figure 2.3. A full definition of the seven (7) technological barriers presented by Ali et al. (2018) is presented in Appendix 1A.

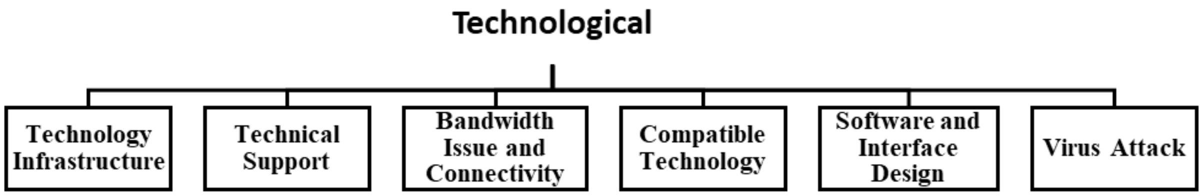

Figure 2.3 7 Technological Category Barriers

Individual barriers relate to student/learner related challenges. This category includes twenty-six (26) barriers shown in Figure 2.4. A full definition of the twenty-six (26) Individual barriers presented by Ali et al. (2018) is presented in Appendix 1B.

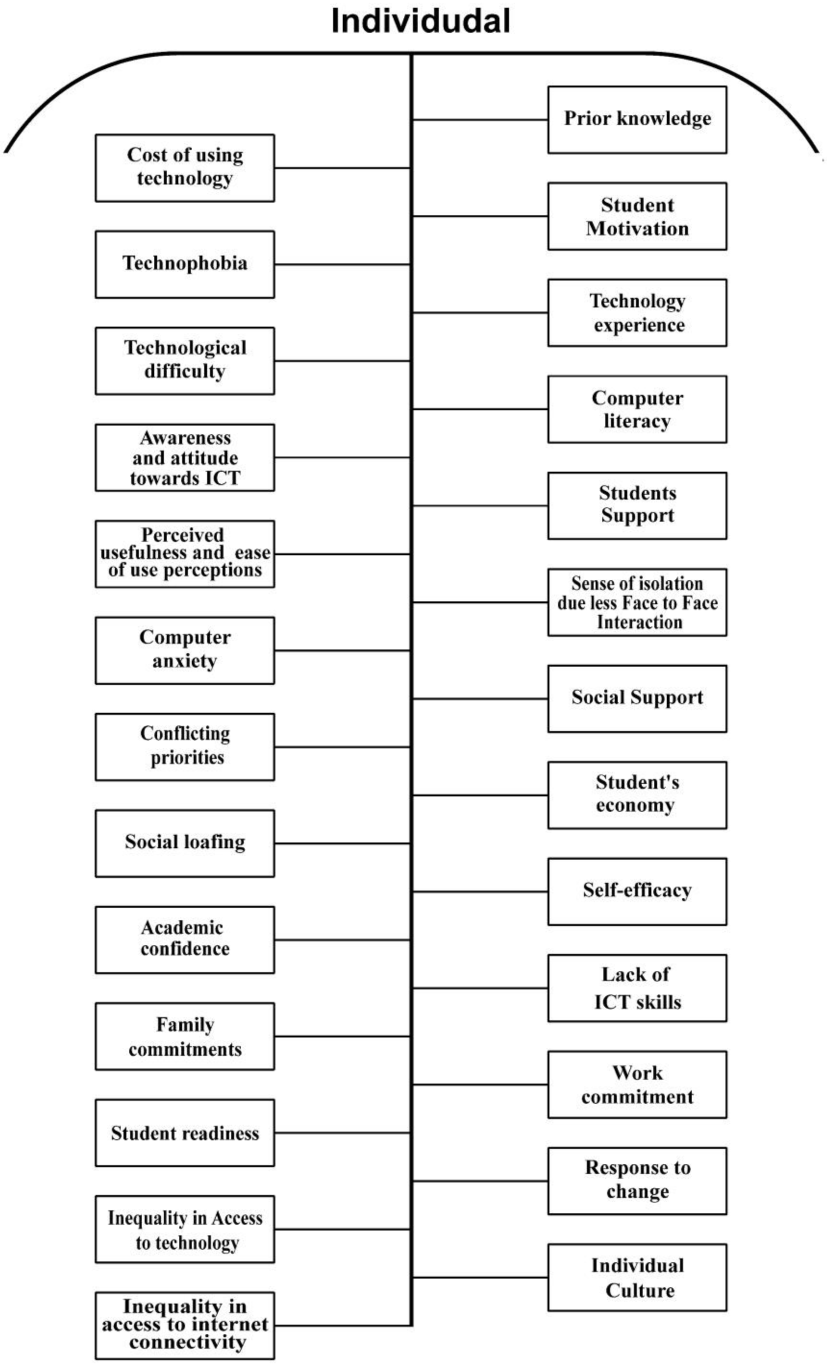

Figure 2.4 TIPEC – 26 Individual Category Barriers

Pedagogical barriers which relate to teaching methodologies, styles, and learner's expectations from the instructor. There are twenty-eight (28) barriers relating to pedagogical category. Figure 2.5 exhibit the list of pedagogical barriers. A full definition of the twenty-eight (28) Pedagogical barriers presented by Ali et al. (2018) is presented in Appendix 1C.

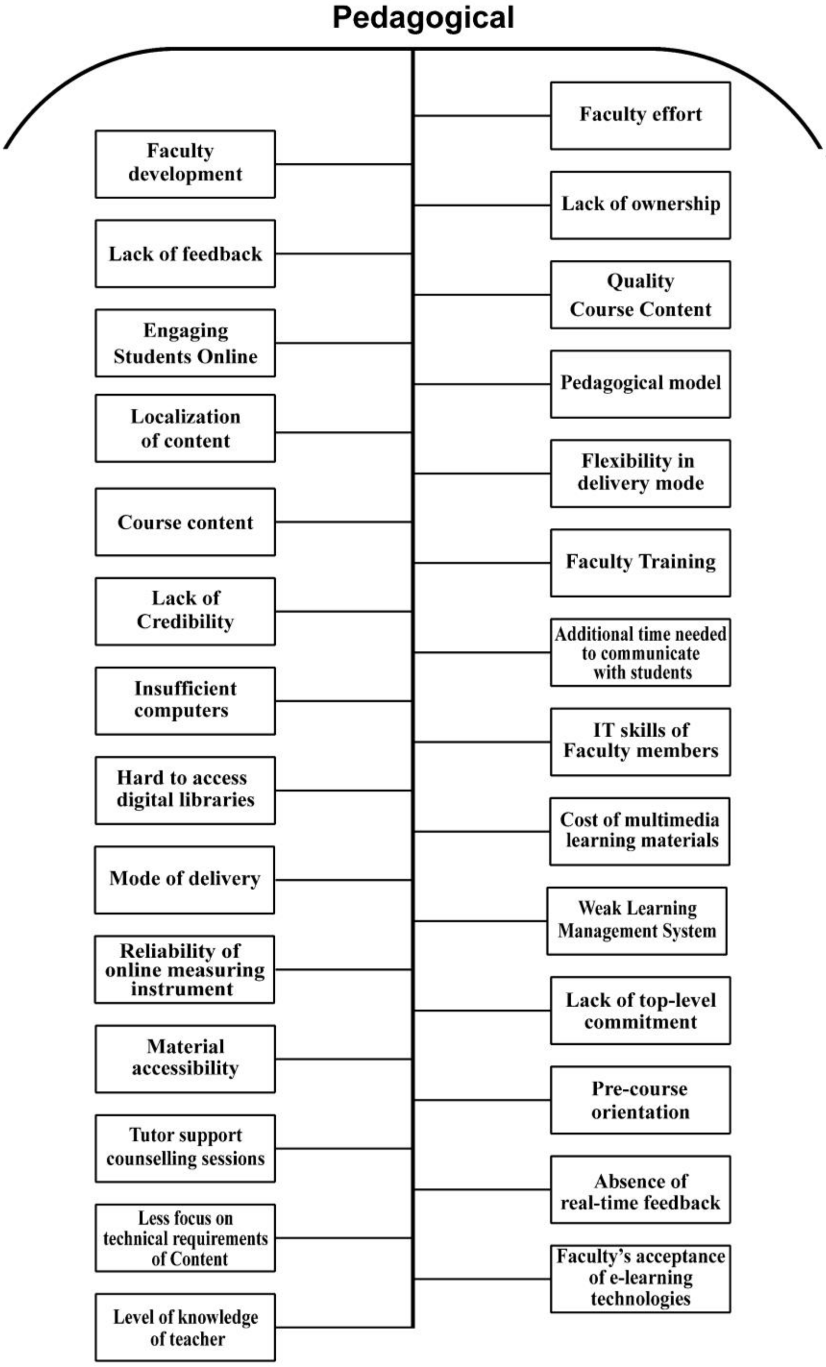

Figure 2.5 TIPEC – 28 Pedagogical Category Barriers

Enabling Conditions are barriers that are not directly student focused, i.e., related to any teaching and learning activity, but effect multiple TIP categories simultaneously. These are seven (7) barriers (see Figure 2.6). A full definition of the seven (7) Individual barriers presented by Ali et al. (2018) is presented in Appendix 1D.

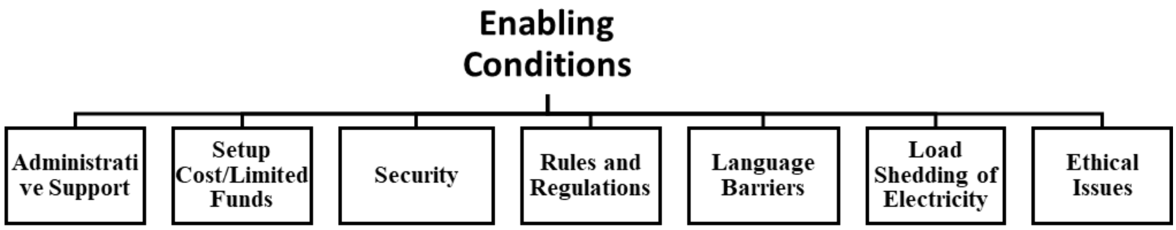

Figure 2.6 TIPEC – 7 Enabling Conditions Category Barriers

Despite the barriers, growth is predicted in use of digital learning solutions to support traditional learning solutions. In 2019, worldwide investments in IT / IS based solutions has reached 18.66 billion US dollars (Business Insider, 2020) and it is expected to reach 350 billion dollars by 2025 (Akhtar, 2021). Although complex E-learning technology exists (e.g., cloud-based computing, digital textbooks, mobile connectivity, high-quality streaming video, and "just-in time" information gathering), there are sadly many case examples of failure. Regardless of these risks, the covid pandemic demonstrated the potential and importance of E-learning technologies; particularly when faced by physical restrictions and limitations on interaction (e.g., those at distance and/or those physically unable to attend). Existence of one or multiple barriers at any point will create issues in the delivery of learning. If technological components of E-learning system are not in place, if the programme does not consider the specific needs of individuals or groups (i.e., individuals), or if pedagogical design of media is not appropriate for the delivery of taught content (Farid et al., 2018), then the E-learning system is at a high risk of being perceived as a failure. Investing in technology and pedagogy may result in top-notch infrastructure and quality materials; but if the learner fails to engage with the course, i.e., because of individual/learner related challenges then the implementation, however functional, should be considered as a failure. The barriers / challenges / issues that existed within E-learning implementations before COVID-19, despite the investment in E-learning solutions in many higher education institutes, are still present (Alhammadi, 2021); and these issues will continue to impact E-learning implementations unless managed. Thus, posing the research question for the current thesis.

How can E-learning practitioners identify, prioritise and manage the challenges / barriers / issues which hinder the implementation of IT based learning solutions? Furthermore, what are the possible challenges and their categorisation that hinder the IT based learning?

Unlike traditional learning, the success of IT / IS based learning revolves around the learner / user (Sun, et al, 2016). Such focus has been recognised by Andersson and Grönlund (2009), in the categorisation of the E-learning barriers. Barriers related to technological components, teaching methodology, and learner have been identified as determining factors for success. Moreover, method of delivering the content and mode of delivery both are there to ensure the transference of learning to the student / learner. Consequently, making the student the key stakeholder, whose expectations and needs require micromanagement. Ali et al., (2018) extended the work of Andersson and Grönlund (2009) considering the student / learner perception as the central point.

On the contrary, the institutes that are utilising these technologies have shown that education technology implementation is majorly affected by three important internal factors, i.e., the instructor, the learner (the major stakeholder), and the infrastructure. Interestingly, these three factors are highly correlated, i.e., the perception and familiarity of the learner and instructor towards the education technologies commonly determine attitude to use and positive feedback (Algahtani, et al., 2020); however, research shows that the instructor teaching methodology and style is also important to student conformance (Gros, et al., 2012). Considerable evidence in literature exists on the IS implementation in education to understand three major aspects i) students i.e., individual perceptions, attitude, skills (Abd El Halim, et al, 2022, Jiang et al., 2021, Sun, et al., 2022); ii) technology solutions (Ali et al., 2021; Quaicoe & Pata, 2020; Echeng & Usoro, 2016) and iii) teaching content and methodology (Uppal et al., 2017; Tynjälä & Häkkinen, 2005; O'Donnell et al., 2015). T, I and P categories of barriers within TIPEC framework in this regard highlight the importance of these aspects for E-learning success. Fourth category i.e., enabling conditions undertakes the challenges / barriers / issues which are not related to any of the three categories. Moreover, these barriers might become irrelevant in some context or region e.g., limited funds for setting up, and energy load shedding. It is quite evident the appreciation of barriers related to technological components, user i.e., student and pedagogical approach is much needed. To make the investigation of these three categories of barriers is thus vital in order to answer the postulated research problem. However, in order to achieve and underpinning the exploration research objectives were set (for detail see Chapter 1 – Research question, aims, and objectives) three sub-objectives are mentioned below.

***Research Objective 2.1 (RO2.1)*:** Development, quantitative validation, comparison, and finalisation of an instrument that will help the E-learning practitioners in the identification of barriers related to the technological component of E-learning.

***Research Objective 2.2 (RO2.2)*:** This sub-objective focuses on the user of the E-learning system. It will involve development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to user / student / learner / individual of E-learning.

***Research Objective 2.3 (RO2.3)*:** This includes development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to pedagogy of E-learning.

To identify and manage E-learning implementation issues and barriers, it is important that i) E-learning failure models are effectively developed and empirically validated, and ii) that implementation teams are provided with empirically validated questionnaire artifacts to allow pre-implementation identification of implementation issues. TIPEC framework in this regard has provided a structured understanding of the E-learning implementation presented in the literature to highlight the importance of the removal of these factors for E-learning success. TIPEC framework is comprehensive in terms of conceptualisation, theory, and consolidation of literature spanning over two and half decades. However, the theoretical nature of the framework limits the application of the proposed categories and barriers in practice. Ali, et al. (2018) also suggested instrument development to aid the practical implementation of the framework. The subsequent chapter will outline the in-depth design and validation process of E-learning barriers / issues /challenges identification instrument aiding the successful implementation of IT / IS based learning.

Chapter 3
Research Methodology

3.1 Introduction

This chapter explains the research methodology selected for the current study. The research question, which was developed at the end of chapter 2 states "*How can E-learning practitioners identify, prioritise and manage the challenges / barriers / issues which hinder the implementation of IT based learning solutions? Furthermore, what are the possible challenges and their categorisation that hinder the IT based learning?*". This question needs to be answered by applying a suitable research philosophy, approach, methodology and strategies. Understanding and/or eliminating barriers / challenges / problems causing hinderance in the success of E-learning system implementation is very crucial and using the appropriate method to quantify and control issues is important. The first step of strategic management is recognising hurdles that may be faced in a newly developed E-learning system, and/or problems that exist in existing E-learning systems that may result in long-term failure. The TIPEC framework was identified, in chapter 2, as providing an extensive list of barriers / challenges / issues reported in literature over the span of twenty-six (26) years; with technology, individual, and pedagogical dimensions – mirrored in Andersson and Grönlund (2009) – supporting student facing activity.

Since the research question poses the need for identification and subsequent removal of barriers / challenges / issues, Chapter 2 provides an analysis of barriers in IT / IS based learning solutions with respect to three domains, i.e., technological component, user / learner related problems, and shortcomings in E-teaching methodology. Development and validation of a structured instrument / tool can help us in the diagnosis of the problems / challenges. Also, tools for studying E-learning factors within each of the domains – i.e., technological component, user / student/ individual, and teaching methodology (pedagogy) – are needed. The division of the research question and objectives into an observable pattern is necessary. Clarke and Braun, (2013) state that use of objectives enables a researcher to sub-divide the question into logically measurable objectives, also assisting in the selection of appropriate methodologies for different questions and/or objectives. Categorising the research question into sub-objectives will allow the investigation and scale development of each domain of E-learning barriers/challenges/issues i.e., Technological, Individual, and Pedagogical. Accordingly, the researcher split the aim of this study into three SMART sub-research objectives to support the answering of the postulated research question. These objectives are:

Research Objective 2.1 (RO2.1)**:** Development, quantitative validation, comparison, and finalisation of an instrument which will help the E-learning practitioners in the identification of barriers related to the technological component of E-learning.

Research Objective 2.2 (RO2.2)**:** This sub-objective focuses on the user of the E-learning system. It will involve development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to user / student / learner / individual of E-learning.

Research Objective 2.3 (RO2.3)**:** This includes development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to pedagogy of E-learning.

To investigate which of the issues and barriers impact your respective project, a structure, and mechanism are needed to identify and validate the existence of specific problems. The TIPEC framework provides an explicit qualitative list of possible hurdles faced in literature, and a structure for categorisation, however, no mechanism exists to support the identification of specific barriers in a specific practical setting. This lack of a usable instrument is due to the qualitative nature of the TIPEC framework. Therefore, the practical use of the TIPEC framework structure requires the validation of these hurdles in practice. Furthermore, development of one or multiple tools / instruments will aid the practical validation of the TIPEC framework, and failure factors (as defined by Ali. et al., 2018). Once the prominent and persistent barriers / challenges / issues have been identified then the management and strategic actions to mitigate those hurdles can be devised.

The outlined objectives will be achieved by following the research methodology discussed in the current chapter, however detail concerning implementation of the methodology is accessible in the three (3) papers presented respectively in chapters 4, 5, and 6, showing the development of E-learning barriers survey instruments to aid the identification of **T**echnological, **I**ndividual and **P**edagogical barriers.

3.2 Research Philosophies

To investigate a defined research problem, the researcher needs to systematically and critically consider the research philosophy and methodology assumptions that define what data needs to be captured, and how the data should be analysed to effectively address the research question (Saunders et al., 2009). The research philosophy defines the researcher's focus and therefore impacts the choice and design of methodology, data collection, data processing, and analysis techniques used to answer the research questions (Žukauskas et al., 2018). Research literature suggests that it is critical for the researcher to get clarity on the research paradigm, i.e., the already established worldview or common beliefs; so that beliefs and research assumptions are critically declared as the foundation of the research process. Thomas (1962) defines paradigms as "the set of beliefs and agreements on how the problem should be understood and addressed". These paradigms are divided into three dimensions, i.e., ontological, epistemological, and methodological assumptions (Guba and Lincoln, 1994; Creswell, 2003). Ontological assumption is known as the "research paradigm concerned with articulating the nature and structure of the world". Saunders et al. (2009) mention ontological assumptions which cover assumptions concerning "how the world operates" and/or the views the research holds concerning certain phenomenon. Epistemological assumptions relate to "what constitutes acceptable knowledge in a field of study". Epistemological assumptions also justify the association of the research inquiry with the investigator. Lastly, methodological assumptions relate to "how research should be undertaken, including the theoretical and philosophical assumptions upon which research is based, and the implications of these for the method or methods adopted". Methodological assumptions cover consideration of the approaches used to capture, analyse, and interpret collected data; i.e., approaches used to uncover an answer to the research question with relevant evidence. Guba and Lincoln (1994; 2000) also states similar definitions and concepts concerning philosophies of research.

Guba and Lincoln (1994; 2000) theoretical explanation of research philosophy is structurally presented by Saunders et al.'s (2009) research onion (see Figure 3.1). Each layer of the onion, systematically from the outer concentric circle to the inner core, helps explain the steps that need to be taken by the researcher to develop a suitable approach for problem investigation. Selection of research approach is based upon the purpose of the research, and which will be of assistance to answer the research question.

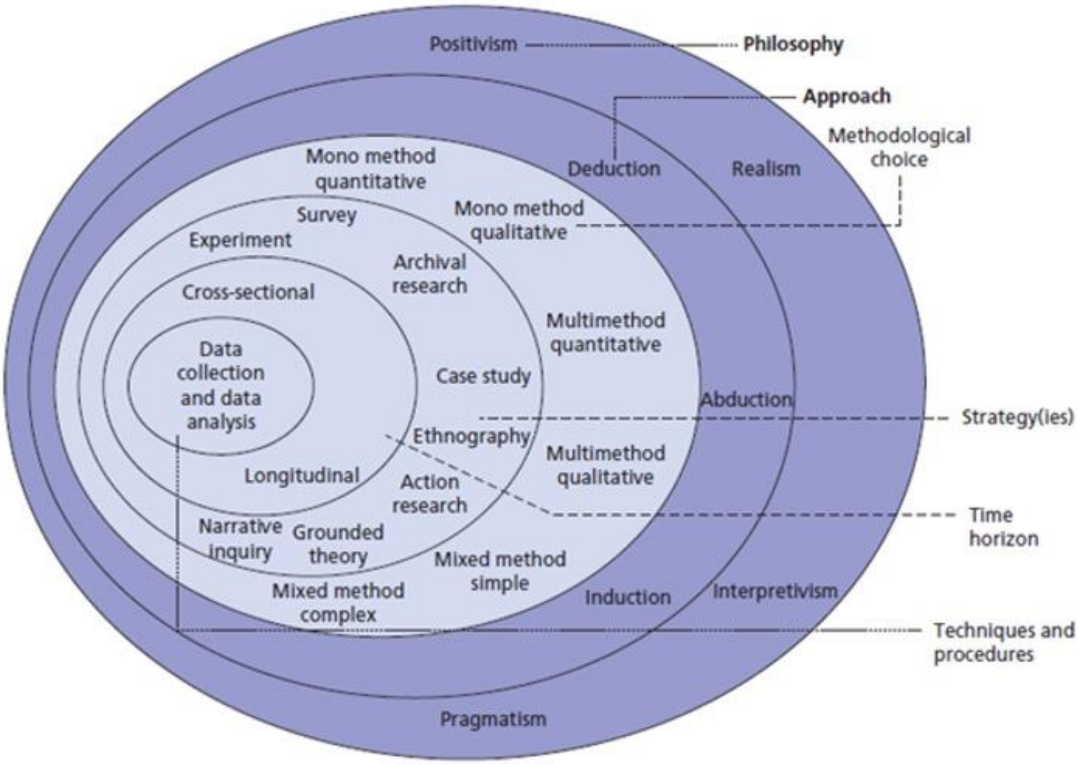

Figure 3.1 The Research Onion (adapted from Saunders et al., 2003**)**

3.2.1 Positivism

A positivist paradigm in social science adopts the "stance of the natural scientist" (Saunders et al. 2009), i.e., supporting and adopting the quantitative methods of inquiry in order to investigate reality. Considerable studies in the social sciences (including within the business and management domain) have opted for positivism as the methodological philosophy (Hussain et al., 2019). The researcher's role is confined to systematic collection, analysis of data, and reporting of findings, as the use of the positivist paradigm requires no subjective interpretation of the analysis. Indeed, a deductive approach, using survey and experimental strategies, is commonly employed (Žukauskas et al., 2018). Studies aiming to undertake hypothesis testing, survey instrument development, understand the casual relationship, theory testing, and / or empirical validation using primary data have been carried out using a positivist paradigm (Ahadzie et al., 2008; Yeo et al., 2018; Yuwei et al., 2021).

3.2.2 Interpretivism

Interpretivism, also referred to as constructivism, allows the implications and applications of collected data to be governed by the subjective opinion of the inquiry. This approach advocates that the reality that people experience is interpreted by participants and includes subjective and intersubjective meaning about a certain phenomenon (Koskosas et al., 2004). Interpretivism / constructivism commonly applies the inductive method of study, i.e., using qualitative methods to develop and elaborate our understanding of the research problem domain. Using empathic dialogue, interpretivist aims to encapsulate the view of the subject in context to the research questions, i.e., to rationalise how humans make sense about the world or the problem under review. Interpretivist research commonly applies in-depth or semi-structured interviews to record responses concerning the subject of study, then utilising hermeneutics and/or thematic analysis techniques to construct subjective yet detailed conclusions to address the research question (William, 2016).

3.2.3 Pragmatism

Pragmatic researchers argue that it is not necessary to follow a specific single philosophy. Aspects of the larger problem under investigation can be related to positivism and some aspects can relate to another philosophy, e.g., interpretivism (Saunders et al., 2009). Creswell (2009) states that pragmatists tend not to limit themselves to a single approach, as they tend to focus on finding the best possible solution to the research problem. Thus, research method is derived based upon the research objectives, rather than any particular philosophical approach. This philosophy is commonly adopted in studies using mixed methods, i.e., application of both quantitative and qualitative techniques.

3.2.4 Realism

Realism relates to the objective understanding of reality, which is what someone can comprehend using senses; since reality exists independent of human influence (Saunders et al., 2009). Realism is sub divided into critical realism and direct realism. Mingers et al. (2013) define critical realism as involving "objects, entities, and structures that exist (even though perhaps unobservable) and generate the events that we observe". Direct realism is where "what you see is what you get" which assumes that what we experience through our senses, is an accurate portrayal of the real world (Saunders et al., 2009). Realism commonly applies scientific methods of inquiry; however, interviews and observation can also be used to capture participant experiences of reality.

3.3 Selection of Positivist Philosophy

Since the research question aims to gain an understanding of E-learning implementation barriers / challenges / issues related to technology, user, and pedagogical approach in the practical application (for detail see Chapter 2). In order to answer the postulated research question, three (3) research objectives were set (see section 3.1). As the research objectives intend to develop a validated survey question instrument that will act as a diagnostic tool to highlight the occurrence, from a student perspective, of the existence of barriers / issues identified in Technological, Individual, and Pedagogical categories. This will be done via items development using a questionnaire method, and subsequent quantitative validation and modeling. Accordingly, the positivist research approach was selected for use in this thesis. The application of a positivist methodology was selected as it allows the deductive method of reasoning for the i) identification, definition, and formulation of constructs (Hox, 1997), ii) use of quantitative validation measures to test and justify the construct established and iii) it allows interpretation with no influence of the researcher at all (Saunders et al., 2009). The numeric and objective nature of this approach has made it popular with information systems researchers. Explicit observation, quantitative questionnaire, and experimental data (field & laboratory) analysed using statistical and quantitative analysis are therefore commonly considered positivist approaches to research problems.

Positivist researchers are passively neutral towards the research question and conceptual modeling of constructs and/or use of appropriate instruments to gauge the relevance of constructs under examination (Qureshi and Vogel, 1999). The three objectives of the studies aim to develop and validate instruments for identification of Technological, Individual, and Pedagogical categories of barriers defined from a students' perspective; allowing the identification of E-learning barriers / challenges / issues that exist in current or proposed E-learning project settings. The defined objectives align to the ontological assumption of positivism within this study since the objectives of the study require the validation of the conceptual framework with the predefined constructs and relationships. Klein and Myers, (1999) state the epistemology of positivism as either the confirmation or rejection of the theoretical constructs using statistical and empirical measures. Statistical findings of the study will also provide the objective verification, i.e., whether barriers / challenges / issues within Technological, Individual, and Pedagogical categories are understood as conceptualised in the theoretical TIPEC framework proposed by Ali et al. (2018).

Lastly, the methodology of positivism in the current study will be a survey instrument creation, application, and validation. Statistical software, such a SPSS (Statistical Package for Social Sciences) and SPSS-AMOS (Analysis of Moment Structures), will be incorporated to analyse the collected responses via survey questionnaire and drawing a conclusion from the statistical findings.

3.4 Time Horizon – Cross-sectional

Depending on the research aim, and objectives, capture of data can be carried out to study a phenomenon at a single or different point in time. Data collected from the same subject over a long period of time is called a "Longitudinal study", which is commonly used to investigate change over a given duration. Data collected from different subjects over multiple sessions is known as a "Cross-sectional study". The current study opted for cross-sectional research, as the objectives of the research require separate conceptual formation and validation of Technological, Individual, and Pedagogical barriers instruments using primary data. Furthermore, cross-sectional studies work well when testing a theoretical model with a survey questionnaire (Saunders et al., 2009) and subsequent validation is performed using structural equation modeling (SEM).

3.5 Population and Sampling

The population is the "totality of elements that are under discussion and about which information is desired" (Mood, Graybill & Boes, 1974). In statistics, and survey methodology, sampling is the process of selecting a statistical subset of individuals from within a statistical population in order to measure as accurately as possible, the characteristics of the whole population, i.e., drawing a sample from the target population to examine the research question. Sampling is also crucial for the generalisation of the results; however, this can only be done if a relevant and adequate number of subjects are selected. The target audience of the current thesis is the primary stakeholder (and user) of E-learning systems, i.e., the student / learner. Accordingly, it is critical that the students' opinion and attitude is captured to determine factors determining E-learning success, however, the process of selecting a sample is dependent upon the population sampling choice and sampling frame.

The sample should aim to have attributes similar to the whole population. Accordingly, a sample can be drawn using many techniques, however, there are two major types of sampling; probability and non-probability sampling. Leavy (2017) defines probability sampling as an "approach based on probability theory and involves the use of any strategy in which samples are selected in a way that every element in the population has a known and nonzero chance of being selected". Whereas "non-probability sampling is where the odds of any member being selected for a sample cannot be calculated" (Saunders et al., 2009).

As the research question in this thesis is aimed to address the formation and validation of instruments to support the identification of challenges / barriers faced in E-learning systems implementation. The current study is carried out in the higher education context of Pakistan by using a survey method which is mostly carried out using non-probability convenience sampling. Saunder et al., (2009) mention researchers conducting research using non-probability sampling should establish a clear sampling frame, carefully select their sample, and use appropriate techniques for selecting that sample. The location of data capture is Pakistan, primarily due to opportunity non-probability sampling; since the researcher works in one of the one-hundred and eighty-seven universities (including both private and public institutes) in Pakistan; with an annual enrolment of 1.6 million every year.

The sample size was calculated using a 5% margin of error, a 95% confidence level, and a population size of 1.6 million, which recommends a minimum sample size of 287. So, for each of the three experiments, any number above 300 was targeted to ensure accuracy in the sample responses. Accordingly, a population of 300+ will counter any minor variation due to local fluctuation of variables.

3.6 Quantitative Research Strategy

Generalisation and empirical validation of the research constructs in social and business studies are carried out by applying quantitative methods so that numeric data can be statistically analysed and interpreted (Creswell, 2003). Creswell (2003) states that "in positivist ontology and epistemology deductive approach via quantitative research strategy is employed to address the problem". The alternative, i.e., qualitative methods employ inductive approaches to help researchers understand and elaborate the researchers underlying understanding of the problem domain.

E-learning information system implementation research highlights and reports numerous cases of failures and challenges (See Chapter 2), accordingly, one of the practical objectives of the current research is to provide E-learning systems implementors, researchers, practitioners, and policy makers with a practically applicable instrument to identify barriers and challenges in new or existing projects.

On the contrary, qualitative and inductive method strategies are more suitable when researchers wish to add to knowledge and theory; often due to there being little previous literature available related to the inquiry. This does not align with the scope and aim of the study.

Accordingly, in this current research, the researcher selected to apply a quantitative research strategy for two reasons: i) it allows validation of the barriers related to technological component (T), user /individual (I), and pedagogical approach (P) by using quantitative measures (Ouma, 2013); and ii) the confirmation, modification and/or removal of the theorised construct vs the validated constructs rely upon the findings of statistical and reliability techniques.

3.7 Choosing Survey Strategy

In the domain of information systems, the choice of research strategy varies quite significantly across literature, with some studies applying experiments (field or laboratory) and some applying survey research methods; with the final choice depending on the contextual research question (Creswell, 2003). Positivist philosophy tends to apply the survey strategy, as it gathers the responses of construct items using a predefined survey instrument, which then helps in the generalisation of the research findings using statistical techniques. Furthermore, the generalise finding can determine the relationship between constructs and/or validation of the model explaining these relationships. Moreover, a deductive survey strategy is ideal for research problems in social sciences that need to investigate the "*who, what, how much, and how many questions*" (Saunders et al. 2009).

Questionnaire for survey research can either be adopted from a previous study or a new instrument can be developed. The aim of this research requires the formation of a new instrument and/or the subsequent validation of this instrument. But the essential factor here is to be sure that the questionnaire used to collect data will achieve the objectives, and therefore answer the research question. To answer the research question, the researcher sub-divided the question into three objectives (see section 3.1) to assist in the investigation and scale development for each barrier category, i.e., **T**echnological, **I**ndividual and **P**edagogical. Furthermore, the extensiveness of the list of barriers within the three categories limits the use of a single questionnaire/instrument. Accordingly, a set of three survey instruments will be developed, with separate consideration of Technological, Individual and Pedagogical categories; and each achieving fulfilment RO 1 to 3 respectively.

3.8 Instrument Development

Theoretical and thematic nature of TPIEC framework will assist in the further development of the survey question items. As barriers within the Technological, Individual and Pedagogical are categorised based on qualitative assumptions. So, to achieve the statistical and asserting numeric foundation of these relations, a measurable instrument is missing. Furthermore, to practically use the constructs requires the development of items which then can be measured using survey strategy. However, Saunder's research onion does not outline detail of process of item development for questionnaire / survey instrument. Tsang, et al. (2017) provides a guideline and a systematic process to develop a measurable instrument from a theoretical framework (see Figure 3.2). It is a three-phase process consisting of i) preliminary considerations, ii) the development process, and iii) validation leading to the development of the survey instrument.

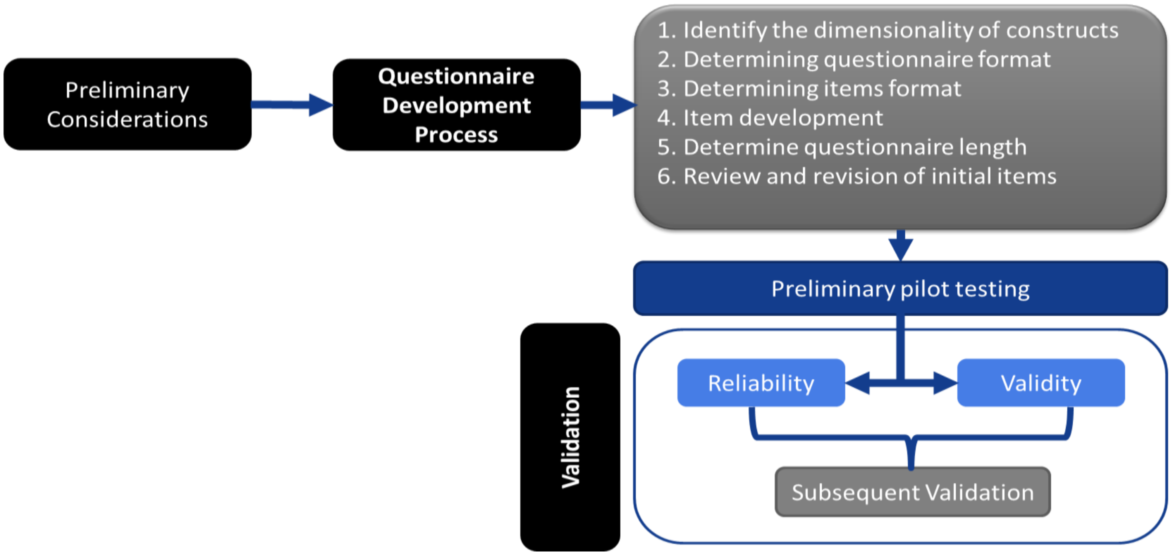

Figure 3.2 Instrument Development Process (Tsang et al., 2017)

3.8.1 Preliminary Considerations

Paré, and Elam (1997) mention two approaches for construct definition to explore a phenomenon in an information technology field, i.e., i) use of existing framework and ii) use of project requirements. The first approach uses pre-known constructs that are already defined within existing conceptual framework, thus enabling the researcher to build research designs based on the relationship proposed in theory. Application of an existent conceptual framework allows the researcher to confirm, update, and/or alter our understanding concerning the theoretical relationship amongst constructs with the quantitative research findings. The second approach does not relay on the previous theoretical assumptions, yet instead uses project requirements and grounded theory to define constructs and the relationship that exists between research objects. In the current thesis the first method, i.e., use of an existing framework, is adopted. The conceptual TIPEC framework provides considerable detail concerning Technological, Individual and Pedagogical barrier constructs, which can be used as a basis of instrument development. Tsang and colleagues advise that commonly thematic and content analysis approaches should be used in the definition of the constructs. This supports the use of TIP dimensions, since similar techniques were adopted for the conceptualisation of the TIPEC framework constructs (Ali et al. 2018).

Once construct definitions are achieved, the researchers are then required to determine the availability of the validated questionnaire instruments in literature. Unfortunately, no validated / measurable instruments for T, I and P category constructs are available in the literature.

3.8.2 Developing a Questionnaire – Development Process

Questionnaire is one of the most common methods used to collect data when applying a quantitative deductive approach. The capability of a questionnaire to ask the same question to respondents is an efficient way of gathering data from a larger pool of respondents, however, the questions need to ensure that questions are clear to address the intended meaning. Numerous experts have advised researchers to give careful consideration to development of the questionnaire as it is a complex process. Tsang et al. (2017) suggest that, if no pre-existing measuring instruments can be found, a researcher needs to undertake a development phase; with the aim to provide a questionnaire to collect reliable data to address the research problem. Developing a questionnaire phase consists of seven sequential sub-steps for the systematic creation of the survey questionnaire.

1) Identify the Dimensionality of Constructs

Identifying the dimensionality of the constructs requires the researcher to dig into literature, i.e., to affirm or modify the scope of the constructs defined within the conceptual framework. There may be constructs in the framework that possess multiple facets that demand a different scale of measurement and/or overlapping concepts that need to be clarified in order to understand participant responses. Thankfully, the definitions of the TIPEC barriers within the three categories (i.e., those barriers in the Technological, Individual, and Pedagogical dimensions) are well defined, and consideration of overlapping concepts is not required. These definitions have also been cross-checked with a literature review and additional references i.e., research published since 2016, however, the full process will be presented in papers contained in chapters 4, 5, and 6 respectively considering Technological, Individual and Pedagogical barriers.

Consequently, the number of constructs being considered within three dimensions are as follows: 1) the Technological category has seven (7) constructs, as defined within the TIPEC framework, for which question items will be created to measure the existence of barriers in an E-learning project environment; 2) the Individual category has twenty-six (26) constructs related to the challenges a user can face while using an E-learning system. Definition of these barriers is clearly defined by Ali et al. (2018), and detail of the definition is also mentioned in Chapter 5; 3) the Pedagogical category has twenty-eight (28) barriers, that are related to teaching methodology and instructor. Like the other two categories, the definition and scope of each barrier are distinctly defined and the need to combine the constructs at this stage was not required.

2) Determining Questionnaire Format

After clarifying the constructs, the researcher is required to identify the format of the question items that are to be developed. Like all other aspects of research methodology, this is dependent on the question that is been investigated. The questionnaire can either be self-administered or administered by the researcher, i.e., read aloud by the researcher, however this choice is also dependent on the research approach, e.g., a positivist approach requires that there is no intervention of the researcher on the subject of study, making the self-administered approach more suitable in this context. Thus, three self-administered questionnaires will be developed to cover the sixty-one (61) constructs (TIP); with a separate question development for each of the three TIPEC categories.

3) Determining Items Format

Studies that possess the aim of understanding the detail of a certain phenomenon through constructs / variables gather data from the respondents through open-ended qualitative question items. This type of study suits situations where there is insufficient knowledge about a specific domain. Open-ended questions allow the researcher to get the border picture of the object of focus by collecting unguided detail from the subjects. In such cases, open-ended question answers are analysed using content analysis to draw objective conclusions and elaborate the understanding of the domain. In most cases, open ended questions are recommended when a full picture of the impactful constructs is not fully appreciated (Gillespie et al., 2012). In the domain of E-learning implementation barriers, considerable work has been done for over 20 years. As such enough literature exists to build a comprehensive understanding of the barriers. If you are looking to assess the relative impact of pre-known and pre-understood constructs, then closed questions can be used; however, question items need to be validated to check that the meaning is clear. As such within this thesis, it was decided to use a close-ended question format with papers presented in chapters 4, 5, and 6. In line with ISO standards, closed ended question items are normally measured using a five or seven-point (1-7) Likert scale (Completely Disagree, Mostly Disagree, Somewhat Disagree, Neither Agree nor Disagree, Somewhat Agree, Mostly Agree, Completely Agree) 1 being Completely Disagree and 7 being Completely Agree. Use of an odd number supports the existence of a neutral or 'Neither agree not disagree' state.

4) Item Development

The writing of multiple question items, used to create each construct, should be precise, clear, and written in simple language, so that i) an average respondent can understand the meaning of the question and ii) responses to questions address the same construct and therefore statistically load together. In the case of attitudinal and behavioural studies, some advisers suggest use of negative items to remove bias, however, the effectiveness is still in contention and the latest studies report some serious problems due to confusion in participant feedback (Aronson, et al., 2021). As long as the developed items are conveying the intended meaning, the researcher can decide not to include the negative items (Tsang et al., 2017).

Development of multiple items for each construct allows the researcher to achieve high reliability for each construct. Using multiple items also formulate a better understanding of the constructs. Consequently, developing multiple items for constructs for each of the three categories is thus necessary.

Technological – A range of question close-ended self-administered structured questions items for each construct will be developed for identified seven technological barriers (see Chapter 4 – section Methodology).

Individual – Similarly for the individual category, self-administered items will be developed to cover the twenty-six (26) individual barriers identified in the TIPEC framework (see table 3.1). Each item statement will be developed after careful scrutiny of the recent literature relating to each of the barriers (see Chapter 5 – section Methodology).

Table 3.1 Technological Factors- TIPEC Framework (Ali et. al 2018)

Sr.	Barriers Names
1	Technology Infrastructure (TI)
2	Technical Support (TS)
3	Bandwidth Issues and Connectivity (BC)
4	Software and Interface Design (SI)
5	Compatible Technology (CT)
6	Poor Quality of Computers (PQ)
7	Virus Attack (VA)

Table 3.2 Individual Factors- TIPEC Framework (Ali et. al 2018)

Barriers Names			
1	Student Motivation (SM)	14	Student's Economy (SE)
2	Self-efficacy (Sef)	15	Cost of Using Technology (CUT)
3	Awareness and Attitude Towards ICT (ATICT)	16	Family Commitments (FC)
4	Inequality in Access to Technology (IAT)	17	Work Commitment (WC)
5	Individual Culture (IC)	18	Conflicting Priorities (CP)
6	Perceived Usefulness and Ease of Use Perceptions (PUEOU)	19	Student Readiness (SR)
7	Inequality in Access to Internet Connectivity (IAIC)	20	Response to Change (RC)
8	Students Support (StSu)	21	Technological Difficulty (TD)
9	Social Support (SoSu)	22	Technology Experience (TE)
10	Technophobia (TP)	23	Computer Literacy (CL)
11	Computer Anxiety (CA)	24	Lack of ICT Skills (LICTS)
12	Sense of Isolation due less Face to Face Interaction (SI)	25	Prior Knowledge (PK)
13	Social Loafing (SL)	26	Academic Confidence (AC)

Table 3.3 Pedagogical Factors- TIPEC Framework (Ali et. al 2018)

Pedagogical Factors- TIPEC Framework (Ali et al., 2018)			
1	Faculty Development (FD)	15	Course Content (CC)
2	Faculty Training (FT)	16	Pedagogical Model (PM)
3	IT Skills of Faculty Members (ITF)	17	Localisation of Content (LC)
4	Flexibility in Delivery Mode (FDM)	18	Faculty Effort (FE)
5	Mode of Delivery (MD)	19	Lack of Ownership (LO)
6	Weak Learning Management System (WLMS)	20	Faculty's Acceptance of E-learning Technologies (FAT)
7	Reliability of Online Measuring Instrument (RMI)	21	Engaging Students Online (ESO)
8	Less Focus on Technical Requirements of Course (LTRC)	22	Material Accessibility (MA)
9	Additional Time Needed to Communicate with Students (ATC)	23	Lack of Top – level Commitment (LTC)
10	Pre-course Orientation (PCO)	24	Lack of Credibility (LoC)
11	Tutor Support Counselling Sessions (TS)	25	Cost of Multimedia Learning Materials (CoM)
12	Lack of Feedback (LF)	26	Level of Knowledge of Teacher (LKT)
13	Absence of Real-time Feedback (ARF)	27	Insufficient Computers (IC)
14	Quality Course Content (QC)	28	Hard to Access Digital Libraries (HAL)

Pedagogical – Table 3.3 presents twenty-eight (28) pedagogical category barriers for which items will be developed to further apply the items for survey instrument (see Chapter 6 – Methodology section).

In addition to the question items for the E-learning barriers, a few questions requesting demographic information will also be asked within the three questionnaires concerning participant i) gender, ii) age, iii) the programme upon which the student is enrolled, and iv) (optional) the household income.

5) Determine Questionnaire Length

The length of the questionnaire should not be too short that it fails to measure the intended objective, however similarly the length of the questionnaire should not be too long that respondents get tired and loose interest in the process. Due to issues faced with using long length questionnaire, a single instrument was not developed to measure the technology component, user, and teaching methodology related challenges.

The use of three questionnaires, and the length of each, is based largely upon the number of questions and items required to collect information about the respective constructs. Interestingly, the length of questionnaire pilot study is recommended to be large than required, because there is a high probability of good number of items will need to be removed if reliability and / or poor / cross loading occurs.

6) Review and Revision of Initial Items

Once the initial pool of items is created, the researcher is encouraged to undertake an expert review. Experts within the domain are asked to review the items for redundancy, content validity, clarity, and readability. In content of the thesis, an expert review requires at least three E-learning systems experts to provide feedback on the three separate questionnaires. In this work, the researcher will conduct an expert review for each of the three questionnaires individually. Feedback from experts will help in the removal of confusing and redundant question items. The final three questionnaires developed for Technological, Individual, and Pedagogical barriers are attached in Appendix 2A, B, and C, respectively.

7) *Justifying use of Preliminary pilot testing*

Once questions are tested by experts to ensure their quality, the researcher is encouraged to undertake a pilot testing of the questionnaires with a small sample of participants. A pilot study helps the researcher to determine whether or not the question items are understood as intended by a small sample of participants – who provide feedback about the questions items as well as answer the questions. Lackey and Wingate (1998) state that conducting a pilot test also allows the researcher to determine more accurately the variation of time that it takes participants to complete the instrument. The pilot study provides the researcher with considerable feedback on question content, and also allows the researcher to identify whether or not participants find any part of the process (or any questions) to be objectionable, difficult, or unclear. In this thesis, the researcher performed pilot screening for each of the three questionnaires separately.

Technological – Feedback from fifty (50) E-learning enrolled students was gathered within the pilot testing of technological construct questions. Results identified that question item statements for 'compatible technology' and 'bandwidth and connectivity' constructs were causing some ambiguity and/or confusion for respondents. These statements were adjusted to clarify the question item meaning, and new questions were checked by a number of E-learning experts to ensure the semantic distinction of question items was clear within each construct. Preliminary data and expert analysis revealed a minor need to reword a number of questions, however, no items were removed at this stage. Finalised question items were then used for full scale data analysis (see Chapter 4, pilot testing).

Individual – Preliminary pilot test with the individual questionnaire was performed with thirty (30) respondents. Analysis identified a number of items were causing problems and reliability concerns. After critical consideration, the researcher decided to remove twelve (12) irrelevant items. Each of the remaining seventy-three (73) question items were then examined critically for clarity and readability, and problematic items were reworded where confusion was raised. Finally, these items were used for final construct and content validation after full scale data collection (see Chapter 5, data analysis).

Pedagogical – Ninety (90) initial items were developed against the twenty-eight (28) pedagogical barriers. However, expert review resulted in the removal of three (3) questions.

Accordingly, eighty-seven (87) items were used for pilot testing. Question items remained within the question instrument. A pilot test for pedagogical questions was conducted with forty-five (45) responses. Results identified no issues with the questionnaire process; however, four (4) question items were perceived as having cross-loading and reliability concerns. After removal of the problematic items, the researcher was left with 83 questionnaire items. After applying changes to all questionnaires, full-scale data collection was started. See Chapter 6 for more details.

3.8.3 Validation

Last stage of the instrument development advised by Tsang et al., (2017) is the validation of the data collected via the instrument. Data analysis for the main study is conducted for validation after all the responses have been received. There are a few tests involved in the sequential interpretation of the data. The Statistical Package for Social Sciences (SPSS) and Analysis of Moment Structures (SPSS-AMOS) will be used to analyse the data collected from the three questionnaires. Since the methodology to develop a new set of questionnaires will allow the researcher to quantitatively validate whether the Technological, Individual, and Pedagogical E-learning barriers presented in the TIPEC framework are reliable, the same data analysis approach will be performed for each of the three datasets collected from the three questionnaires; leading us to the next step after development of instrument i.e., analysis to achieve the validation of the created instrument.

3.9 Data Analysis

3.9.1 Preparing Data for Analysis

Once the researcher has received the responses, the data is entered for preliminary tests to check data for validation. It is quite common in the studies conducted using questionnaires to have missing values (Redyuk et al., 2021). Dealing with missing values at an initial stage is very important otherwise it will cause problems in the next steps of data analysis. Missing values are sorted out using the imputation analysis method, however, statistical experts have advised removal of the missing responses if the researchers are unable to practically solve the missing values (Hair et al., 2010).

Once missing responses have been removed, data is tested for normality and outliers. Outliers are considered as the less frequent and/or extreme value responses in the data set (He et al. 2005). Existence of outliers in the data set causes normality issues, which can lead to incorrect interpretation of the results or problems in the later stages of data analysis (Seo, 2006). Outliers and normality issues can be overcome by removing the items or grouping the outliers to represent a single response.

3.9.2 Ensuring Reliability

Reliability is the measure to check the questionnaire reproducibility with respect to the sample size. This test provides the researcher with three explanations. First the consistency of multiple items relating to the single conceptualised construct and/or variable. Secondly, it provides the consistency of all-surveyed items with respect to the respondents. Lastly, it provides an internal correlation between the question items (Hair et al., 2010); tested using Cronbach's Alpha. Ensuring reliability aids in the generalisability of findings to the wider population (Lehman & Tompkins, 1998).

3.9.3 Considering Validity

Validity is the measure to check the intended aim of the questionnaire with respect to the actual understanding of the data. This validation is achieved through Factor Analysis, which is performed in two steps and techniques Exploratory Factor Analysis (EFA) and then Confirmatory Factor Analysis (CFA). EFA is performed through SPSS and later is performed using AMOS. CFA can be performed using the path-analysis techniques but in the current study, AMOS is applied.

Exploratory Factor Analysis (EFA)

Studies using the item-based questionnaire will apply EFA to test the structure of questions used with the model theorised. EFA helps to validate a conceptual framework in the screening of the problematic questionnaire items. There are a number of measures involved in fulfilling the EFA assumptions, i.e., Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, Bartlett's Test of Sphericity, and Eigenvalues and Communalities.

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test shows whether or not the data supports factor analysis and is a measure of variance amongst linked factors. A rule of thumb suggests that KMO value less than 0.5 imply factor correlation; i.e., that factor analysis is unviable. KMO value between 0.5 and 0.6 implies that action should be taken to remove data items. KMO value between 0.8 and 1 imply that sampling is adequate and factor analysis is possible.

The Bartlett's Test of Sphericity test compares the observed matrix against the identity matrix, i.e., to identify whether or not variables are related. A significant test (<0.005) shows that factors are not significantly related; supporting the use of factor analysis. Eigenvalues and Communalities represent the total amount of variance that can be explained by a factor. If Eigenvalues are greater than 1 then we should include this factor, if the Eigenvalue is less than 0.7 then this factor should not be considered. Communality (h^2) is the proportion of the variable explained by the factor. It is possible that the factor should be considered, i.e., has an eigenvalue > 1) yet the impact of this factor is not significant on the output variable.

Finally, factor loading (Factor matrix) shows whether the extracted factor satisfying the assumptions of above tests, is used to guide further validation testing. Hair et al. (2010) state, however, that confirmatory factor analysis is necessary to confirm the factor solution extracted using EFA. Structure Equation Modeling (SEM) is commonly applied to perform Confirmatory Factor Analysis (CFA).

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis falls under the techniques of structural equation modeling (SEM), which is commonly carried out using AMOS. CFA is "a multivariate technique that combines features of multiple regression and factor analysis in order to estimate a multiple of networking relationships simultaneously" (Hair et al. 2010). Testing of constructs and model is performed using Construct Reliability (CR), Convergent Validity, Discriminant Validity, and Model Fitness.

Construct Reliability (CR) – much like Cronbach's alpha, the CR measure refers to the internal consistency of all observed items within a questionnaire with all constructs in the model (Fornell & Larcker, 1981). The higher the value, the stronger the relation between items and the relevant constructs. It is recommended that the reliability value is at least 0.7, however, values above 0.75 indicate that all question items measure the same construct.

Convergent Validity – allows the researcher to validate theoretical assumptions of the developed items against observed data. A value closer to 1 denotes a higher correlation between theory and facts. Convergent validity is sometimes claimed if the correlation coefficient is above 0.5, although it's usually recommended at above 0.7.

Discriminant Validity – contrary to previous validity assumptions, discriminant validity proves the difference amongst items within the observed model, and tests whether concepts or measurements that are not supposed to be related are unrelated in the data. Two types of discriminant validity are i) difference between all questionnaire items, i.e., item level, and ii) difference between all observed constructs, i.e., construct level. Fornell and Larcker (1981) state that the "degree to which two conceptually similar concepts are distinct from each other" is item-level discriminant validity. Hair et al., (2010) define "degree to which two conceptually similar concepts are distinct" as construct level discriminant validity. Although there is no standard value for discriminant validity, a result less than 0.7 suggests that discriminant validity most likely exists between the two scales. A result greater than 0.7 suggests that overlap probably exists between constructs.

Model Fitness – The last assumption of CFA is achieving a measurement model goodness of fit. Performing the model-fitness varies based on the relationship one aims to test. For the current study all three models, i.e., Technological, Individual, and Pedagogical, will be respectively evaluated to check how well the theorised constructs within the observed TIPEC categories account for correlation between the construct overall measurement. Achieving the recommended measures threshold for each of the categories confirms a higher correlation between the theorised constructs and the observed dataset. Table 3.4 presents the measures and minimum thresholds to fulfil the assumptions.

Table 3.4 Measures and Minimum thresholds values supporting Reliability and Validity

Assumptions	Measure	Acceptable Value
Construct Reliability	Composite Reliability	CR > 0.7
Convergent Validity	Average Variance Extracted	AVE > 0.5
Discriminant Validity – Construct Level	Inter – Correlation	Correlation <1
Discriminant Validity – Item Level	Maximum Variance Shared	MSV < AVE
Model-Fitness	Minimum Discrepancy Per Degree of Freedom	(CMIN/df) < 3, < 5 allowed in sometimes
	Confirmatory Fit Index	CFI >0.95 great, >0.90 traditional, >0.80 allowed sometimes
	Adjusted Goodness of Fit Index	AGFI > 0.80
	Standardised Root Mean Square Residual	SRMR < 0.90
	Root Mean Square Error of Approximation	RMSEA < 0.50 good, 0.50 – 0.10 moderate

Achieving the acceptable range of the measures mentioned in the previous section will confirm the validity of the developed instrument (s). The resultant model and factor solution will allow the researcher to state the findings and draw conclusions.

3.10 Ethical Consideration

The nature and design of tools within this research indicate a low level of risk to respondents. Since the study is cross-sectional, there is no need to track data to an individual. Accordingly, the data can automatically be made anonymous. However, ethical considerations require that the scope and purpose of the research be explained to respondents. Ethical compliance for the current study is ensured as per the guidelines of the Henley Business School (University of

Reading). During the data collection, participants will be asked to sign the consent form which explains the right of withdrawal at any time during the study. A consent form will be presented to each participant, and each participant will have the right to decline involvement. The consent form mentions that the responses of participants will only be used for the research purposes and information they provide will be stored in a secured fashion. Although a unique ID was assigned to each respondent, this approach will be used only to support the purpose of tracking data. This process helps us get the honest opinion from respondents. Ethical concerns after data collection will also be checked during the data analysis and reporting stages.

3.11 Conclusion

The current chapter outlines the discussion and justification of the methods adopted to answer the research question and attainment of the relevant research objectives. Utilising the "Research Onion" approach of Saunders et al., (2009) methodology of the current thesis was designed. Selecting the positivist paradigm in a cross-sectional time frame, three experiments will be conducted. Survey questionnaire will be used as an instrument to collect responses from the higher education students by drawing sample using convenience sampling. Sample size and method discussed in section 3.5 will be adopted for the selection of sample to gather data in the subsequent chapters (4, 5, and 6). Unavailability of research survey instrument poses the need to design and development of question items. Theoretical dimensions postulating challenges / barriers / issues related to "Technology" "User / Student" and "Teaching Methodology" within TIPEC framework will be employed as the basing for questionnaire item generation. Following the questionnaire development approach discussed in section 3.7, survey instruments will be developed to identify the barriers / challenges / issues in IT / IS based learning solutions. Diagnostic tool / instrument for E-learning barriers / challenges / issues related to 'E' in the E-learning will be designed, tested, and validated in chapter 4. Similarly, instrument / tool aiding the identification of barriers / challenges / issues related to user of E-learning, i.e., individual / student, will be developed and confirmed in chapter 5. Finally, the third experiment will be undertaken by the validation of a survey instrument measuring the barriers / challenges / issues in E-learning related to teaching methodology.

Paper I

Validating the TIPEC Framework from the Student Perspective: Understanding the Technological Dimension

Chapter 4

Understanding E-learning Technological Barriers / Challenges / Issues

4.1 Paper Overview

This chapter presents first of three papers submitted as part of the current thesis. The paper looks at the validation of an instrument aiding the identification of technology related challenges in E-learning category. The use of technology is not just confined to corporate sector, universities have, for a considerable time, been trying to adopt new E-learning technologies, to enhance / broaden the scope of existing learning solutions. Paper I highlights the efforts made by educational institutes around the world to integrate technologies and relevant Information Systems (IS) to enhance the learning experience of students. Despite the effect, and investment of resources, many barriers / issues / themes concerning technological components still exist. These issues are consistent in both developing and developed countries, regardless of the numerous advantages and rooted benefits that technology instills.

IT or IS based learning solutions are the first and core interaction point in an E-learning environment. Issues in the system will lead to the loss of interest, trust, usability, and overall success of technology in learning. User / student being the ultimate user of learning based on information systems (IS) & technology and his / her ability, attitude, and perception to use or not to use will directly influence the ultimate success of the E-learning system.

Primary aim of this paper is to identify barriers / issues / themes that students face by reviewing published research on the current topic and then replicating the methodologies to help identify those barriers. Through extensive literature review (see Chapter 2 – Challenges of E-learning) the TIPEC framework was identified as the most extensive and structured model which consolidates the IS based barriers in E-learning into four (4) categories.

However, as mentioned in chapter 2, the TIPEC framework despite its extensiveness, one cannot apply the framework as is, to identify the theorised barriers in an E-learning system. In order to understand the technological component related challenges / barriers /issues in a practical setting, an empirically validated instrument is required. Pertaining to this aim, Paper I aimed to quantify the "T" in the TIPEC, resultant questionnaire will act as a diagnostic tool in the investigation of the challenges relating to E-learning technological factors. Corresponding to the RO2.1 findings of this chapter focused towards providing i) a simplified list of Technological related E-learning barriers/issues, ii) quantitatively validating whether the theorised Technological category barriers are confirmed with the primary data, and finally iii) developing an empirically verified instrument which can help the researchers, E-learning experts/implementors, policy makers and HEI decision makers to highlight the barriers/issues related to IS in their institutes.

4.2 Abstract

Purpose – Despite the rooted benefits of the technology-based learning modules, failures of E-learning are well understood. Researchers, implementors and practitioners have all reported that these failures are due to underlying barriers/challenges/issues which hinders E-learning to deliver the promised benefits. Identification and subsequent removal of these reported hindering factors can increase the likelihood of success of E-learning platforms. In E-learning, technological components are the primary means of interaction and are considered to be the most important as compared to other aspects of E-learning modules. Appreciating the challenges related to E-learning technologies can help in designing, improving, and implementing a user-friendly, cross-platform compatible and robust E-learning solution. However, the literature also reports a lack of structured measuring instrument to identify and subsequent management of such challenges.

Design / Methodology / Approach – Three hundred and ninety-six (396) E-learning students, from three (3) universities, studying a range of management degree programs, were asked to complete a pre-defined structured quantitative questionnaire. Results are achieved by performing exploratory and confirmatory factor analysis using Structured Equation Modelling (SEM).

Findings – Principal component analysis (PCA) identified six (6) statistically significant barriers from the student perspective data, i.e., instead of the seven (7) original theorised within the TIPEC Framework (see Ali et al., 2018), resulting in the joining of 'Virus Attack' and 'Poor Quality of Computers' barrier constructs in the validated model.

Originality / Value – This study focuses on the seven (7) 'technology' related barriers and i) empirically validating whether or not these implementation barriers can be assessed by measuring the students perception, and ii) producing an empirically validated set of question items to support the identification of the technical barriers in practice. Being aware of technological barriers can assist the practitioners to appreciate the shortcomings related to "E' component in the E-learning systems in the project planning process, thus minimizing the impact of the barriers on long-term implementation success.

Keywords – TIPEC framework, student perspective, E-learning information systems, implementation technology Barriers, framework validation

4.3 Introduction

The implementation of E-learning Information System (IS) involves the complex interplay of people, technology, organisational structures, and the complex alignment of informal, formal, and technical norms held by multiple project stakeholders across educational institutions (Nadee et al., 2017). IS implementation failure is a well understood domain (Pankratz and Basten, 2013), and much is known about the barriers that limit E-learning implementations (Ali et al. 2018), yet still, 70% of E-learning IS projects fail to deliver all functional objectives (Hladik, 2013).

Due to the high risk / rate of failure, and despite the potential advantages, risk-averse Higher Education Institutions (HEIs) have traditionally rejected online solutions in preference of face-to-face and / or blended E-learning solutions (Farid et al., 2018). In January 2020, however, the World Health Organization (WHO) declared a global emergency, due to the COVID-19 pandemic, which resulted in governments across the world mandating social distancing. As a result of COVID-19, there has been a forced transformation in the way that people work, do business, receive services, study and learn, and socially connect with each other. This shift towards remote working gave a boost to the use of IT platforms and IS based solutions, and businesses who previously relied solely on traditional face-to-face approaches had to explore and develop new ways to conduct their business. As such corporations have come to experience first-hand the efficiency savings that virtual working can make on cost reduction and utilisation of resources (Azman et al. 2021; Dean et al. 2020).

Covid-19 restrictions overnight made traditional classroom-based teaching untenable; resulting in the closure of educational institutions in over 50 countries worldwide. Although many schools and universities shut their doors, physical closure did not mean an end to teaching and learning activities (Brooks and Bennett, 2021). Educators turned instead to the implementation and use of E-learning solutions, which are able to deliver (to various degrees of interactivity) educational material to users (i.e., full-time students and professional learners) via use of digital technology and the internet. In theory, E-learning technologies can help mediate life-long learning habits (Gillet, 2013), and can allow flexibility by supporting ubiquitous learning, i.e., anywhere and at any time (Batalla-Busquets and Pacheco-Bernal, 2013). Moreover, E-learning (over time) is arguably more cost effective per head than traditional learning modes (Kimiloglu et al., 2017), and can be used by commercial education providers to virtually enhance individual employee and team skill development (Muuro et al, 2014). Much research has shown that use of technology in education, if implemented and managed well, facilitates a 'better' solution than pure face-to-face models. The forced adoption of E-learning solutions led to an overnight shift towards the use of technology mediated education systems, however, the success of E-learning solution implementation has historically been hindered by a range of implementation barriers (Daultani et al., 2021). For over 30 years, researchers and education providers have struggled with, and sought to understand, the barriers that limit E-learning implementation. As a result, an increasingly significant body of literature exists, which summarises the failures that commonly occur (see Andersson and Grönlund (2009), Gaeta et al., 2011; Kwofie and Henten, 2011; Ali et al., 2018). Researchers have highlighted three major domains in which barriers exists i) students i.e., individual perceptions, attitude, skills (Abd El Halim, et al, 2022); ii) technology solutions (Quaicoe & Pata, 2020; Ali et al., 2021) and iii) teaching content and methodology (Uppal et al., 2017). To adapt continuously to ever evolving technologies thus require appreciating challenges related to technological components to increase the usability and ultimate conformance of learning.

To summarise issues that impact E-learning system implementation failure, Andersson and Grönlund (2009) proposed a framework, with a particular focus on developing countries. The proposed framework mapped related 30 papers, published between 1998 to 2008, against four issues 'types' that were identified in E-learning implementations i.e.,: Course related issues – research concerned with content, design, and delivery of courses {17 papers}; Individuals related issues – research that is pertinent to an individual's characteristics {26 papers}; Technological issues – research concerned with infrastructure, costs usability, and appropriate ness of technology {7 papers}; and Context related issues – research concerned with organizational, cultural, and societal challenges {2 papers}. Technology challenges included: Access, Cost, Software and interface design, and localisation. Context challenges were split into organizational (knowledge management, economy, and funding, and training of teachers and staff) and societal/cultural (role of teacher, attitudes on E-learning and IT, and rules and regulations) sub-groups. Course challenges were split into course design (curriculum, pedagogical model, subject content, teaching and learning activities, localisation, and flexibility) and support provided (support for student from faculty, and support for faculty) sub-groups. Individual challenge issues were split between role into student (motivation, conflicting priorities, economy, academic confidence, technological confidence, social support from home and employers, Gender, Age) and teacher / staff (technological confidence, motivation and commitment, qualification and competence, and time) sub-groups. Anderson and Grönlund concluded that although all challenges were equally valid in both developed and developing countries, research in developing countries focuses more on technology access and context issues, whilst research undertaken in developed countries tend to focus on individuals.

Ali et al. (2018), extending the work of Andersson and Grönlund (2009), developed a more extensive theoretical framework, entitled the TIPEC framework. The TIPEC framework is based on 26 years of published literature – 259 papers between 1990 to 2016 – and thematically identified sixty-eight (68) distinct theoretical E-learning IS implementation barriers. These 68 E-learning IS barriers (see Figure P1.1), were divided into four dimensions – similar in nature the high level concepts defined by Andersson and Grönlund, i.e.,: **T**echnology – E-learning barriers in literature related to Technology; **I**ndividual – E-learning barriers in literature related to Individual characteristics; **P**edagogy – E-learning barriers in literature related to teaching methodology, faculty, supporting staff, and course content; and **E**nabling **C**onditions – E-learning barrier that impacts all three other dimensions (e.g. administrative support, limited funds, security, etc).

The TIPEC framework provides us with an extensive list of theoretical barriers that literature discusses as potentially limiting E-learning IS implementation projects. Moreover, TIPEC framework encapsulates the three major aspects of E-learning barriers i.e., student/learner, pedagogy and technology related issues. Utilising the TIPEC dimensions can help researchers and implementors in the identification of prevalent E-learning components related issues in an institute. Resultantly an E-learning system which is user-friendly, addresses the needs of users i.e., students and a high-quality pedagogical design can be developed. Although the TIPEC framework provides a strong theoretical understanding of potential E-learning implementation barriers, the TIPEC framework, as proposed by Ali et al. (2018), is of limited practical use due to lack of contextual application. In order to be practically useful i) the TIPEC barriers need to be validated from the perspective of a key stakeholder, and ii) a set of structured question items needs to be developed to allow the project team (in advance) to identify the existence of problem barriers (Ali et al., 2018).

If issue validation could be achieved, and structured questions could be developed, then the E-learning factors within each of the TIPEC framework dimensions (e.g., Technology, Individual, Pedagogy and Enabling Conditions) could be identified within E-learning contexts in advance; allowing IS implementers to focus on contextually relevant barriers during the planning phase. Accordingly, this paper aims to validate issues within the technical TIPEC dimensions from a students' perspective – as the student is arguably the key stakeholder of education. Confirming the technical issues impacting students and developing a set of validated questionnaire items to highlight these technology factors in practice, will allow the implementation team to practically use the TIPEC framework to identify technical issues in advance of solution deployment.

4.4 Understanding Technological Challenges

Although all TIPEC barriers are important, the effort involved in validating all barriers, i.e., as part of one data collection session, is practically impossible and ethically inappropriate. Accordingly, in this paper we focus on consideration of the Technology barriers (i.e., technology infrastructure, technical support, bandwidth and connectivity, software and interface design, compatibility, computer quality, and virus attacks). The TIPEC framework describes sixty-eight (68) barriers (see Figure P1.1). Seven (7) barriers relate to Technology, twenty-six (26) relate to Individual, twenty-eight (28) relate to Pedagogy, and seven (7) relate to Enabling Conditions. Basir et al. (2021) already empirically validated the Individual TIPEC dimensions, and identified 16 significant barriers impacting students, i.e., instead of the 26 theoretical barriers mentioned in the TIPEC framework. The major differentiator between traditional learning and E-learning is use of technology in the transfer of knowledge.

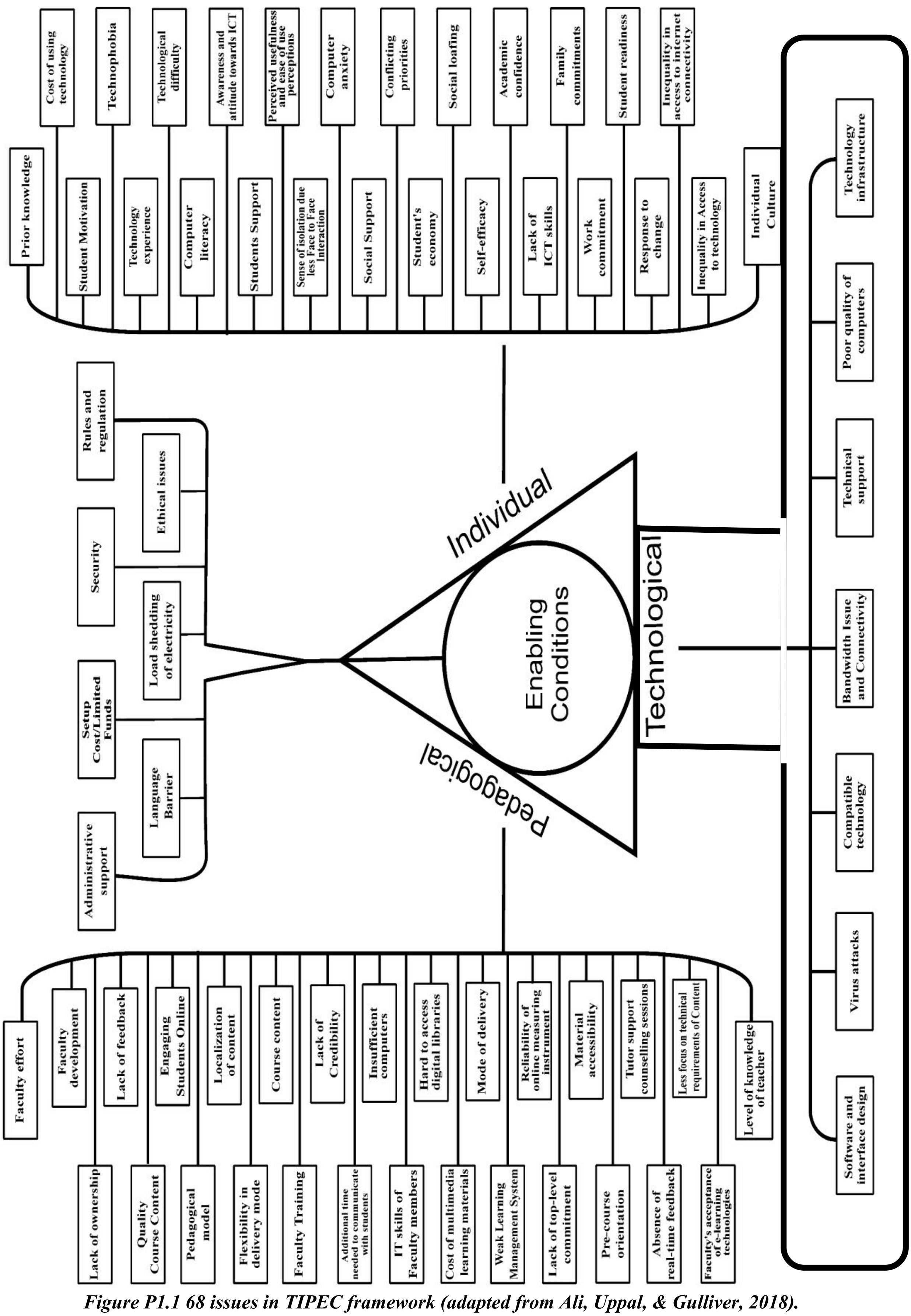

Figure P1.1 68 issues in TIPEC framework (adapted from Ali, Uppal, & Gulliver, 2018).

As such, technology is selected in our study because, although the number of technical factors is limited (i.e., to 7 theoretical barriers), E-learning technological components need to be in place before all other dimensions can be considered (Farid et al., 2018). Technical barriers are the most frequent when considering online communication (Gutirrez-Santiuste et al., 2016), and accessibility to technology remains a key issue; especially in developing countries (Davies and West, 2014). Accordingly, in this research the authors aim to i) validate whether the seven theoretical technical barriers, highlighted within the TIPEC model (see Table P1.1), are seen as distinct by student users, and ii) develop a set of explicit questionnaire items to practically identify the existence of these issues in practice.

To support the reader, the following text expounds on the seven theoretical factors categorised within the technical TIPEC dimension, i.e., as proposed by Ali et al. (2018); with a mapping to relevant literature (see table P1.1), and the original definition of the terms.

Table P1.1 Definitions Technological Barriers (adapted from Ali, et al. 2018)

BARRIER	LITERATURE	DESCRIPTION
Technological Infrastructure	Davie and Wels (1991), Soong et al. (2001), Wild et al. (2002), Little (2003), Vrasidas (2004), Surry et al. (2005), Voogt (2009), Goyal et al. (2010), Meyer and Barefield (2010), Waycott et al. (2010), Shelton (2011), Teo (2011), Alshwaier et al. (2012), Guy (2012), Kipsoi et al. (2012), Qureshi et al. (2012), Reeves and Li (2012), Alsabawy et al. (2013), Graham et al. (2013), Nwabufo et al. (2013), Gutiérrez-Santiuste and Gallego-Arrufat (2016), Güllü et al. (2016), Ozudogru and Hismanoglu (2016)	Refers to the hardware, software, facilities, and network capabilities within the college/institution.
Technical support	Venkatesh (2000), Pagram and Pagram (2006), Sife, Lwoga, and Sanga (2007), De Freitas & Oliver (2005), Poon and Koo (2010), Soong, Chan, Chua, & Loh (2001)	Unavailability of technical staff and lack of facilities to perform various activities (installation, operation, maintenance, network administration and security).
Bandwidth Issue and Connectivity	Ali (2004), Poon and Koo (2010), Mahanta and Ahmed, (2012), Homan and Macpherson (2005), Reilly et al. (2012), Nor and Mohamad (2013)	Slow speed of Internet and high internet traffic during E-learning experience.
Software and interface design	Andersson and Grönlund (2009), Swan (2004), Kwofie and Henten (2011), Marzilli et al. (2014)	Less user-friendly software and interface design during E-learning experience.
Compatible technology	Koller et al. (2008), Gudanescu (2010), Marzilli et al. (2014)	Incompatibility of content with a variety of learning management systems / technology.
Poor quality of computers	Radijeng (2010)	Low quality computers that freeze frequently and outdated computer systems.
Virus attacks	Qureshi et al. (2012), Aruna and Prakasa (2013), Shonola and Jo (2014), Nikoi and Edirisingha (2008), Gong and Cai (2006), Chao (2008)	Virus attacks on E-learning systems during E-learning experience.

4.4.1 Technology Infrastructure

Chang and Chuang (2011) define technology infrastructure as the technical systems within an organisation that determines how knowledge is disseminated by the organization and accessed by the user. If technological deficiencies exist, most E-learning systems fail to deliver the desired system requirements and content service level. Users commonly do not have the technical expertise available to support and maintain the technology (Alexander and McKenzie, 1998) resulting in system failure and lack of continuance. Soong et al. (2001) mentioned that all the efforts to make E-learning successful would be 'useless' if the technological infrastructure is either i) not up to date, ii) slow, or iii) if the user has problems (e.g., errors or faults) when trying to access course content. The findings of Soong et al. reveal that students lose interest in, and stopped using, the E-learning system if the system froze or failed to deliver smooth content. The University of Istanbul reported similar findings, i.e., that poor / outdated technology hinders student acceptance and adoption of E-learning programmes (Güllü et al., 2016).

4.4.2 Technical Support

The level of knowledge that teachers and students have (across the organization) when engaging with E-learning based technology is critical to the ultimate learning experience. To ensure that stakeholders, both lecturers and students, are able to capture, upload, disseminate, and/or access remote learning material, it is essential that educational institutions provide continuous technical assistance and support. Literature argues that a lack of relevant technical support provision can result in low motivation and commitment (from both students and staff) towards the adoption and continued use of E-learning technology (Kwofie and Henten, 2011). Indeed, the results of related academic studies showed that a lack of technical support is a major barrier to student's system adoption (Marzilli et al., 2014); with most students / teachers losing interest in the use of E-learning systems if support problems persist (Soong et al., 2001).

4.4.3 Bandwidth and Connectivity

Transfer of video content is one of the major facilities of E-learning IS, but slow internet connections can cause lag, jitter, and/or termination of the media (Nor and Mohamad, 2013). Low bandwidth connections also hinder the sharing of large media files, downloading of course material, and use of complex interactivity. Barriers to Internet connectivity, as a result of device or network limitations, impact the teacher's ability to capture and upload high-bandwidth content in a timely fashion, and the students' ability to download high-bandwidth streamed material and / or be involved in complex interactive experiences. A significant portion of the proportion of the world, due to limitations in infrastructure, still struggle with limited access to high-end computing devices due to internet connection speed. Students, particularly in developing countries where E-learning is most in demand, are limited to low-bandwidth solutions often accessed via use of a mobile phone (Gudanescu, 2010).

4.4.4 Software and Interface design

Software interface is a barrier that refers to the ease by which either student or staff are able to interact with the E-learning system software. Less user-friendly interfaces can hinder human computer interaction, which in turn can lead to rejection of the E-learning system (Andersson and Grönlund, 2009). Systems that are seen to be more user-friendly were found to be more successful, and adoption rates for usable E-learning were found to be higher (Kwofie and Henten, 2011). Poorly designed and complex user interfaces commonly lead to confusion and can end with user frustration; leading to IS rejection and failure. In short, interface design plays a vital role in the acceptance and intention to use the system by the user.

4.4.5 Compatible Technology

Despite the wide use of technology in higher education, the most commonly used teaching models and methodologies are not compatible with the latest in technological development (Khashunika, et al., 2021). Ensuring compatibility between educational technology and the learning needs of students is critically important (Gudanescu, 2010). Curriculum that is designed without effective consideration of the technology component will not likely achieve the desired learning outcome (Marzilli et al., 2014).

4.4.6 Poor Quality of Computers

Performance and quality of E-learning devices positively correlate with students' attitude toward the E-learning (Pehlivanova et al. 2009). This result suggests that students who use low quality and/or outdated devices are more likely to have a poor attitude towards E-learning services; due to network and process freezing issues, which hinder the E-learning experience

(Radijeng, 2010). It is critically important, therefore, to manage the students' perception of E-learning service, that appropriate user device management is considered.

4.4.7 Virus Attacks

The final technical category proposed by Ali et al. (2018) relates to the concern caused by the impact of virus and malware attack on personal devices (Shonola and Joy, 2014). A system virus attack does not only impact a single user but can silently damage an entire network; spreading to other devices via email or portable media (Rjaibi et al., 2012). Users who have experienced virus attacks have experienced problems including loss of data, reduced system efficiency (Gong and Cai, 2006), loss of sensitive information (Chao, 2008), and total loss of system functionality (Aruna and Prakasam, 2013). The impact of such attacks, especially as many students use their own devices to view educational material, is enough to deter some users from using the E-learning system at all (Qureshi et al., 2012). Making E-learning IS virus free is very difficult, and Universities, therefore, advertise the risk of virus attacks, yet this compounds the student perception of risk and negatively impacts system engagement.

Although the seven theoretical technical barriers proposed by Ali et al. (2018) were clearly defined and justified, no contextual validation of these technical barriers, i.e., from a specific stakeholder's perspective, was completed. Moreover, no practical set of question items was defined to highlight the existence of these barriers; and hence implementation project teams are unable to practically use the TIPEC framework to identify the existence of these barriers as part of E-learning system implementations. The following study aims to address these two limitations for technical dimension barriers.

4.5 Methods and Analysis

This section provides a detailed description of the instrument development, respondent profiles, pilot analysis, and final model testing.

Instrument Development, Pilot Study, and Respondent Profile

One outcome of this study is a set of empirical questionnaire items, to facilitate the validation and quantification of theoretical TIPEC framework technological dimension barriers from the students' perspective. The authors reviewed the published literature for the seven (7) technical constructs (see table P1.1) and, using closed and self-administered structured questions, the authors developed a range of question items for each construct. Initially, thirty-one (31) question items were developed, i.e., five (5) items for Technology Infrastructure (TI), four (4) items for Technical Support (TS), five (5) items for Bandwidth Issues and Connectivity (BC), four (4) items for Software and Interface Design (SI), five (5) items for Compatible Technology (CT), four (4) items for Poor Quality of Computers (PQ), and four (4) items for Virus Attack (VA). A 7-point Likert scale was used for each questionnaire item, with responses 7 and 1 representing respectively 'Completely Agree' and 'Completely Disagree'. A pilot test was conducted with fifty (50) students, and responses were analysed to identify whether any items failed to load, loaded with very low values, or loaded to incorrect constructs.

Feedback from the pilot study identified that question item statements for 'compatible technology' and 'bandwidth and connectivity' constructs were causing some ambiguity and/or confusion for respondents. These statements were adjusted to clarify the question item's meaning, and new questions were checked by some E-learning experts to ensure the semantic distinction of question items within each category. The main dataset consisted of data collected from three hundred and ninety-six (396) students. Respondents were currently registered on BBA, BSc, MBA, Executive MBA, and Corporate Executive university courses across a range of universities and training institutes (in Pakistan). All respondents had existing experience with E-learning courses and had the functional technical ability. Data was initially analysed (using SPSS) to consider normality, reliability, and means. Fourteen (14) responses were discarded due to missing values and/or normality and reliability issues, leaving three hundred and eighty-two (382) full responses for final analysis.

Exploratory Factor Analysis

In order to check the reliability and validity of constructs and items, Exploratory Factor Analysis (EFA) and Confirmatory Factor analysis (CFA) were conducted. Kaiser-Meyer-Olkin

Measure of Sampling Adequacy, with Varimax rotation and Maximum likelihood extraction, was used. Hair et al. (2010) encouraged careful evaluation of the factor matrix, in order to remove items that do not load to constructs with values greater than 0.5. Initial EFA identified that 8 items had either loading values less than 0.5 or were cross-loading into other factors. These 8 items were removed (i.e. TI_5, TS_4, BC_3, BC_4, CT_4, VA_3, VA_4, and PQ_3) and the model loadings were re-performed using a varimax rotation and maximum likelihood. The final resultant items can be seen in appendix P1.A.

Table P1.2 Rotated Factor Matrix (Maximum Likelihood)

Items	**Factor Loadings**					
	1	**2**	**3**	**4**	**5**	**6**
TI_1				.818		
TI_2				.854		
TI_3				.762		
TI_4				.729		
TS_1						.887
TS_2						.867
TS_3						.815
BC_1					.886	
BC_2					.903	
BC_5					.860	
SI_1			.762			
SI_2			.804			
SI_3			.785			
SI_4			.780			
CT_1		.926				
CT_2		.751				
CT_3		.778				
CT_5		.785				
PQ_1	.863					
PQ_2	.888					
PQ_4	.887					
VA_1	.862					
VA_2	.816					
Cronbach's Alpha	**0.955**	**0.894**	**0.829**	**0.883**	**0.946**	**0.928**

Results (see Table P1.2) showed that all 23 items loaded to constructs with values greater than 0.5, yet 'Virus Attack' items (i.e., VA_1 and VA_2) cross loaded with the 'Poor Quality of Computers' items (PQ_1, PQ_2, and PQ_3); suggesting that students identified questions as being linked to a single construct. Accordingly, VA and PQ items were combined to create a new construct, which the authors entitled 'Device quality and security'. Six factors were extracted in the final rotated component matrix (see Table P1.2). The cumulative variance of the six factors was 81.775%, and eigenvalues of all extracted factors were above 1; thus, implying that extracted factors account for a valid proportion of variance. The communalities for all 23 question items (presented in Appendix P1.A) were higher than 0.65, with most being higher than 0.8, suggesting that factor analysis is reliable and that constructs are distinct and discrete. The final Cronbach's Alpha of all final six factors was greater than 0.80 (See Table P1.2), demonstrating a high level of reliability within each construct (Nunnally and Bernstein, 1994). KMO sampling adequacy values were found to be 0.870 (see Table P1.3), and Bartlett's test sig < 0.05; implying that the chosen variables correlated.

Table P1.3 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.870
Bartlett's Test of Sphericity	Approx. Chi-Square	7392.291
	Df	253
	Sig.	.000

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was conducted to confirm the six factors extracted using EFA. Figure P1.2 presents the exploratory factor SEM analysis model for the 23 question items and six extracted constructs (i.e., TecInf – Technical Infrastructure; TecSup – Technical Support; BanCon – Bandwidth Issue and Connectivity; SofID – Software and Interface Design; ComTec – Compatible Technology; DeQS - Device quality and security), and shows correlation between the respective items, as well as correlation amongst each construct. Factor loadings for all 23 items, with their respective constructs, were above 0.7 (with majority being higher than 0.8); thus confirming a strong correlation amongst extracted factors with respective constructs. Composite reliability (CR) was tested to investigate internal consistency amongst all the items (Fornell and Larcker, 1981). The threshold value of Composite reliability, for each of the six constructs, was above 0.8, thus confirming their reliability (see Table P1.4). AVE for all six constructs was higher than 0.5 (Igbaria and Iivari, 1995); thus, verifying the convergent validity. Discriminant validity, which signifies the distinction amongst the different constructs used to measure different traits (Carmines and Zeller, 1979), was less than the average variance extracted (AVE) (Hair et al., 2010) - see Table P1.4.

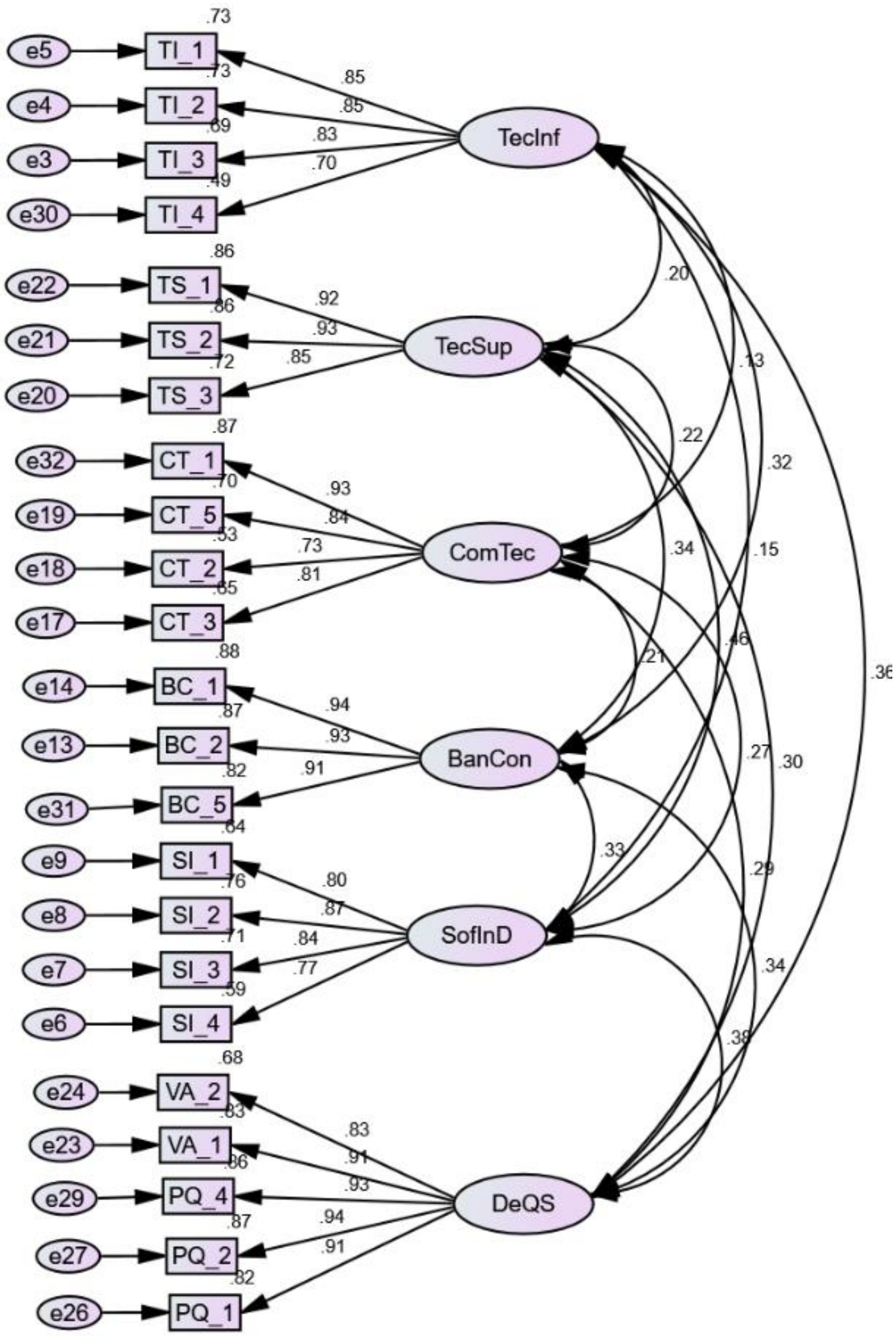

Figure P1.2 Structured Equation Model for CFA

Table P1.4 Construct Validity and Reliability

Constructs	CR	AVE	MSV	ASV	DeQS	TecInf	TecSup	BanCon	SofInD	ComTech
Device Quality and Security (DeQS)	0.96	0.81	0.15	0.11	**0.90**					
Technology Infrastructure (TecInf)	0.89	0.66	0.13	0.06	0.36	**0.81**				
Technical Support (TecSup)	0.93	0.81	0.21	0.10	0.30	0.20	**0.90**			
Bandwidth Issue and Connectivity (BanCon)	0.95	0.86	0.12	0.10	0.34	0.32	0.34	**0.93**		
Software Interface and Design (SofInD)	0.89	0.68	0.21	0.11	0.38	0.15	0.46	0.33	**0.82**	
Compatible Technology (ComTech)	0.90	0.69	0.08	0.05	0.29	0.13	0.22	0.21	0.27	**0.83**

Model Fitness

Table P1.5 presents the obtained model fitness values, and the threshold of each measure (Hu and Bentler, 1999). The six constructs were identified using a student focused empirically captured quantitative data; thus results, which suggest that students perceive six failure categories, and combine VA and PQ items within the new 'Device quality and security' construct, have been validated and confirmed.

Table P1.5 Measures of Model Fitness

Measures	Values	Threshold
CMIN/DF	**2.225**	< 3 good
CFI	**0.964**	> 0.90
AGFI	**0.870**	> 0.80
SRMR	**0.050**	< 0.09
RMSEA	**0.057**	< 0.05 good, 0.05 – 0.10 moderate
PCLOSE	**0.053**	> 0.05

4.6 Discussion

Contribution to Theory and Research

Throughout the covid-19 pandemic, remote E-learning technologies have offered an alternative to face-to-face learning, yet the many benefits gained by using E-learning are partnered by a number of issues and barriers that were highlighted in literature well before the pandemic started. The speedy implementation of E-learning systems in schools and higher education institutions resulted in a spike in the use of IS based E-learning solutions, however, the barriers summarised in the TIPEC framework (Ali et al., 2018) were not removed.

This study extends the theoretical work of Ali et al. (2018) by validating, from the student stakeholder perspective, six (6) Technology-focused barriers; instead of the seven (7) thematically conceptualised by Ali et al. (2018). Since technology is arguably the most critical component in any E-learning system (Liu and Wang, 2009), validation and quantification of the Technological TIPEC dimension allows us to get a better understanding, from the student stakeholder perspective, of critical implementation barriers.

Table P1.6 – Original TIPEC Factors VS Validated Technology Focused Factors (after EFA and CFA)

Technological Factors- TIPEC Framework (Ali et. al 2018)		**Technological Factors - Validated Student Perspective**	
1	Technological Infrastructure	**Factor 1**	Technological Infrastructure (TecInf)
2	Technical Support	**Factor 2**	Technical support (TecSup)
3	Bandwidth Issue and Connectivity	**Factor 3**	Bandwidth Issue and Connectivity (BanCon)
4	Software And Interface Design	**Factor 4**	Software and interface design (SofInD)
5	Compatible Technology	**Factor 5**	Compatible Technology (ComTec)
6	Poor Quality of Computers	**Factor 6**	Device Quality and Security (DeQS)
7	Virus Attacks		

This study contributes to the research domain by both validating 5 of the original barriers proposed by Ali et al. (2018) - i.e., Technology infrastructure, Technical support, Bandwidth and connectivity, Software interface and Design, and Compatible technology) – and by introducing and validating a combined 'Device Quality and Security' barrier (see Table P1.6). Table P1.6 provides the empirical versus the theorised factors proposed within the technological dimension of the TIPEC framework, which provides a more structured and objective understanding of short-comings of the "E" component in e-learning. Factor 6 "Device Quality and Security" also signifies the need for validation as the system vulnerability and the quality is considered to be a single challenge. Much focus in the past has been given to understanding and investigating the students' intentions, the requirement for the design of the system, critical success factors, learning quality and behavioural studies, etc. However, studies aimed towards providing a structured approach to support the identification of technological limitations that hinder student experience of learning had not been previously developed and/or validated.

Practical Implications

Despite the comprehensive nature of the TIPEC framework, and the rigor with which it was developed, the TIPEC framework has the major shortcoming of being theoretical in nature. This lack of empirically validated question items limited the practical use of the TIPEC framework in E-learning implementation projects. Only when practitioners are given validated tools, i.e., validated construct question items, they will be able to identify in advance the barriers and issues that exist in context of each reality; thus, helping implementors to improve the likelihood of project success. Additionally, this understanding and subsequent removal of barriers/challenges can assist in the design of a learning solution that is robust, easy to use, and simple to interact. A robust and user-friendly system attracts more users and is more quickly adopted. Further to this, it can also support in the development of system which compatible across different devices (Laptop, Tablet, or Smartphone). In contrast to utility in a pre-implementation project environment, the current study can also support in answering critical questions where a system is not able to achieve its full potential, i.e., i) is our system easy to use? ii) does our system support cross-device compatibility? iii) what are the infrastructural challenges for the users? etc. Answering these questions will highlight additional prominent challenges that limit the success of the final solution. At the same time allowing the project team to manage these issues as part of the recognized project scope; thus, minimizing the chance of unplanned scope and failure.

The set of twenty-three (23) question items, which represent the six (6) student-perceived technical barriers (see Appendix A), can also be employed to gather user feedback, i.e., to consider the assistance required for users; since timely support can improve user perception and subsequent usage of the system. Making the management aware of the strong and weak aspects of the E-learning module.

4.7 Conclusion

Due to the global Covid-19 pandemic, education facilitated technology is being adopted across the globe to support a wide range of self-paced E-learning solutions. A rapid technological revolution offers considerable potential for transforming the methods used within teaching and learning (Caverly & MacDonald, 2003), however, the success rate of E-learning system implementation, and the level of subsequent student adoption of E-learning systems, is still low when compared to traditional face-to-face teaching models (Uppal et al., 2018). If E-learning solution providers are not able to identify barriers for consideration prior to the implementation of E-learning solutions, then we risk the proliferation of high failure rates. This high level of failure (post covid) risks education institutions turning away from E-learning tools in preference of traditional teaching and learning models.

By systematically reviewing E-learning barriers identified within literature, Ali et al. (2018) developed the theory-based TIPEC framework. The TIPEC framework categorised E-learning barriers into four dimensions (Technology, Individual, Pedagogy, and Enabling Conditions). Although this framework provided an extensive theoretical description of sixty-eight (68) implementation barriers (Ali et al., 2018), the framework itself failed to support practical identification of E-learning implementation barriers. If implementation project teams are not aware of implementation barriers before project commencement, education institutions risk not meeting the needs of students and / or academic staff; repeating the high failure rates that have traditionally impacted E-learning system implementations.

This paper validates barriers within the technical dimension of the TIPEC framework. Validation of technical barriers was achieved from the student's perception and supported the development of 23 question items that can identify six (6) distinct implementation barriers (see Figure P1.3). This study is limited to validation of just the technical dimension, leaving validation of the other three dimensions (Individual, Pedagogy, and Enabling conditions) outside the scope of this study; as validating all dimensions at one time would be practically difficult to achieve. As such additional work is now being done to validate the other dimensions, which in time will result in i) a revised (validated) TIPEC model representing the student's perspective of E-learning failure, and ii) an extensive set of question items that support the identification of all students facing E-learning implementation dimensions.

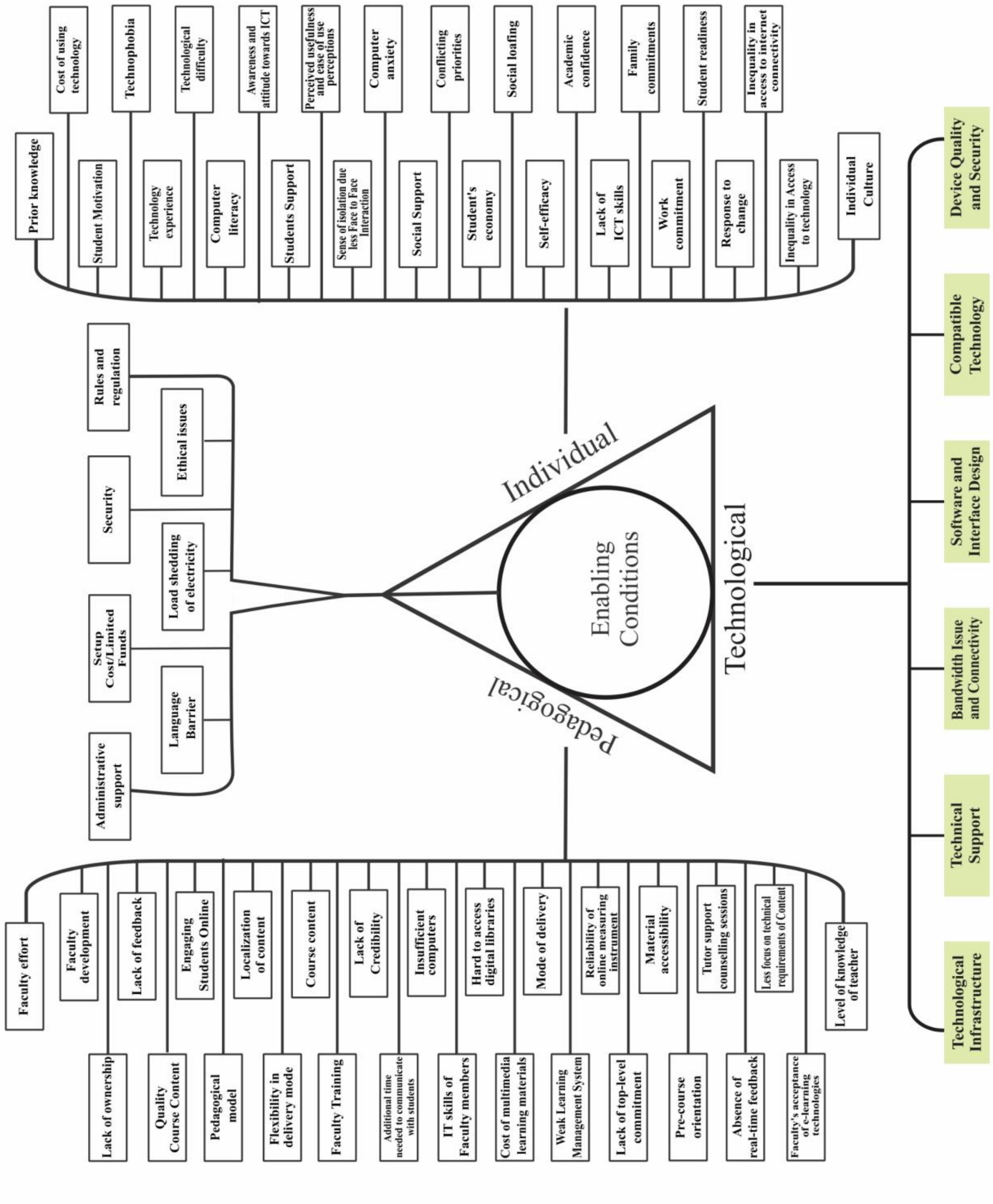

Figure P1.3 TIPEC Framework – Technological Dimensions Validated

4.8 References

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4.9 Appendix P1.A – Final 23 Items for Technological Barriers.

1	**Technology Infrastructure**
TI_1	No access to a computer/device hinders E-learning
TI_2	Slow/old computers/devices hinder in E-learning
TI_3	Infrastructure inefficiencies are a barrier to e-learning
TI_4	Too many IDs and login passwords are a barrier to E-learning
2	**Technical support**
TS_1	Unavailability of technical support staff (i.e., lab attendant, computer technician) hinders in E-learning
TS_2	Late response (turn-around) time from administration/technical staff is a barrier to E-learning.
TS_3	Facing difficulty in taking prints of assignments and materials hinders in E-learning
3	**Bandwidth Issue and Connectivity**
BC_1	Slow internet connectivity hinders E-learning at university campus
BC_2	Slow internet connectivity hinders E-learning at home and/or at work
BC_5	Slow Browsing speed hinders E-learning
4	**Software and Interface Design**
SI_1	Overly complex Screen design or User Interface hinders in E-learning
SI_2	Non-user-friendly system interface/design is a barrier to E-learning
SI_3	Poor E-learning system interface design (i.e., Website, LMS) is a barrier to E-learning
SI_4	Difficult navigation on the Website or LMS is a barrier to E-learning
5	**Compatible Technology**
CT_1	Inconsistency of course material is a barrier to E-learning on my device
CT_2	Course material format does not always run/open on my device
CT_3	Outdated E-learning system is a barrier to E-learning
CT_5	Outdated Technology devices which are inconsistent with the Course material are a barrier to E-learning
6	**Device Quality and Security**
DeQS_1	Outdated and poor quality of computers hinders in E-learning
DeQS_2	Local computer faults have results in my loosing work
DeQS_3	Computer/device which freezes frequently is a barrier to E-learning
DeQS_4	Virus and malware attacks hinders in E-learning
DeQS_5	I have lost my tasks due to virus attacks on more than one time

Paper II

Validating Learner based E-learning Barriers: Developing an Instrument to Aid E-learning Implementation Management and Leadership

Basir, M., Ali, S., & Gulliver, S. R. (2021)

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Chapter 5

Understanding E-learning User related Barriers / Challenges / Issues

5.1 Paper Overview

This chapter presents the second of three papers submitted as part of this thesis. Paper II considers the validation of user / student related barriers in E-learning systems, as education facilitated by technology is well appreciated around the globe to support a wide range of self-paced information technology-based learning solutions. A rapid technological revolution offers considerable potential for transforming the methods used within teaching and learning, however, the success rate of E-learning system implementation, and the level of subsequent student adoption of E-learning systems, is low when compared to traditional face-to-face teaching models.

Paper II aims to identify the individual/student related factors that limit the success of IS based solutions in teaching and learning. Expectations and issues faced by an individual/student should be managed carefully because an E-learning student works mostly in isolation from the instructor, the other students, and the educational institute, which makes him/her more subject to dissatisfaction towards E-learning systems and increases the chances of dropout.

The Individual category, as considered in the TIPEC framework, identifies 26 barriers that a(n) individual/student can face while using technological solution-based learning. To better understand the student's problems, addressing these barriers is very important for HEI decision makers either i) whilst planning to implement, ii) during and implementation, or iii) after the implementation of an E-learning based system. The qualitative nature of the TIPEC framework limits the application of the identified barriers in a real-time. Furthermore, researchers, E-learning experts / implementors, policy makers, and HEI decision makers aiming to investigate the barriers / issues that are prominent, and the cause of hinderance amongst individual / student

/ learners in their organisations, need these Individual category barriers in an instrument form which is measurable.

In line with the research objective 2.2 findings of this chapter focused towards providing i) a simplified understanding of user / student related E-learning barriers/issues, ii) quantitative validation of whether the theorised individual category barriers are confirmed with the primary data, and finally iii) an empirically tested instrument that can help the researchers, E-learning experts / implementors, policy maker, and HEI decision makers to highlight the barriers / issues related to individual/student in their institutes.

5.2 Abstract

Purpose

COVID-19 has had global repercussions on use of E-learning solutions. In order to maximise the promise of E-learning, it is necessary for managers to understand, control and avoid barriers that impact learner continuance of E-learning systems. The TIPEC framework (Ali et al., 2018) identified theoretical barriers to E-learning implementation, i.e., grouped into four theoretical concepts (7 Technology, 26 Individual, 28 Pedagogy, and 7 Enabling Conditions). This study validates the 26 theoretical individual barriers. Appreciating individual barriers will help the E-learning implementation team to better scope system requirements, and help achieve better student engagement, continuation, and ultimately success.

Design / Methodology / Approach

Data was collected from 344 E-learning students and corporate trainees, across a range of degree programs. Exploratory and confirmatory factor analysis was used to define and validate barrier themes. Comparison of results against Ali et al (2018) allow comparison of theoretical and validated compound factors.

Findings

Results of exploratory and confirmatory factor analysis combined several factors and defined 16 significant categories of barriers instead of the 26 mentioned in TIPEC Framework.

Originality / Value

Individual learner barriers, unlike technology and pedological barriers which can be directly identified and managed, appear abstract and unmanageable. This paper, considering implementation from the learner perspective, not only suggests a more simplified ontology of individual barriers, but presents empirically validated questionnaire items (see Appendix P2.A) that can be used by implementation managers and practitioners as an instrument to highlight the barriers that impact individuals using E-learning factors. Awareness of individual barriers can help content providers to adapt system design and/or use conditions to maximise the benefits of E-learning users.

Keywords – TIPEC framework, E-learning information systems, Implementation, Individual Barriers

5.3 Introduction

Heraclitus claimed that change is the only constant in life. Since the start of the twenty-first century there has been significant change - e.g., in society, health management, economics, business management – which is driven in part by the significant technology changes that have transformed how mankind captures, stores, and disseminates information and knowledge around the globe. In an increasingly virtual world, business managers, organization leaders, and education providers are increasingly enquiring whether technology solutions can be used to effectively and efficiently support their future education needs.

Internet-based technologies have been used to support ‘E-learning’ since the 1960s, however, tools were often limited in scope, limited in interactivity and functionality. As such, numerous researchers have criticised the effectiveness of using such E-learning solutions (Ali et al, 2018); raising concerns that remote E-learning students feel secluded, E-learning students suffer in their studies due to the low levels of student-teacher interactivity, and completion and satisfaction rates for online education / training are 10-20% lower than traditional face-to-face education (Ahmady et al. 2018).

Such findings, compounded by high upfront investment costs and cases of system implementation failure and rejection, have resulted in business managers, policy makers, and education providers defining E-learning education solutions as a poor-quality alternative to face-to-face teaching. On the of 30th January 2020, however, a paradigm shift occurred when the World Health Organization (WHO) declared the global COVID-19 pandemic. Governments around the world mandated social distancing and nationwide lockdowns, which resulted in the physical closure of educational institutes in over 50 countries. Although face-to-face teaching was stopped, the closure of educational institutions did not mean the cessation of teaching and learning activities. Throughout 2021 and 2022 businesses and education providers were forced to embrace E-learning solutions, i.e., because E-learning was the only viable solution to remote delivery of interactive education / training. As such, there has been a considerable investment made since 2020 in the development of E-learning solutions; since E-learning facilitates access to learning content in remote locations, by learners with unpredictable or unsociable working hours, with content accessible via low-cost client technologies (such a mobile phone). Accordingly, the demand for E-learning courses has grown exponentially, particularly in developing countries, and E-learning is rapidly becoming integral to the growth and success stories of education dissemination (Allen & Seaman, 2015). The global pandemic resulted in an increased adoption and use of technology mediated education, and much progress has been made to the scope and functionality of E-learning solutions, however, many of the barriers that hindered pre-covid implementation success, and ultimately the learner satisfaction of E-learning programs, still threaten the long-term continuance of E-learning solutions. Literature highlights many potential barriers to E-learning system success (e.g., Kunene & Barnes, 2017; Juutinen et al., 2018; Yunus, Lubis, & Lin, 2009; Aldowah, Ghazal, & Muniandy, 2015; Panda & Mishra, 2007; Andreea & Elena, 2020; Leary & Berge, 2006; Andersson & Grönlund 2009), which really need to be identified, and effectively managed, if E-learning systems are going to continue to be used once face-to-face options return. To summarise implementation barriers Ali et al. (2018) developed the Technology, Individual, Pedagogy and Enabling Conditions (TIPEC) framework, which identified 68 unique theoretical barriers to E-learning implementation success. The TIPEC framework considered research between 1999 and 2016 (i.e., 259 papers related to E-learning barriers), and thematically grouped barriers into 5 categories, i.e., Technology (7), Individual (26), Pedagogy (28), and Enabling Conditions (7). To date, the TIPEC model stands as the most comprehensive theoretical framework relating to E-learning barriers (Andreea & Elena, 2020), and offers considerable support to implementation practitioners in understanding and managing the barriers that possibly prevent the successful completion and use of E-learning systems.

Technical and pedagogy barriers can be internally identified, and managed more directly by the implementation project team, however, it is difficult for the project team to fully appreciate, measure, and/or manage the twenty-six {26} individual factors (e.g., limited technical ability/access, lack of confidence, and lack of motivation) which were highlighted by Ali et. al (2018) in the TIPEC framework - see figure P2.1. When evaluating challenges and barriers facing E-learning systems implementation, Tao et al. (2012) highlighted the importance of considering the learner's perception; since the learner is the ultimate stakeholder who determines E-learning system success or failure. Since the student's satisfaction is key to system acceptance and retention, which is also key to E-learning system success, it is critical that educators identify the existence of individual resistance barriers. Appreciation of individual differences, such as financial constraints, external commitments, technical ability /

access issues, lack of confidence, and lack of motivation, is critical to ensuring that the E-learning solution are not perceived as respectively being ‘too expensive’, ‘too inflexible’, ‘too technical’, ‘too intimidating’, or just ‘not what we wanted’. Currently, however, no mechanism exists to support the implementation project team in identification of individual barriers.

Technology and Pedagogy barriers may be overcome by developing infrastructure and/or by effectively managing the development of better education content, yet the significant invest required to develop the technology and/or pedagogy quality if meaningless if the learner fails to engage with the course due to a lack of basic technical skills and/or a lack of core resources at their discretion (Anagnostopoulou et al., 2015). To date, no attempt has been made to i) validate the Individual factors theoretically presented within the TIPEC framework, and/or ii) empirically validate a set of questionnaire items that can be used as an instrument to highlight the existence of individual barriers within a specific student cohort.

This paper, by capturing empirical data from the learner's perspective, not only aims to simplify the ontology of individual barriers, but develops a set of empirically validated questionnaire items to highlight the existence of individual barriers. Validating the impact of individual factors within the TIPEC framework clarifies the list of factors that need to be considered by implementation practitioners and education managers. Development of a validated and standard question items, which flag the existence of specific barriers, will help education providers maximise the chance that critical barriers are included/considered at the project requirements analysis and planning stage.

5.4 Literature Review

Good education is significant to the development of high value human capital (Liu, Li, & McLean, 2017). As such on-going education is critical to both economic competitiveness and business productivity (British Council, 2012), and education management is central to ensuring a highly skilled labour force. Traditional face-to-face education has considerable physical and temporal limitations (Saleem & Gouse, 2018). For that reason, traditional education is being transformed and augmented with technology-based learning solutions (Gillet, 2013). E-learning solutions, which support technology-based delivery and interaction with learning materials via a computer network (Zhang et al., 2004), are therefore increasingly being developed for use in society and business as the most likely answer to lifelong learning and effective education. Research shows that use of technology in education, if implemented and managed well, facilitates a 'better' solution than face-to-face alone, which is more efficient (over time), more effective (supporting technology, interface, and content customization/personalization), and is not limited by time and space over limitations of conventional learning approaches (Nnazor, 2009; Rajasingham, 2012).

The increasing demand for E-learning solutions is driving researchers and educational practitioners to better understand the antecedents that support successful E-learning implementation (Lee et al., 2009; Miliszewska, 2011). Esterhuyse & Scholtz (2015) classified E-learning barriers into five (5) dimensions – lack of resources, infrastructure issues, technical issues, organisation management, and social interaction. Sadeghi (2016) considers four E-learning issue categories – pedagogy, culture, technology, and e-practice. Gutirrez-Santiuste et al. (2016) presented four (4) students facing elearning barrier dimensions – Psychological Barriers, Sociological Barriers, Technical Barriers, and Cognitive issues. Andersson & Grönlund (2009), based on a review of 60 papers related to E-learning implementation failure, proposed a framework containing four (4) barrier dimensions: Course related issues; Individuals related issues; Technological issues; and Context related issues. Ali et. al (2018) expanded Andersson & Grönlund (2009) framework, based on a more comprehensive 259 papers from a range of countries and cultures, and proposed the TIPEC framework, which comprised of four (4) categories (i.e.,Technology, Individual, Pedagogy and Enabling Conditions) containing a total of sixty-eight (68) E-learning barriers (see Figure P2.1). The 'Technology', 'Individual', 'Pedagogy', and 'Enabling Conditions' categories contained respectively seven (7), twenty-six (26), twenty-eight (28), and seven (7) distinct implementation barriers (see Figure P2.1). This TIPEC framework, to date, is the most extensive model of E-learning success antecedents, reviewing 259 papers from 26 years of research (1990 to 2016) relating to E-learning barriers. The TIPEC framework presents a theoretical conceptual understanding of E-learning implementation barriers, however, the TIPEC framework is unvalidated, in part as validation of all 68 barriers is not practically possible at one time. Since the TIPEC framework as-is is unvalidated, use of the TIPEC framework in practice to guide implementation success is ill advised (Ali, Uppal, & Gulliver, 2018). As such, there is a considerable need to validate the existence of barriers, in order to promote consideration of barriers in practice.

When implementing any E-learning system, the most important stakeholder is arguably the student, since his/her motivation and satisfaction with the system will determine the ultimate impact of the E-learning system. Since E-learning success is directly linked to student acceptance of the system, student perception of barriers is therefore important, and needs to be identified and managed throughout any E-learning systems implementation project in order to ensure that the quality of the final E-learning experience is maximised (Serban, 2019); i.e., because poor student satisfaction will lead to long-term system failure (Alshehri, 2017). Accordingly, this study aims to empirically validate, via use of a structured questionnaire, how the twenty-six (26) theoretical individual barriers are perceived by students, i.e., the primary stakeholder of the higher education system (Ali et al., 2018).

5.5 Understanding the TIPEC Individual Barriers

To effectively capture the student perception of 'individual' implementation barriers, it is critical that the reader fully understands the 26 individual barriers defined in the TIPEC framework (Ali et al., 2018). The following describes each factor in turn:

1. **Student Motivation (SM) -** Because of the autonomous nature of E-learning, one of the documented downsides for students of online working is that self-discipline and self-motivation that is critical. Unlike a traditional face-to-face class, class times vary, and individuals do not often meet at a specific day or time, which reduces the responsibility to log on and complete their work to specific deadlines (Willging & Johnson, 2004).

2. **Self-efficacy (SEf) -** Lack of confidence, whilst handling computers, is seen as a key issue for not adopting E-learning. SEf (Joo et al., 2000) relates to a users' self-assessment of their ability to apply computer skills to accomplish tasks and is directly linked with the success and failure of the E-learning system (Cheng, 2011).

3. **Awareness and Attitude Towards ICT (ATICT) -** Lack of IT awareness can result in low rates of adoption because people are unaware of, or do not think positively to use of technology (Nagunwa & Lwoga, 2012; Mahmoodi-Shahrebabaki, 2014; Datuk & Ali, 2013). Findings of the study conducted by Kitchakarn (2016) stated that attitude towards the technology is an important factor in learning performance.

4. **Inequality in Access to Technology (IAT) – Hardware -** One of the important metrics of the digital divide is inequality in access to technology (Fairlie, 2004); particularly impacting developing nations. This inequality limits access to use of technology, and sometimes access to only outdated systems hinders E-learning.

5. **Individual Culture (IC) -** Students or individuals each have a unique set of beliefs, attitude and cultural norms, which plays a vital role in developing his/her attitude towards E-learning. The concept of individual culture states that each individual has a unique culture, which is different to that experienced at national or organiational levels (Yoo et al., 2011).

6. **Perceived Usefulness and Ease of Use Perceptions (PUEOU) –** In this context, perceived usefulness and ease of use relate to the users' perception concerning using an E-learning system. These perceptions have a direct impact on the students' intention to use the E-learning system (Davis, 1989; Venkatesh & Davis, 2000).

7. **Equality in Access to Internet Connectivity (IAIC) – Bandwidth -** Inequality in access to internet connectivity (bandwidth) is a main component for E-learning and for the lower-class high bandwidth solutions are still unaffordable (Okine et al., 2012; Farid et al., 2014). Hardware provision is not the same thing, as low bandwidth results in low interactivity in E-learning courses.

8. **Students Support (StSu) -** Mavroidis et al. (2013) reported that students prefer technology mediated learning if there is strong peer and staff support. The effectiveness of the E-learning can therefore be improved if the level of student support is improved (Valkanos & Fragoulis, 2007).

9. **Social Support (SoSu) -** "Social support is conceptualised as a protective factor in students' lives that contributes to students' successful adjustment to university" (Solberg & Viliarreal, 1997). Masoumi & Lindström (2012) also mention social support as being necessary to bring students into a E-learning environment; with effectiveness of support determining the perceived quality from the learners' perspective.

10. **Technophobia (TP) -** TP is the anxiety around future interactions with any technological component (Purushothaman & Zhou, 2014). Students who exhibit this phobia (unlike barrier 3, i.e., **ATICT**) are actively dismissive to new technology and unwilling to use technology as part of the learning experience (Juutinen et al., 2011; Khasawneh, 2018).

11. **Computer Anxiety (CA) -** CA is the anxiety around interaction with computers; however, some other technologies are used without concern (Powell, 2013). Learners with computer anxiety are almost totally resistant to use of E-learning (Stiller & Köster, 2016).

12. **Sense of Isolation due to reduced Face to Face Interaction (SI) –** Online, it is very difficult to engage learners because face to face interaction with the learner is not always possible (Mahmoodi-Shahrebabaki, 2014; Datuk & Ali, 2013). Literature signifies that reduced face to face interaction is one of the major reasons for E-learning students dropout rates (Luo et al., 2017; Nortvig et al., 2018).

13. **Social Loafing (SL) -** Williams & Karau (1991) define social loafing as the tendency to reduce individual effort when working in groups. In E-learning social loafing exists - when undertaking groups work – since there is often limited physical checks by lecturers that all group members are delivering an equal contribution. Literature mentions that individuals will be unlikely to exert extraordinary effort unless they view their individual task within the group project as meaningful (Karau & Williams, 1993).

14. **Student's Economy (SE) -** Lack of student funding is a major reason for E-learning student dropout (Kwofie & Henten, 2011). If the ongoing financial cost of the E-learning course is high, then the student may be reluctant to continue and/or complete the programme.

15. **Cost of Using Technology (CUT) –** CUT, similar to barrier 13, i.e., CA, can hinder the adoption of any E-learning system (Gupta & Jain, 2014) if upfront cost and/or cost of use (such as licence fee) is high; particularly relevant in developing nations where students may have low incomes.

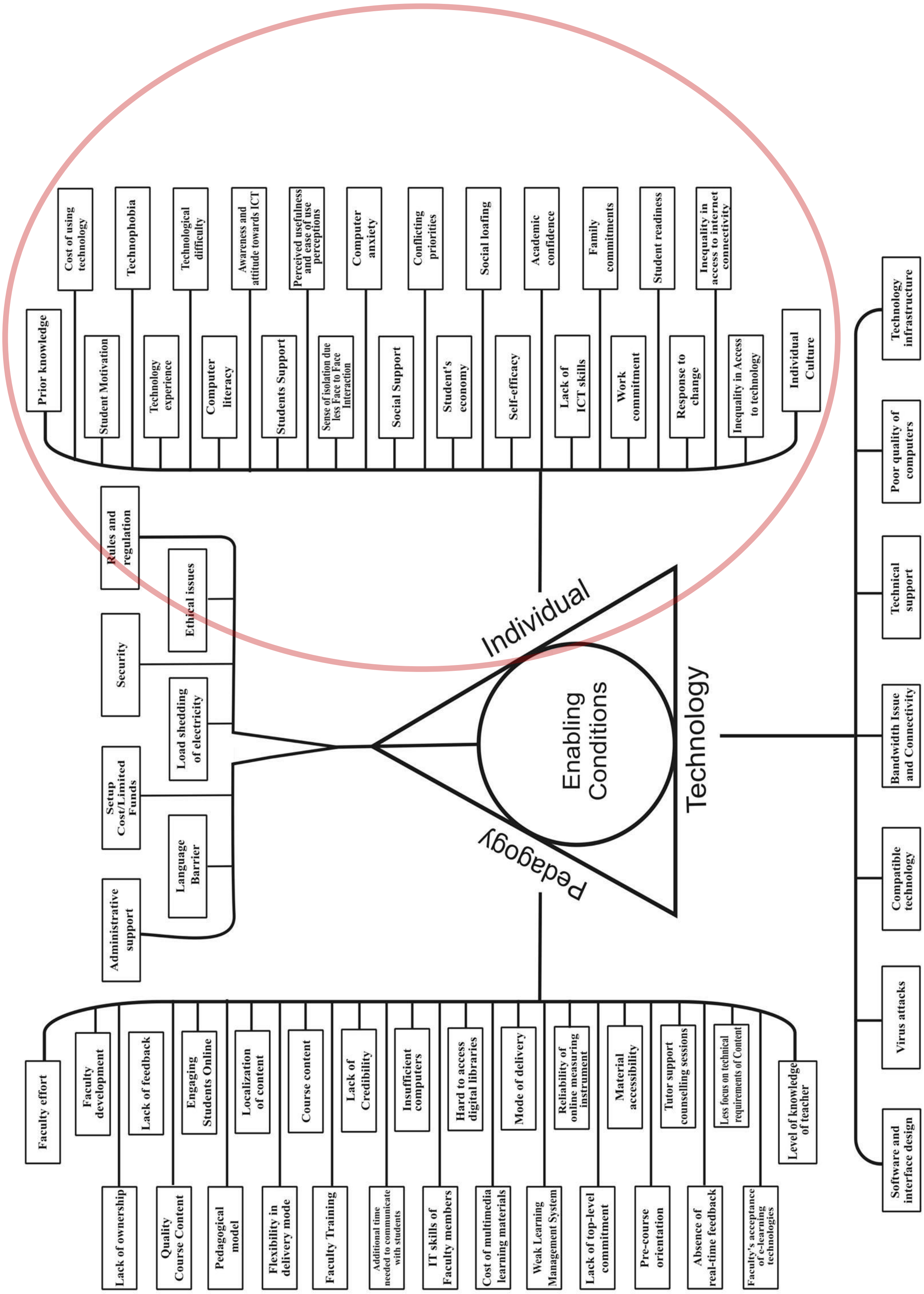

Figure P2.1. 68 issues in TIPEC framework (Ali et al., 2018). Individual issues are highlighted.

16. **Family Commitments (FC) -** A great deal of students who start E-learning courses have family commitments, which is one of the reasons they choose an E-learning programme over traditional programme (McManus et al., 2017). Many studies reported, however, that many students eventually stop studying due to these commitments (Valencia-Forrester et al., 2019).

17. **Work Commitment (WC) -** Students with work commitments are far more likely to dropout (Hack, 2016). Literature has reported that students often miss classes and deadlines due to their work commitments (Trede et al., 2019).

18. **Conflicting Priorities (CP) –** The amount of time an E-learning student has / wants to devote to the online courses – due to other personal and professional priorities – will impact the level of dropout and ultimate success (Safie & Aljunid, 2013). Idachaba and Idachaba (2012) state that over-reaching e-learners often feel more stressed and have a big problem in managing their time due to conflicting priorities.

19. **Student Readiness (SR) -** is the student's self-perception concerning their own ability to accomplish the learning task (Khanh & Gim, 2014). SR is perceived as a catalyst to successful online learning (Kunene & Barnes, 2017).

20. **Response to Change (RC) -** is a major issue in adoption of E-learning as people find it difficult to work in a fully electronic environment (Jager & Lokman, 1999; Song & Keller, 2001). Resistance to change can therefore hinder adoption of E-learning.

21. **Technological Difficulty (TD) -** Students still face technological difficulty and consider it as a barrier to E-learning success (Li & Jiang, 2017). TD is the difficulty students face while operating E-learning systems. Complex design of E-learning systems can also lead to student hinderance concerning usage of E-learning systems.

22. **Technology Experience (TE) -** Individual's exposure to, and experience of, learning technology systems impacts their learning experience (Al-Busaidi, 2013), and has a direct impact on the learning outcome (Wan et al., 2007). Arbaguh and Duray (2002) stated that experienced student satisfaction was greater than unexperienced student satisfaction.

23. **Computer Literacy (CL) -** Computer literacy is the declarative and procedural computer-related knowledge, familiarity with computers, and therefore self-confidence in using computers (Parlakkiliç, 2017). A low level of computer literacy will negatively affect student knowledge acquisition (Wecker, Kohnle, & Fischer, 2007).

24. **Lack of ICT Skills (LICTS) -** LICTS is arguably similar to factors 3, 22 and 23, however, this factor relates to a lack of specific ICT skills / training and is not related to a lack of access, experience, a phobia, or lack of self-confidence. Learners with no technical skill often get frustrated (Jarvis & Szymczyk, 2010) and are not always able to benefit or engage with E-learning opportunities (Al-Adwan & Smedley, 2012).

25. **Prior Knowledge (PK) –** Prior knowledge is referred to, by Ali. et al. (2018), as whether or not a student had exposure to the relevant material of the course. Student prior knowledge, i.e., of the subject / content, impacts E-learning success and student learning style (Akanabi & Dwyer, 1989). Use of E-learning and other technology aided learning can help the learning outcome of students with low prior knowledge (Last et al., 2001).

26. **Academic Confidence (AC) -** The student's academic confidence is a good predictor of an E-learning student success (Andersson, 2008).

Ali et al. hypothesised that these twenty-six (26) themed individual barriers need to be considered and/or managed in order to ensure E-learning success, however the TIPEC framework study is based on the theoretical concept theming of literature, and has not been quantitatively validated using real-world data (Ali et al., 2018).

5.6 Methodology

In order to validate the theoretical framework, there is a need to convert each of the individual barriers into testable instruments, in order to employ empirical observation through structured survey using a deductive approach (Petticrew et al., 2013). The approach used for item generation and selection during the process of questionnaire development is thus crucial (Glass & Arnkoff, 1997). We developed a bank of 85 items for the 26 individual barriers. Each item statement was developed after careful scrutiny of the recent literature relating to each of the barriers. To refine the construct items, initial lists of items were subjected to expert judgment for redundancy, content validity, clarity, and readability. This round of item assessment resulted in the elimination of (12) irrelevant items. Each of the remaining 73 question items was then examined critically for clarity and readability, and problematic items were reworded where confusion raised.

Closed ended questions and use of self-administered structured questionnaire method was selected. A 7-point Likert Scale was used to measure feedback for each of the remaining 73 item statements, i.e., with 7 representing 'Completely Agree' and 1 representing respectively 'Completely Disagree'. Finally, the revised instrument was piloted with 30 students for additional feedback concerning clarity of the items. Pilot testing is very important to determine how long it takes to complete the instrument, to establish if the instructions are clear, and most importantly, to identify if participants found anything objectionable, difficult, or unclear about the instrument item statements (Lackey & Wingate, 1998). The researchers analysed the results of the pilot study and identified that some of the statements were perceived as 'slightly confusing'. After making relevant changes to item statements, data collection was initialised. Respondents, due to the nature of the research, were students – from BBA, BSc, MBA, Executive MBA, and Corporate Executives degrees. In total, the authors gained responses from 344 participants. This data was cleaned and entered within SPSS, to facilitate preliminary tests to consider normality, reliability, and means. In total 17 responses were discarded due to missing values, and/or normality and reliability issues; leaving 327 full responses for use in analysis.

5.7 Findings

Exploratory Factor Analysis (EFA)

The very first step, after scale development, is to check the reliability and validity of constructs and items of the scale. Initially, before performing further analysis, and in order to group items based on the strong correlations, and check both reliability and discriminant validity, Exploratory and Confirmatory Factor analysis (EFA and CFA respectively) were conducted. EFA helps screen out the problematic questionnaire items/constructs. Kaiser-Meyer-Olkin Measure of Sampling Adequacy, with Varimax rotation and Maximum likelihood extraction, was used. KMO value should be greater than 0.5 for a satisfactory factor analysis to proceed.

Table P2.1 shows that the values of KMO and Bartlett's Test show higher strength of the relationship amongst observed factors.

Table P2.1 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.786
Bartlett's Test of Sphericity	Approx. Chi-Square	1625.9
	Df	1275
	Sig.	.000

We started with the 73 items, linked to 26 constructs, however, according to Hair et al. (2010) researchers should carefully evaluate the factor matrix for items that are loading to another factor, or load, with values less than 0.5. During the initial EFA iteration we found multiple cross-loadings, and low total variance. Hair et al. (2010) suggests that researchers can systematically remove problematic items, i.e., items with a low loading - less than 0.5 – and/or items that do not load.

After the removal of problematic question items, a 16-factor solution model was identified (see table P2.2) with a cumulative total variance of 81.5%. Eigenvalues of all extracted factors were above 1; implying that extracted factors account for a large proportion of the variable's variance. The communalities for the remaining 51 question items were higher than 0.55, with most being higher than 0.8, suggesting that factor analysis is indeed reliable. Table P2.2 shows the rotated factor analysis exhibiting 16 extracted factors along with respective factor loading using the maximum likelihood extraction method.

Table P2.2 Rotated Component Matrix (Maximum Likelihood Extraction)

Items	Factor															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SM_1	0.93															
SM_2	0.92															
SM_4	0.91															
SM_3	0.90															
SEf_3		0.88														
SEf_2		0.84														
SEf_4		0.68														
ATICT_2			0.87													
ATICT_1			0.73													
ATICT_3			0.64													
IAT_3				0.99												
IAT_2				0.88												
IC_2					0.77											
IC_3					0.72											
IC_1					0.69											
PUEOU_5						0.89										
PUEOU_3						0.75										
PUEOU_1						0.48										
IAIC_3							0.90									
IAIC_1							0.83									
StSu_4								0.93								
StSu_3								0.92								
StSu_1								0.91								
SoSu_2								0.90								
SoSu_3								0.90								
TP_2									0.92							
TP_1									0.91							
CA_1									0.90							
CA_3									0.88							
SL_2										0.95						
SL_1										0.93						
SI_1										0.77						
SI_3										0.75						
SE_1											0.94					
SE_2											0.94					
CUT_2											0.91					
FC_1												0.92				
CP_2												0.92				
WC_2												0.91				
SR_1													0.96			
SR_2													0.93			
RC_2													0.90			
TE_3														0.94		
TD_1														0.92		
TE_2														0.90		
LICTS_2															0.94	
LICTS_1															0.89	
CL_2															0.87	
AC_2																0.91
AC_1																0.89
PK_2																0.87

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis is necessary to confirm the factors that are in EFA. CFA was performed using SPSS AMOS on the 16 extracted factors / constructs. Construct validity and reliability of the 16 constructs and 51 items were tested and proved. First measure is Composite reliability (CR) it shows the internal consistency amongst all the items; to measure a single construct (Fornell & Larcker, 1981). The threshold value of CR for each single factor should be greater than 0.7. Composite reliability for all 16 constructs was above 0.8, thus confirming their reliability (see Table P2.3). Secondly, the construct validity is evaluated by confirming convergent and discriminant validity. Convergent validity is met when Average Variance Extracted (AVE) of the observed constructs is greater than 0.5 (Igbaria & Iivari, 1995). AVE for the 16 extracted constructs was higher than 0.5; with the majority being higher than 0.8 which confirms the convergent validity.

Table P2.3 Construct Validity and Reliability

	CR	AVE	MSV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Factor 1	0.96	0.85	0.03	**0.92**															
Factor 2	0.88	0.71	0.15	-0.01	**0.84**														
Factor 3	0.82	0.60	0.11	0.03	0.20	**0.77**													
Factor 4	0.94	0.89	0.01	0.10	0.07	0.08	**0.94**												
Factor 5	0.79	0.56	0.06	0.10	0.23	0.14	0.11	**0.75**											
Factor 6	0.78	0.56	0.06	0.03	0.20	0.18	-0.02	0.12	**0.75**										
Factor 7	0.96	0.92	0.03	0.02	0.04	0.17	-0.09	0.17	0.07	**0.96**									
Factor 8	0.97	0.86	0.06	-0.01	0.15	0.12	-0.05	0.09	0.24	0.08	**0.93**								
Factor 9	0.95	0.84	0.03	0.00	0.18	0.12	0.09	0.14	0.00	0.09	0.14	**0.91**							
Factor 10	0.93	0.76	0.04	-0.02	0.17	0.19	-0.04	0.05	0.12	0.07	0.19	0.15	**0.87**						
Factor 11	0.97	0.91	0.07	0.17	0.20	0.16	0.04	0.22	0.17	0.07	0.07	0.08	0.14	**0.95**					
Factor 12	0.96	0.90	0.11	0.02	0.23	0.17	0.05	0.25	0.13	0.10	0.04	0.12	0.15	0.16	**0.95**				
Factor 13	0.96	0.90	0.06	0.07	0.13	0.15	0.08	0.20	0.05	0.19	-0.03	0.12	0.02	0.16	0.24	**0.95**			
Factor 14	0.96	0.89	0.11	0.11	0.10	0.33	0.01	0.22	0.05	0.06	0.01	-0.06	0.05	0.12	0.12	0.08	**0.94**		
Factor 15	0.94	0.85	0.05	0.05	0.16	0.19	0.10	0.16	0.16	0.13	0.12	0.10	0.14	0.11	0.10	0.17	0.23	**0.92**	
Factor 16	0.96	0.89	0.15	0.08	0.39	0.11	0.08	0.21	0.21	0.04	0.21	0.09	0.21	0.27	0.34	0.08	0.04	0.11	**0.94**

As for the discriminant validity it is a major measure for CFA to confirm there is no multicollinearity issue in the observed model (Alarcón, Sánchez, & De Olavide, 2015). Maximum Shared Value (MSV) should be less than AVE to validate the discriminant validity, Table P2.3 shows that MSV for all 16 constructs is less than AVE.

Model Fitness

The last step of CFA is the model fit, which is used to measure / check how well the factors in the structure correlate with the variables in the dataset. A good fit signifies that factors in the model are correct, i.e., supported by the empirical data set. Table P2.4 presents the model fit values obtained, and the threshold of each measure (Hu & Bentler, 1999). Results suggest a good model fit; thus, confirming the observed model, which consists of 16 validated and confirmed constructs (See table P2.5). Accordingly, empirical validation of TIPEC Individual factors shows that students – in practice – combine together some of the 26 theoretical Individual barriers proposed by Ali et al. (2018), resulting in 16 distinct useable factors. See table P2.5, which presents an alignment between the theoretical categorisation in Ali et al. (2018) vs the results of the empirically validated model.

Table P2.4 Measures of Model Fitness

Measures	Values	Threshold
CMIN/DF(χ^2/df)	1.58	< 3 good
Confirmatory Fit Index (CFI)	0.96	> 0.90
Adjusted Goodness of Fit Index (AGFI)	0.80	> 0.80
Standardised Root Mean Square Residual (SRMR)	0.05	< 0.09
Root Mean Squared Error of Approximation (RMSEA)	0.04	< 0.05 good, 0.05 – 0.10 moderate

Nine (9) out of these sixteen (16) factors are compounded themes, which were formed by combining two or more factors from the theoretical TIPEC framework. The validated factors, see table P2.5, facilitates a revision to the individual factors contained in the TIPEC model. Detail of these nine (9) compound factors (8 to 16 – see table P2.5) are also described below:

8. **Support by Peers & Society (SPS) –** TIPEC factors Social Support (SoSu) and support from the fellow students, i.e., Students Support (StSu), were combined to encompass issues related to stakeholder support. To reflect inclusion of both original factors this factor was named 'Support by Peers & Society'.

9. **Computer Anxiety & Technophobia (CATP) –** Unsurprisingly, items related to Computer anxiety (CA) and Technophobia (TP) cross-loaded, hence factors were combined forming a single factor entitled 'Computer Anxiety & Technophobia' (CATP).

10. **Reduced Face to Face interaction (RFI) -** Social loafing (SL) and Sense of Isolation (SI) are both impacted by reduced levels of face-to-face interaction. Based on their definitions, the items we combined under a new factor entitled 'Reduced face to face interaction'.

Table P2.5 TIPEC Original Theorised Factors vs Validated Factors after EFA & CFA

Individual Factors- TIPEC Framework (Ali et. al 2018)		Individual Factors- Validated Current Study (2020)	
1	Student Motivation (SM)	Factor 1	Student Motivation (SM)
2	Self-efficacy (SEf)	Factor 2	Self-Efficacy (SEf)
3	Awareness and Attitude Towards ICT (ATICT)	Factor 3	Awareness and attitude towards ICT (ATICT)
4	Inequality in Access to Technology (IAT)	Factor 4	Inequality in Access to technology (IAT)
5	Individual Culture (IC)	Factor 5	Individual Culture (IC)
6	Perceived Usefulness and Ease of Use Perceptions (PUEOU)	Factor 6	Perceived usefulness and ease of use perceptions (PUEOU)
7	Inequality in Access to Internet Connectivity (IAIC)	Factor 7	Inequality in access to internet connectivity (IAIC)
8	Students Support (StSu)	Factor 8	Support by Peers & Society (SPS)
9	Social Support (SoSu)		
10	Technophobia (TP)	Factor 9	Computer anxiety & Technophobia (CATP)
11	Computer Anxiety (CA)		
12	Sense of Isolation due less Face to Face Interaction (SI)	Factor 10	Reduced Face to Face interaction (RFI)
13	Social Loafing (SL)		
14	Student's Economy (SE)	Factor 11	Students Finances (SF)
15	Cost of Using Technology (CUT)		
16	Family Commitments (FC)	Factor 12	Conflicting Priorities based on Commitments (CPC)
17	Work Commitment (WC)		
18	Conflicting Priorities (CP)		
19	Student Readiness (SR)	Factor 13	Student Readiness (SR)
20	Response to Change (RC)		
21	Technological Difficulty (TD)	Factor 14	Student's Technical Capability (STC)
22	Technology Experience (TE)		
23	Computer Literacy (CL)	Factor 15	Computer literacy (CL)
24	Lack of ICT Skills (LICTS)		
25	Prior Knowledge (PK)	Factor 16	Academic and Experiential Relevance (AER)
26	Academic Confidence (AC)		

11. **Students Finances (FE) -** Student's Economy (SE) and Cost of using Technology (CUT) were perceived as relating to a single factor, which was called 'Student finances' relating to money issues.

12. **Conflicting Priorities based on commitments (CPC) -** Three separate TIPEC factors, i.e., 'Work commitments' (WC), 'Family Commitments' (FC), and 'Conflicting Priorities' (CP), were combined within a single factor entitled 'Conflicting Priorities based Commitments'.

13. **Student Readiness –** Original 'Response to Change' (RC) and 'Student Readiness' (SR) items were combined within a new broader 'Student Readiness (SR) definition.

14. **Student's Technical Capability (STC) -** The factor/barriers 'Technological Difficulty' (TD) and 'Technology Experience' (TE) were combined under the term 'Student's

Technical Capability' (STC). This theme covers the broader definition of the students' ability and skills to use and handle the E-learning system.

15. **Computer literacy (CL) -** Question items for 'Lack of ICT skills' (LICTS) and 'Computer Literacy' (CL) were found to strongly correlate, under the new broader category 'Computer Literacy'.

16. **Academic and Experiential Relevance (AER) -** Question items from 'Academic Confidence' (AC) and 'Prior Knowledge' (PK) cross-loaded together, creating a new modified compound theme entitled 'Academic and Experiential Relevance' (AER).

5.8 Conclusion

Good education is significant to the development of high value human capital (Liu et al., 2017), which itself is core to effective management and organisational success. As such, investment in education and through-life training is critical to both the individual learner, who aims to maximise their own potential, and to business leaders, who need to ensure that staff continue to acquire the skills and knowledge required to maximise business performance and facilitate business evolution in light of domain, technology, and societal change. Technology facilitated education is increasingly being adopted by Higher Education Institutions (HEIs) and business organisations around the globe to facilitate self-paced training services. This shift in acceptance and use of E-learning solutions, offers considerable transformation to traditional models of teaching and learning (Caverly & MacDonald, 2003), yet individual learner barriers, if left unmanaged, risks continuance of E-learning solutions moving forward.

E-learning solutions are often perceived as a low-quality alternative to face-to-face teaching models (Uppal et al., 2018). To combat this negative perception in the future, it is important that E-learning system implementers fully consider, i.e., within requirements analysis, relevant factors that impact the learners' perception of system satisfaction, or we risk businesses, HEIs, and individuals rejecting use of E-learning solutions once face-to-face teaching options return.

Ali et al. (2018) developed the TIPEC framework by systematically reviewing literature and thematically forming a theoretical understanding of E-learning barriers that existed. The TIPEC framework categorised E-learning barriers into four (4) categories (Technology, Individual, Pedagogy and Enabling Conditions). Ali et al. (2018) identified numerous barriers / challenges that occur during E-learning implementation, yet i) the TIPEC framework was not validated against real-world data, and ii) no practical tool existed to determine the existence of specific factors in a specific context. In order to practically utilise / apply the TIPEC framework in E-learning projects, validated question items were needed to empirically link statement feedback to the existence of certain failure factors. This study provides researchers, practitioners, policy makers, and other managers with a validated instrument (see appendix P2.A) that can highlight the existence of individual barriers to use / acceptance of E-learning system.

Instrument development, testing, and validation, showed that, from the learner's perspective, there are 16 distinct and measurable barriers to E-learning use (see Appendix P2.A); including 9 compound factors that were formulated using results of our EFA and CFA analysis (see Figure P2.2). Our consolidated instrument not only supports measurement and identification of failure barriers / factors within real-world projects – as the questions can be used in practice - but will also help higher education institutions in order to gain a better understanding of how systems are impacting their students at an individual level. We also hope that question items, when asked across a range of HEI and professional service providers, across different countries, will help researcher understand which barriers are more prominent in specific cultures / countries / and organisation types.

The success of any information system is directly dependent upon the acceptance and use of its users. By using the validated items, in advance of an E-learning solution implementation, education organisations, and implementation managers, should be able to identify the presence of barrier impacting students (as individual). Since barriers can now be identified in advance of project deployment, the authors believe there is an increased likelihood that problems can be effectively managed, and that implementation problems can be more effectively avoided as part of the implementation project. As such, the authors believe that questionnaire items (see Appendix P2.A) can be used to forecast prominent barriers to E-learning, from the perspective of the learner (users), which can be then used to define system requirements and shape a positively enriching educational experience for all.

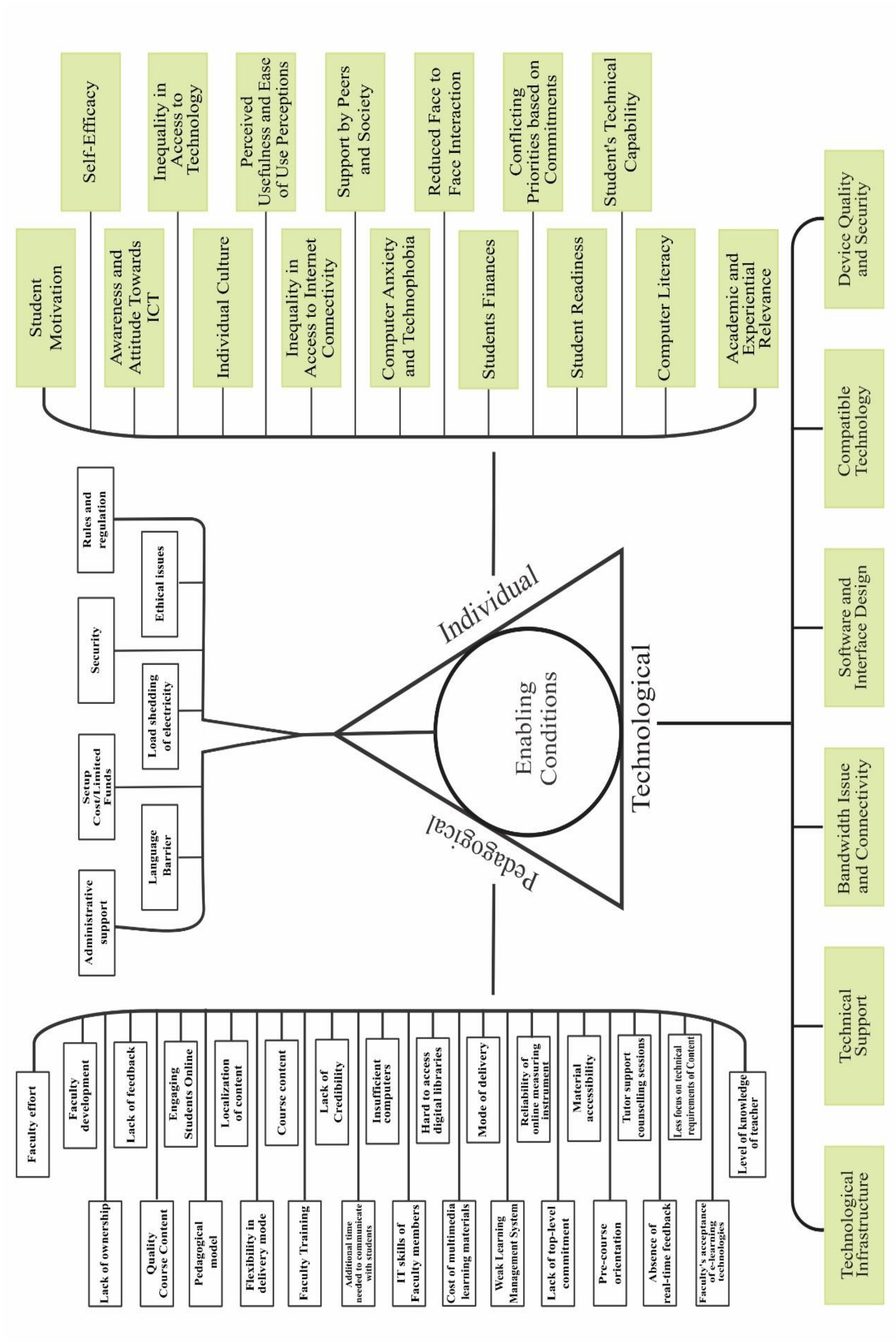

Figure P2.2 – TIPEC Framework – Individual Dimensions Validated

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5.10 Appendix P2.A

Factor (Question Item)	
1. Student Motivation	
If the course content being taught in the class is irrelevant, it would demotivate you and hinders in E-learning. (SM_1)	0.93
If you dislike learning through E-learning technologies in the class, it would demotivate you and hinder in E-learning. (SM_2)	0.92
If you have little or no motivation towards E-learning, it would hinder use of E-learning. (SM_4)	0.91
If the E-learning class is not interesting, it would demotivate you and hinder interest in E-learning. (SM_3)	0.90
2. Self-Efficacy (SEf)	
If you are sure that that you will not be able to complete the tasks assigned for the E-learning classes, it will hinder adoption of E-learning. (SEf_3)	0.88
If you are certain that you will not understand the ideas taught in the E-learning course, it will hinder adoption of E-learning. (SEf_2)	0.84
If you think that you will not receive a good grade in the class, it will hinder adoption of E-learning (SEf_4)	0.68
3. Awareness and attitude towards ICT (ATICT)	
Absence of awareness towards E-learning systems, hinders E-learning use. (ATICT_2)	0.87
Having a negative attitude towards E-learning would hinder E-learning. (ATICT_1)	0.73
If interaction with an E-learning system is not a fun experience, it would hinder use of E-learning. (ATICT_3)	0.64
4. Inequality in Access to technology (IAT)	
Students using outdated technology can hinder E-learning (IAT_3)	0.99
Unavailability of the required E-learning technologies hinders adoption (IAT_2)	0.88
5. Individual Culture (IC)	
If E-learning system does not align to your learning style, it will hinder use of E-learning (IC_2)	0.77
Providing E-learning solutions that do not consider the student's cultural values hinders use of E-learning (IC_3)	0.72
Do you think that student's personal expectation hinders E-learning? (IC_1)	0.69
6. Perceived usefulness and ease of use perceptions (PUEOU)	
I find it easy to get the E-learning system to do what I want it to do. (PUEOU_5)	0.89
Using the E-learning system will allow me to accomplish learning tasks more efficiently. (PUEOU_3)	0.75
The use of an E-learning system within a module improves my learning performance. (PUEOU_1)	0.48
7. Inequality in access to internet connectivity (IAIC)	
Low bandwidth internet connection hinders E-learning. (IAIC_3)	0.90
Does problems accessing the internet hinder E-learning. (IAIC_1)	0.83
8. Support by Peers & Society (SPS)	
No support from fellow students will hinder use of E-learning. (StSu_4)	0.93
Inability to contact instructors when necessary, hinders my use of E-learning. (StSu_3)	0.92
I get enough support via E-learning systems to manage my student affairs. (StSu_1)	0.91
No organizational support towards E-learning hinders use of E-learning. (SoSu_2)	0.90
Having non-conducive environment during E-learning sessions hinders use of E-learning. (SoSu_3)	0.90
9. Computer Anxiety & Technophobia (CATP)	
Feeling scared of working with the latest technologies hinders use of E-learning. (TP_2)	0.92
Feeling afraid of operating new systems hinders use of E-learning. (TP_1)	0.91

Nervousness about using E-learning is a barrier to use of E-learning. (CA_1)	0.90
E-learning systems being intimidating is a barrier to E-learning. (CA_3)	0.88
10. Reduced Face to Face Interaction (RFI)	
Does having less or no interaction amongst students hinder E-learning. (SL_2)	0.95
Does having less or no interaction between student and teacher hinder E-learning. (SL_1)	0.93
Absence of Physical meetings with instructor is a barrier to E-learning use. (SI_1)	0.77
Feeling of isolation during E-learning sessions hinders E-learning use. (SI_3)	0.75
11. Student Finances (SF)	
Financial cost of undertaking the E-learning course hinders adoption of E-learning. (SE_1)	0.94
Having limited funds would hinder my access to E-learning. (SE_2)	0.94
If the cost of technological components required in E-learning is high, it will hinder E-learning (CUT_2)	0.91
12. Conflicting Priorities based on Commitments (CPC)	
If family commitment takes up most of your time and resources, it hinders use of E-learning (FC_1)	0.92
Conflicts in an individual's priorities, due to undertaking an E-learning course, hinders E-learning use. (CP_2)	0.92
Absence from the exam and late submission of assignments, due to job commitments, can hinder your use of E-learning (WC_2)	0.91
13. Student Readiness (SR)	
Unwillingness to learn through E-learning, hinders adoption E-learning (SR_1)	0.96
If you are not ready for an E-learning course, it hinders your adoption of E-learning (SR_2)	0.93
Resistance to change, e.g., from the existing educational system to the new tools of E-learning, hinders adoption of E-learning (RC_2)	0.90
14. Students Technical Capability (STC)	
Being unable to solve technical problems might hinder use of E-learning. (TE_3)	0.94
Difficulty in operating E-learning systems hinders intention to use E-learning. (TD_1)	0.92
Lacking of technology experience will stop me completing E-learning tasks. (TE_2)	0.90
15. Computer Literacy (CL)	
Having less or no skills to operate technology hinders in E-learning. (LICTS_2)	0.94
If you do not possess adequate computer skills, it will hinder adoption of E-learning. (LICTS_1)	0.89
Little or no knowledge about computers will hinder the E-learning experience. (CL_2)	0.87
16. Academic and Experiential Relevance (AER)	
Having no academic experience related to the E-learning course would hinder adoption of E-learning (AC_2)	0.91
Not having relevant academic qualification hinders adoption of E-learning. (AC_1)	0.89
Do you think having no background knowledge related to the course content would hinder in E-learning? (PK_2)	0.87

Paper III

Empirical Validation of the TIPEC Framework – Understanding Pedagogy E-learning Implementation Barriers

Chapter 6

Understanding E-learning Teaching Methodology related Barriers / Challenges / Issues

6.1 Paper Overview

This chapter presents the third paper of three submitted as part of this thesis. This paper considers the validation of the challenges / barriers related to E-learning teaching methodology. Incorporation of technology in the field of teaching and learning has brought us many advantages, e.g., ubiquitous resources, self-paced learning, low cost, flexibility of time and space etc. These advantages have motivated many educational institutions to introduce E-learning systems as informal tools for learning and teaching inside and outside of classroom. This widespread adoption, with many promised benefits, however, experience numerous issues and problems that hinder implementation success, which in turn results in a high level of dropout and/or E-learning project failure.

There are various causes of the pedagogical failures, which impact course quality. Influencing factors include: usability / locality of content, instructor support, less interactive content, faculty member IT skills etc. Challenges / barrier / issues arising due to the lack of training and support given to educators, which limits their subsequent use of these technologies, must also be given relevant consideration. Barriers / issues related to teaching methodology and instructor are well grouped as part of the Pedagogical category of the TIPEC framework (see Chapter 2 – Dimensions of TIPEC Framework). Understanding pedagogical barriers / issues from the perspective of learner / student is necessary to identify his / her expectations, perceived shortcomings in teaching methodology and/or provision of learning content available within the IS based E-learning environment.

In paper III, the researcher addresses research objective 2.3. The findings of this chapter focus on providing i) a simplified list of Pedagogical related E-learning barriers/issues, ii) quantitative validation of the theorised Pedagogical category barriers confirmed by primary data, and iii) empirically tested instrument that can help the researchers, E-learning experts / implementors, policy makers, and HEI decision makers to highlight the barriers and issues related to pedagogical methodologies adopted in their institutions.

6.2 Abstract

Educational technology solutions offer considerable potential to the creation of value within the student learning experience; however, implementation failure is prolific and widespread. The TIPEC framework, which presents a theoretical summary of E-learning implementation barriers, provides an extensive and systematic review of E-learning barriers. In order to practically utilise the TIPEC framework, a set of validated question items was required. Accordingly, primary data from 426 respondents was gathered to quantitatively validate a developed set of question items using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Empirical data suggests the existence of 17 distinct student-facing pedagogical barriers, i.e., instead of the 28 theoretically theorised within the TIPEC framework. Eight compounded barriers were identified, which cover the scope of 19 original barriers. This paper provides a validated question instrument that will not only support measurement and identification of failure barriers within real-world projects, but help education providers, professional development and training institutes, to gain a better understanding of how to improve existing systems, and develop new teaching systems, methodologies, and content for online use.

6.3 Structured Practitioner Notes

What is already known about this topic:

- Using E-learning can add value to the student learning experience.
- E-learning implementation barriers have a negative impact on E-learning success.
- E-learning barriers are well documented, and numerous theoretical models exist.
- E-learning barrier models, such as TIPEC, are not commonly empirically validated.

What this paper adds:

- This paper empirically validates, from the student's perspective, the pedagogical TIPEC dimension.
- Analysis shows the existence of 17 distinct student-facing pedagogical barriers, i.e., instead of 28 theoretically theorised within the TIPEC framework.
- 19 original TIPEC factors were compounded, but the TIPEC structure is validated.

Implications for practice and/or policy

- The validated question instruments, which were developed in this paper, support the practical identification of failure barriers within real-world projects.
- Proactively identifying barriers to help education providers to improve old systems, delivery new systems, and make better use of teaching, methodology, and content within E-learning solutions.

Keywords

TIPEC Framework, Educational Technology Barriers, Pedagogical barriers, Questionnaire, SEM, Scale Development

6.4 Introduction

The Corona virus (COVID-19) epidemic has affected over 200 countries around the world. The first case outside China was reported on 14th of January 2020. Since that time there has been hundreds of millions of cases, and millions of deaths worldwide (Yan, et al., 2021). To face this crisis, companies and researchers around the globe have been seeking to efficiently address the information dissemination challenges, i.e., allowing the effective continuance of human education-based activities (Nadikattu et al., 2020). Due to ongoing restrictions, the education sector has been heavily affected in more than 200 countries (Cooper et al., 2020); with over 1.5 billion learners suffering because of institutional closure. Technology, in the form of E-learning, has provided a set of clear alternative tools that, despite restrictions to travel and location, support the effective and efficient dissemination of knowledge (Njiku et al., 2019).

The use of technological components in training and education is in constant flux (Beardsley, et al., 2021). In the 70s, 80s, and 90's many colleges supported 'distance learning', however, with the acceptance of the world wide web, many institutions worldwide have developed online learning solutions; later called E-learning or computer-mediated learning solutions.

E-learning includes any learning where software and online-learning information delivery platforms are used (Campbell, 2004). E-learning Information Systems (IS) are increasingly used to support "traditional" face-to-face learning solutions (Talip et al., 2018); and researchers have provided considerable evidence that E-learning systems provide many benefits for learners. The benefits of E-learning include self-paced learning (Labaran, 2017), resource sharing (So et al. 2019; Khan & Shah, 2020), cost effectiveness (Kamba, 2009), flexibility of time and space (Khamparia & Pandey, 2018; Rowe et al., 2013), and higher interactivity (Buniamin et al. 2020). Despite the many benefits of using E-learning, and the considerable projection of growth, literature is full of issues and barriers that ultimately result in low student engagement and increased student drop-out. The potential benefits of using E-learning, compounded by the pressure of the global pandemic, motivated many educational institutions to integrate E-learning systems in the support of learning and teaching, both inside (synchronous) and outside (asynchronous) the classroom (Almaiah & Alyoussef, 2019). As such, E-learning systems have become core to remote delivery and assessment of content throughout the covid pandemic – without which most universities would not have been able to function.

Despite the numerous benefits gained by adopting E-learning systems, educators must not ignore the many documented issues and problems that have been shown to hinder the implementation of E-learning solutions (Güllü et al., 2016; Prince et al., 2020; Huda et al., 2018; Ali et al., 2018; Basir et al., 2021; Selwyn & Aagaard, 2021). E-learning has facilitated the continuation of education-based activity throughout the pandemic, whilst maintaining remote working and spatial distancing (Lizcano et al., 2020), yet as the world pushes back towards foundation of a 'new normal', will E-learning continue to be accepted, or will it be rejected in preference of face-to-face solutions? Throughout the pandemic, E-learning has changed significantly, however, long-term use will require the strategic management of long-standing implementation barriers, problems, and issues (Basir et al., 2021).

To appreciate the extent of these barriers, Ali et al. (2018) proposed a comprehensive theoretical conceptual framework, called the TIPEC framework, which themed E-learning implementation barriers under four theoretical dimensions, i.e., Technological, Individual, Pedagogical and Enabling Conditions. Basir et al. (2021) empirically validated the "Individual" category of TIPEC framework. They proposed a concise and validated list of Individual barriers from the student stakeholder perspective, to support the practical identification of individual barriers within E-learning solutions. Basir et al. (2021) only considered one of the four TIPEC categories, yet suggested that the validation of the other dimensions was required. Accordingly, the aim of this paper is to empirically validate, from the students' perspective, the pedagogical TIPEC dimension, which includes consideration of barriers that relate to the method and practice of teaching.

6.5 Literature Review

Traditionally, education institutions have relied heavily on the use of face-to-face delivery of content. With students now gaining ubiquitous access to browser technologies, the pedagogical modes and models used by education institutions have been changing fast. Education by means of information system (IS), facilitated by use of information technology (IT), have resulted in the development to numerous fields of research, e.g., distance learning, online learning, blended learning, mobile-learning (M-learning), however, all areas can reasonably be encapsulated as subsets of E-learning. Despite the considerable potential of E-learning systems, substantial failure was identified in both implementation project success and E-learning system acceptance.

Andersson and Grönlund (2009) proposed a framework to model the issues limiting E-learning implementation in developing countries. The framework considered four types of issues that exist in E-learning implementation (i.e., Course related issues, Individuals related issues, Technological issues, and Context related issues). Kwofie and Henten (2011) mention 30 major challenges and categorised them into four major categories: i) individual characteristics (both students and teachers); ii) technological challenges; iii) course challenges; and iv) contextual challenges. The TIPEC (Technology, Individual, Pedagogical and Enabling Conditions) framework, proposed by Ali et al. (2018), considered 259 research papers (between 1990 and 2016) concerning E-learning implementation challenges / barriers / issues / factors; and theorised the existence of sixty-eight unique themes grouped into four dimensions - i.e., Technological (7), Individual (26), Pedagogical (28) and Enabling Conditions (6) (see figure P3.1). The TIPEC framework presents an extensive conceptual understanding of E-learning implementation barriers. However, the TIPEC framework is unvalidated in practice, and as such is unable, in practice, to guide E-learning implementation project team as to the existence of critical failure factors, barriers, and themes (Ali et al., 2018). Using Structural Equation

Modeling (SEM), Basir et al. (2021) subsequently empirically validated the individual dimension, and developed a survey instrument to facilitate the practical application of the TIPEC framework. Basir et al., revealed that, from a student perspective, 16 barriers existed, instead of the 26 theoretical barriers proposed by Ali et al. (2018).

In light of Basir et al.'s (2021) proof that TIPEC dimension validation is viable, there is a need to validate all TIPEC dimensions, i.e., to compare the empirical findings with the original conceptualised framework. Accordingly, this paper aims to validate, from a student perspective, the Pedagogical barriers that impact E-learning systems implementation. Once validated, findings result in i) a revised (validated) understanding of pedagogical barriers, from a student perspective, impacting E-learning failure, and ii) creation of a useable set of question items to support the pre-implementation identification of student facing pedagogical E-learning implementation barriers.

6.6 Understanding TIPEC Pedagogical barriers

To fully understand pedagogical barriers, the reader needs to understand in more detail the 28 theoretical barriers proposed within Ali et al.'s TIPEC theoretical framework (see figure P3.1):

1. **Faculty Development (FD)** – In a fast-paced world, teachers must embrace change. FD relates to the processes and activities required to improve the skills and knowledge crucial to improvement of teacher performance. The goal of faculty development is to support the faculty in addressing the learners' needs (Vandenhouten et al., 2012). FD determines how ready staff are to adopt new ways of teaching. Moreover, under-developed and unprepared faculty can cause many problems (Lotti, 2020).

2. **Faculty Training (FT)** – Teaching faculty are often left to work out E-learning solutions. A lack of teacher training is a major barrier to the roll out, adoption, and success of E-learning systems (Dagnino et al., 2018). Realising that faculty are not always equipped with the full set of skills needed to develop, deliver, and support E-learning programs can result in dissatisfaction, which has a negative effect on learning outcomes (Huda et al., 2018).

3. **IT Skills of Faculty Members (ITF)** - The shift from face-to-face learning to E-learning requires faculty to possess a base level of technical skills; i.e., in order to create, deliver, and manage E-learning content. Lack of basic technological skills is one of the consistent E-learning barriers (Al-Snaidi, 2009; Elliott et al., 2015).

4. **Flexibility in Delivery Mode (FDM)** – E-learning solutions offer higher ubiquity than traditional face-to-face methods (Carm and Øgrim, 2013), yet ability to benefit from this flexibility is sometimes curtailed by inflexibility in policy, time-tabling, administrative processes, and teaching content that restricts the application of E-learning flexibility.

5. **Mode of Delivery (MD)** – Keeping student engagement high is directly dependent upon the mode of delivery (Aini et al., 2020). Moreover, learner difference and experiences impact mode of delivery preference (Arthur-Nyarko & Kariuki, 2019). E-learning course materials should therefore be prepared to flexibly support the learner's specific delivery needs and learning styles (Osubor & Chiemeke, 2015).

6. **Weak Learning Management System (WLMS)** – Learner's preference and satisfaction towards the use of IS based learning can be negatively impacted by IS shortcomings (Mathrani et al., 2020). A lack of interactivity, vague features, lack of sharing, lack of support and/or discussion forums are all reported as barriers impacting weak system functionality (Al-Senaidi, 2009; Moekotte et al., 2017).

7. **Reliability of online Measuring Instrument (RMI)** – Some believe that use of IS based learning and assessment results in unreliable grading of students. The problem relates to increased risk of security, plagiarism, unauthorised collaboration (collusion), and cheating (Young and Duncan, 2014). Although these problems do exist in the traditional face-to-face learning environment, they are amplified when instructors do not physically see the students and their surroundings (Akimov & Malin, 2020). Concerns of validity and the reliability of online assessment, lead to resistance from academic and industry stakeholders (Fluck, 2019).

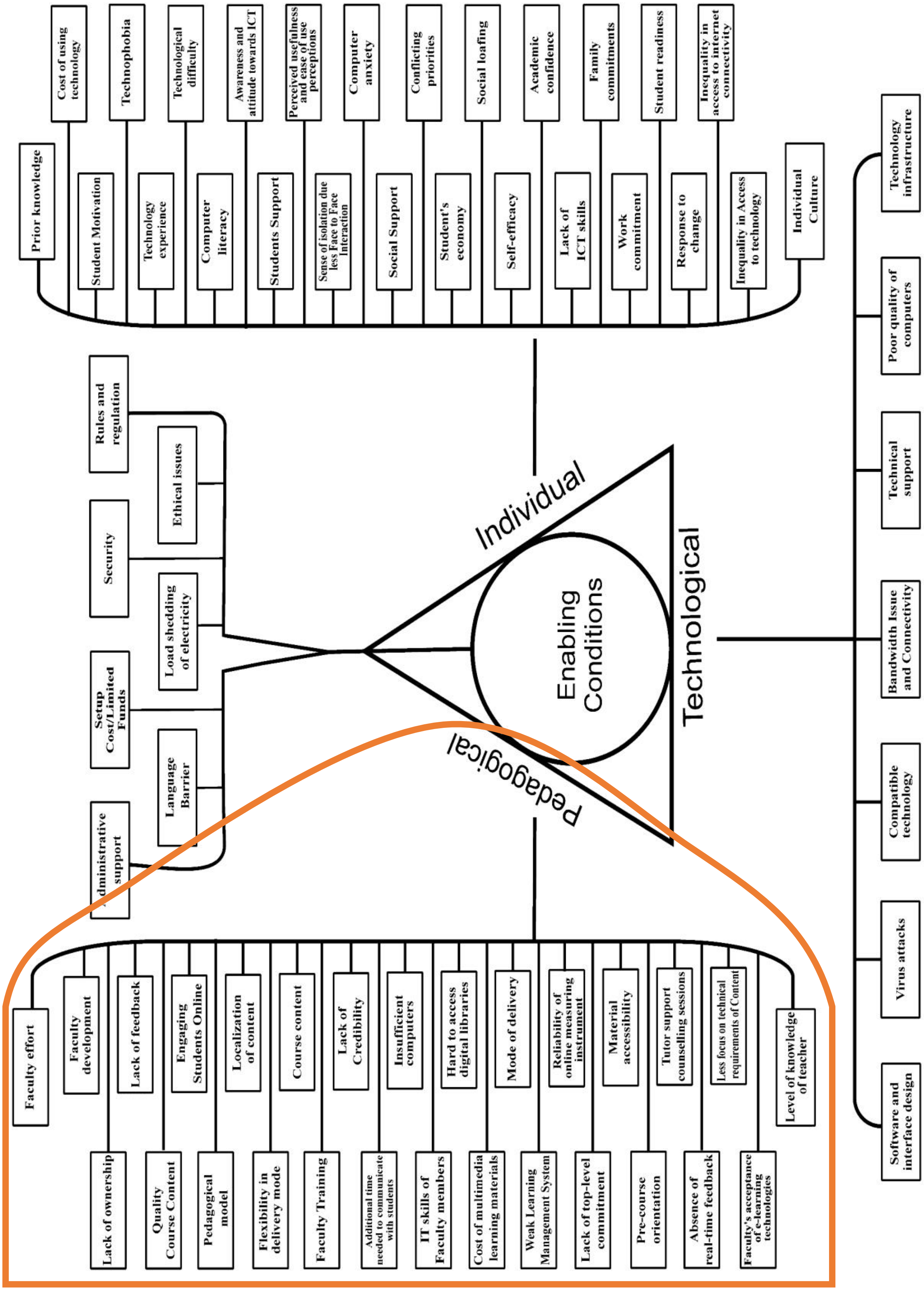

Figure P3.1 Pedagogical Barriers Selected within TIPEC framework (adapted from Ali et al., 2018)

8. **<u>Less focus on Technical Requirements of Content (LTRC)</u>** - A critical component of E-learning success is the compatibility of learning style with the technological use. Instructors not focusing on getting the content to align with the technical features of the E-learning system can cause problems that result in dissatisfaction amongst learners (Heinonen et al., 2017).

9. **<u>Additional Time needed to Communicate with students (ATC)</u>** – Students not receiving adequate communication from faculty is one of the major factors impacting dissatisfaction and dropout (Al-Senaidi, 2009). Research shows that students expect staff to be ubiquitously accessible (Teo, 2011), yet multiple factors practically prevent this from happening. Al-Jarf (2020) showed that most students in E-learning programmes faced long faculty response time throughout the duration of the course, which is a significant factor impacting student satisfaction.

10. **<u>Pre-Course Orientation (PCO)</u>** – Pre-course orientation is a valued first step in the E-learner's journey through the institution, i.e. offering the student, the opportunity to prepare for online learning with the assistance of institutional support (Beckford, 2015). Orientation comprises of a series of units covering high level program information, course tools tutorials, plagiarism and web source tutorials, introduction to course facilitators, and assignments to highlight student knowledge and problem areas. Orientation has a positive impact on learners' confidence, useability of software, and overall student results (Walters, 2018).

11. **<u>Tutor Support counselling sessions (TS)</u>** – A lack of counselling support has a negative impact on E-learning effectiveness (Coman et al., 2020) and student satisfaction (Ashby, 2004).

12. **<u>Lack of Feedback (LF)</u>** – If faculty put little or no effort into the provision of feedback, then learners are more likely to drop out or fail (Guy, 2012). The constant loop of feedback keeps learners engaged, and regular feedback on work helps them to improve the quality of their final assessment (Andersson & Grönlund, 2009).

13. **Absence of Real-time Feedback (ARF)** – The attitude of learners who do not gain prompt response / feedback from instructors is negatively impacted (Oluka et al., 2021). Aftab et al. showed that speedy replies are linked to satisfaction regarding E-learning (Aftab et al., 2019).

14. **Quality course Content (QC)** - The quality of course content is defined as the learner judgment concerning the value of content in context of learner needs (Mtebe & Raisamo, 2014). The quality of course content may be measured by considering its timeliness, relevance, usefulness, accuracy, importance, availability, and completeness (Xiao et al., 2020). Quality of course content is said to be the most important attribute influencing user satisfaction and successful implementation of E-learning; with course content quality dependent on good programme design and navigable delivery structure (Navimipour & Zareie, 2015).

15. **Course Content (CC)** – CC focuses on building the skills and competencies that lead learners to developing knowledge and problem-solving skills (Mittal & Raghuvaran, 2021); a strong path to successful employment. Alignment of IS based teaching to the employability market has faced criticism when compared to face-to-face teaching (Ozudogru & Hismanoglu, 2016). Accuracy of course content (Lester and Perini, 2010) and alignment of course content with employers' needs is therefore essential (Annan et al. 2020).

16. **Pedagogical Model (PM)** – Selection of the pedagogical model has a direct effect on the outcome of learning and teaching (Hamdan et al., 2020). Selection of the right teaching model impacts both learner and instructor. As such, to ensure adoption, the online E-learning system must support faculty in the preparation and delivery of relevant content / interactions.

17. **Localisation of Content (LC)** - Lack of customisation and adaptation of course content to local culture, language, and religious beliefs is a significant hinderance to E-learning system use (Nasrat et al., 2020); particularly in non-first world countries. Accordingly, E-learning tools must support course content provision / interaction that aligns to local needs (Ramoutar, 2021).

18. **Faculty Effort (FE)** – FE is the effort and support being invested by faculty members in the adoption and use of E-learning (Ali et al. 2018). If faculty fail to adopt and / or learn how to use the new E-learning technologies, then E-learning tools are likely to be under-used. Research shows that i) female faculty were more in favour of using E-learning than male faculty, and ii) faculty members do not commonly use the full range of capabilities available in the E-learning solutions (Darawsheh & Al-Shaar, 2020).

19. **Lack of Ownership (LO)** – LO relates to faculty not taking ownership of successful implementation of E-learning technologies, and lacking interest in meeting E-learning challenges. Ownership of every stakeholder is crucial to the effective implementing of E-learning technologies (Masalela, 2011). Faculty must not treat E-learning IS as being in 'competition' for student attention, or conversely, IT as 'the replacement' to designed education. The educators need to own the technology to improve their teaching practices across the whole organisation (Duveskog et al., 2014).

20. **Faculty Acceptance of E-learning Technologies (FAT)** – Faculty resistance to use of E-learning has always been high (Sánchez-Prieto et al., 2016), however, resistance risks impacting learner adoption and satisfaction (Porto, 2020).

21. **Engaging Students Online (ESO)** - Student engagement, a problem in remote E-learning (Moore & Signor, 2014), is essential in learning and is key to promoting student satisfaction. Many faculty report that, in the online environment, it takes more time, effort, and content creativity to engage students (Chen et al., 2011); with student engagement linked to student retention (Farrel et al., 2018). Paradoxically, developing student engagement for online courses is more important than traditional face-to-face courses because online students naturally have fewer opportunities to connect to peers, faculty, and the university (Prince et al., 2020).

22. **Material Accessibility (MA)** – One of the benefits of IS based education is its ubiquitous (anywhere / anytime) nature. Spring et al. (2016) stated that it is of paramount importance that all content is readily available to all learners when required. The E-learning experience can be rich, however, learners – particularly those with special learning needs - expect material to be accessible at any time (Anthony et al. 2019).

23. **Lack of Top-level Commitment (LTC)** - Insufficient support from top-level management, and absence of a clear vision and policy for E-learning development, can hinder long-term adoption of E-learning (Al-Senaidi 2009; Ng'ambi, et al., 2016). Institutional support is key, for both learners and faculty members, attitude towards the E-learning use and satisfaction (Güllü, et al., 2016).

24. **Lack of Credibility (LoC)** – Literature highlights a reluctance from employers to hire graduates who possess an online certification/degree (Dashtestani, 2020). Sharma et al. (2020) stated that the credibility of online programs can have a significant effect on learners' attitude and perception to engage and continue study. Many learners believe that engagement with E-learning solutions may result in them not getting an education of equal quality; and that this may impact their long-term employment options.

25. **Cost of multimedia learning Materials (CoM)** – The growing demand for E-learning programs requires learning material to be created or adapted, from traditional face-to-face courses, so that material can be delivered without the restrictions of time and space (Young and Duncan, 2014). Accordingly, it is essential that faculty are provided with the additional support and resources required to develop / adapt course material and activities (Rogers et al., 2018). A lack of adequate financial support, to support development of technology-based course content, can result in faculty resistance (Al-Senaidi, 2009).

26. **Level of Knowledge of Teacher (LKT)** - With increased focus on E-learning based delivery, concerns exist about faculty readiness, technical skills, and pedagogical knowledge (Sangwan, et al., 2021). Marzilli et al. (2014) stated that learners often complained that faculty members failed to grip the technological features of E-learning systems (2014).

27. **Insufficient Computers (IC)** – Students studying on campus are often guaranteed access to relevant learning technologies. Students studying online, however, are commonly expected to provide their own devices. Studies show that technology provision (for both learners and faculty member) need to be in place (Zimba et al., 2021) and that different devices present learning content differently to students.

28. **Hard to Access digital Libraries (HAL)** – When learners are working remotely, they need to have access to relevant supporting digital libraries. If users find it hard to access supporting quality digital resources, the ability of students using E-learning to complete assessments and succeed on the program will be affected (Sana & Mariam, 2013).

Pedagogical TIPEC barriers ideally need to be considered in advance of systems implementation and carefully managed by the project team to maximise the chance of E-learning success (Ali et al., 2018), yet empirical validation of these barriers is necessary before E-learning systems researchers / implementors / practitioners / policy makers can practically benefit from this comprehensive framework in the real project IS environment.

6.7 Methods and Analysis

Instrument Development, Pilot Study, and Respondent Profile

The aim of this research paper is to undertake empirical validation of the Pedagogical barriers, as illustrated in the TIPEC framework. To achieve this aim, a structured questionnaire was used (Chen, 2012), and considerable attention was given to the generation and selection of questionnaire items (Glass & Arnkoff, 1997). A bank of 90 items was developed to assess the twenty-eight (28) Pedagogical barriers. Before moving to pilot testing, initial validation for redundancy, content validity, clarity, and readability was undertaken by consulting a number of field experts; resulting in the rewording of a number of question items, and removal of three (3) question items due to redundancy and/or lack of clarity. Eighty-seven (87) question items remained within the question instrument. A 7-point Likert Scale was used to rate each statement; 7 being Completely Agree and 1 being Completely Disagree. Before moving to full-scale data collection, we did a pilot test with forty-five (45) responses. Pilot testing allowed us to determine i) the amount of time it takes to complete the instrument, ii) establish whether or not the questionnaire instructions were clear, and most importantly iii) identify whether or not participants found any part of the process to be objectionable, difficult, or unclear (Lackey & Wingate, 1998). Pilot study results were analysed to test question loadings, intercorrelations, and standard deviations. Pilot study feedback identified no issues in the questionnaire process; however, four (4) question items were perceived to be 'confusing'. After removal of the problem items, the researchers were left with 83 questionnaire items, which were tested using a self-administered method (See Appendix P3.A). After applying changes to the questionnaire, the full-scale data collection was conducted.

Respondents were students studying for a BBA, BSc (Management and Applied Sciences), MBA, Executive MBA, M.Phil., and executives enrolled in corporate training. A total of 426 responses were gathered, however 18 responses were discarded due to missing values and/or normality and reliability issues. As such, 408 responses were used for further data analysis.

Data Analysis

Statistical Package for Social Sciences (SPSS) and Analysis of Moment Structures (AMOS) software were used to undertake the analysis. To check the theorised question items, both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used.

Exploratory Factor Analysis

According to Hair et al. (2010) careful evaluation of question item loadings is required. Items with loading values below 0.5, and cross-loading items, are therefore removed to improve model reliability. The initial factor matrix solution exhibited both cross loadings, low total variance, and zero-loadings. We incrementally removed all cross-loading, loading below 0.5 and zero loading items (12 question items in total).

Table P3.1 Rotated Component Matrix (Maximum Likelihood Extraction)

Factor No.	Items	Factor																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Factor 1	FT_1	0.89																
	ITF_3	0.88																
	FT_2	0.87																
	ITF_1	0.86																
	FD_1	0.86																
	FD_2	0.86																
Factor 2	FDM_1		0.86															
	FDM_2		0.86															
	MD_2		0.86															
	FDM_3		0.84															
	MD_1		0.82															
Factor 3	RMI_1			0.95														
	RMI_3			0.94														
	LTRC_3			0.94														
	LTRC_2			0.91														
	WLMS_1			0.85														
	WLMS_2			0.82														
Factor 4	ATC_2				0.93													
	ATC_1				0.91													
	PCO_1				0.90													
	ATC_3				0.89													
	TS_2				0.89													
	TS_1				0.88													
Factor 5	ARF_1					0.87												
	ARF_2					0.86												
	LF_1					0.85												
	LF_2					0.83												
	LF_3					0.79												
Factor 6	CC_1						0.91											
	CC_2						0.87											
	QC_3						0.86											
	QC_2						0.84											
	QC_4						0.80											
Factor 7	PM_2							0.95										
	LC_1							0.95										
	PM_3							0.94										
	LC_2							0.82										
Factor 8	FAT_1								0.86									
	FAT_2								0.85									
	FAT_3								0.80									
	FAT_4								0.72									
Factor 9	ESO_2									0.89								
	ESO_1									0.87								
	ESO_3									0.83								
	ESO_4									0.81								
Factor 10	MA_1										0.85							
	MA_3										0.81							
	MA_2										0.79							
	MA_4										0.78							
Factor 11	LTC_1											0.93						
	LTC_2											0.92						
	LTC_4											0.87						
	LTC_3											0.87						
Factor 12	LO_1												0.92					
	FE_1												0.91					
	LO_2												0.89					
	FE_2												0.89					
	FE_3												0.82					
Factor 13	LoC_2													0.90				
	LoC_1													0.88				
	LoC_3													0.76				
Factor 14	CoM_1														0.94			
	CoM_2														0.83			
	CoM_3														0.81			
Factor 15	LKT_1															0.90		
	LKT_2															0.89		
	LKT_3															0.88		
Factor 16	IC_2																0.96	
	IC_1																0.79	
Factor 17	HAL_2																	0.97
	HAL_1																	0.84

Data analysis revealed seventeen (17) distinct factors (see table P3.1); using seventy-one (71) question items with the cumulative total variance of 81.4%, i.e., should be > 60% (Hair et al. 2010). Eigenvalues for each of the seventeen (17) factors were above one, implying that extracted factors account for a large proportion of the variable variance. Table P3.1 shows the rotated factor analysis exhibiting 17 extracted factors along with respective factor loading using the maximum likelihood extraction method. For all 71 question items communalities were higher than 0.7, with most being higher than 0.8, suggesting that factor analysis is reliable (Tarhini et al., 2015). Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, with Varimax rotation and Maximum likelihood extraction, was used to test the significant correlation between the items so, then the extracted factor solution can be used for further analysis. A significant KMO value above 0.5 is considered satisfactory (Kaiser, 1960), however a value above 0.7 is considered good. Table P3.2 shows a high strength of the relationship amongst observed factors, thus validating the factor solution is significantly reliable for further analysis.

Table P3.2 - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.844
Bartlett's Test of Sphericity	Approx. Chi-Square	31523.6
	Df	2485
	Sig.	.000

Confirmatory Factor Analysis (CFA)

Hair et al. (2010) stated that confirmatory factor analysis is necessary to confirm the factor solution extracted from EFA. Structure Equation Modeling (SEM) was used, with AMOS, to perform the CFA (see Figure P3.2). To test factor validity and reliability three tests were conducted:

- Internal consistency requires that Composite Reliability (CR) to be greater than 0.7 for all factors.
- Convergent validity, measured using Average Variance Extracted (AVE), ensures that items measure a distinct factor / construct. To be internally consistent AVE values must be above 0.5.
- Discriminant validity, which ensures no multicollinearity (Alarcón et al., 2015), is achieved when AVE is less than the Maximum Share Value (MSV) (Igbaria & Iivari, 1995).

Table P3.3 - Construct Validity and Reliability

Factors	CR	AVE	MSV
Factor 1	0.95	0.75	0.04
Factor 2	0.95	0.78	0.19
Factor 3	0.97	0.84	0.09
Factor 4	0.97	0.84	0.11
Factor 5	0.93	0.73	0.07
Factor 6	0.94	0.74	0.09
Factor 7	0.97	0.88	0.05
Factor 8	0.92	0.75	0.19
Factor 9	0.92	0.74	0.03
Factor 10	0.92	0.74	0.14
Factor 11	0.95	0.82	0.06
Factor 12	0.95	0.81	0.08
Factor 13	0.92	0.79	0.15
Factor 14	0.93	0.81	0.09
Factor 15	0.95	0.85	0.07
Factor 16	0.92	0.86	0.15
Factor 17	0.94	0.89	0.05

Table P3.4 - Internal Consistency for identified factors

Factors	**Factors**																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Factor 1	**0.87**																
Factor 2	0.06	**0.88**															
Factor 3	0.03	0.27	**0.92**														
Factor 4	0.09	0.27	0.21	**0.92**													
Factor 5	0.13	0.05	0.01	0.04	**0.85**												
Factor 6	0.12	0.00	-0.01	0.09	0.08	**0.86**											
Factor 7	0.07	0.09	0.09	0.17	0.23	-0.03	**0.94**										
Factor 8	0.09	0.44	0.29	0.33	0.09	0.06	0.12	**0.87**									
Factor 9	-0.01	0.06	0.10	0.07	0.12	0.12	0.09	0.07	**0.86**								
Factor 10	0.11	0.37	0.26	0.32	0.12	0.07	0.13	0.33	0.09	**0.86**							
Factor 11	0.03	0.05	0.08	0.05	0.25	0.11	0.07	0.13	0.06	0.09	**0.91**						
Factor 12	0.03	0.28	0.11	0.15	-0.04	0.04	0.04	0.19	0.01	0.24	0.06	**0.90**					
Factor 13	0.14	0.09	0.10	0.14	0.27	0.19	0.16	0.13	0.17	0.18	0.20	0.09	**0.89**				
Factor 14	0.09	0.09	0.06	0.18	0.18	0.29	0.19	0.09	0.11	0.14	0.10	0.02	0.20	**0.90**			
Factor 15	0.21	0.05	0.06	0.09	0.16	0.19	-0.04	-0.04	0.09	0.15	0.13	0.05	0.20	0.27	**0.92**		
Factor 16	0.11	0.10	0.15	0.11	0.15	0.14	0.18	0.08	0.13	0.08	0.14	0.03	0.39	0.13	0.20	**0.93**	
Factor 17	0.08	0.13	0.00	0.07	0.22	0.21	0.13	0.03	0.03	0.12	0.14	0.00	0.19	0.15	0.20	0.16	**0.94**

These measures clearly confirm the reliability and validity of current instrument factors and its relevant items for this paper (see tables P3.3 and P3.4).

Testing for Model Fitness

Hu & Bentler (1999) state that a good model fit signifies, that factors and questions in the model are adequate, i.e., the observed data fits established theoretical or empirical model as shown in Figure P3.2. In CFA, a model fit refers to how closely observed data match the relationships specified in a model created. Model fitness is achieved if Minimum Discrepancy Per Degree of Freedom (CMIN/df) is < 3; with P-value <0.05, Confirmatory Fit Index (CFI) > 0.90, Adjusted Goodness of Fit Index (AGFI) => 0.80, Standardised Root Mean Square Residual (SRMR) < 0.09, and Root Mean Squared Error of Approximation (RMSEA) < 0.05. Table P3.5 shows that all the assumptions of a good model fit are fulfilled, thus confirming use of the 17 student-focused pedagogical E-learning implementation barriers.

Table P3.5 - Measures of Model Fitness

Measures	**Values**	**Threshold**
CMIN/DF(χ^2/df)	1.55*	**< 3 good,**
Confirmatory Fit Index (CFI)	0.96	**> 0.90**
Adjusted Goodness of Fit Index (AGFI)	0.80	**=> 0.80**
Standardised Root Mean Square Residual (SRMR)	0.03	**< 0.09**
Root Mean Squared Error of Approximation (RMSEA)	0.03	**< 0.05 good, 0.05 – 0.10 moderate**

$^*P \le 0.05$, $^{**}P \le 0.01$, $^{***}P \le 0.001$, $^{****} P \le 0.0001$

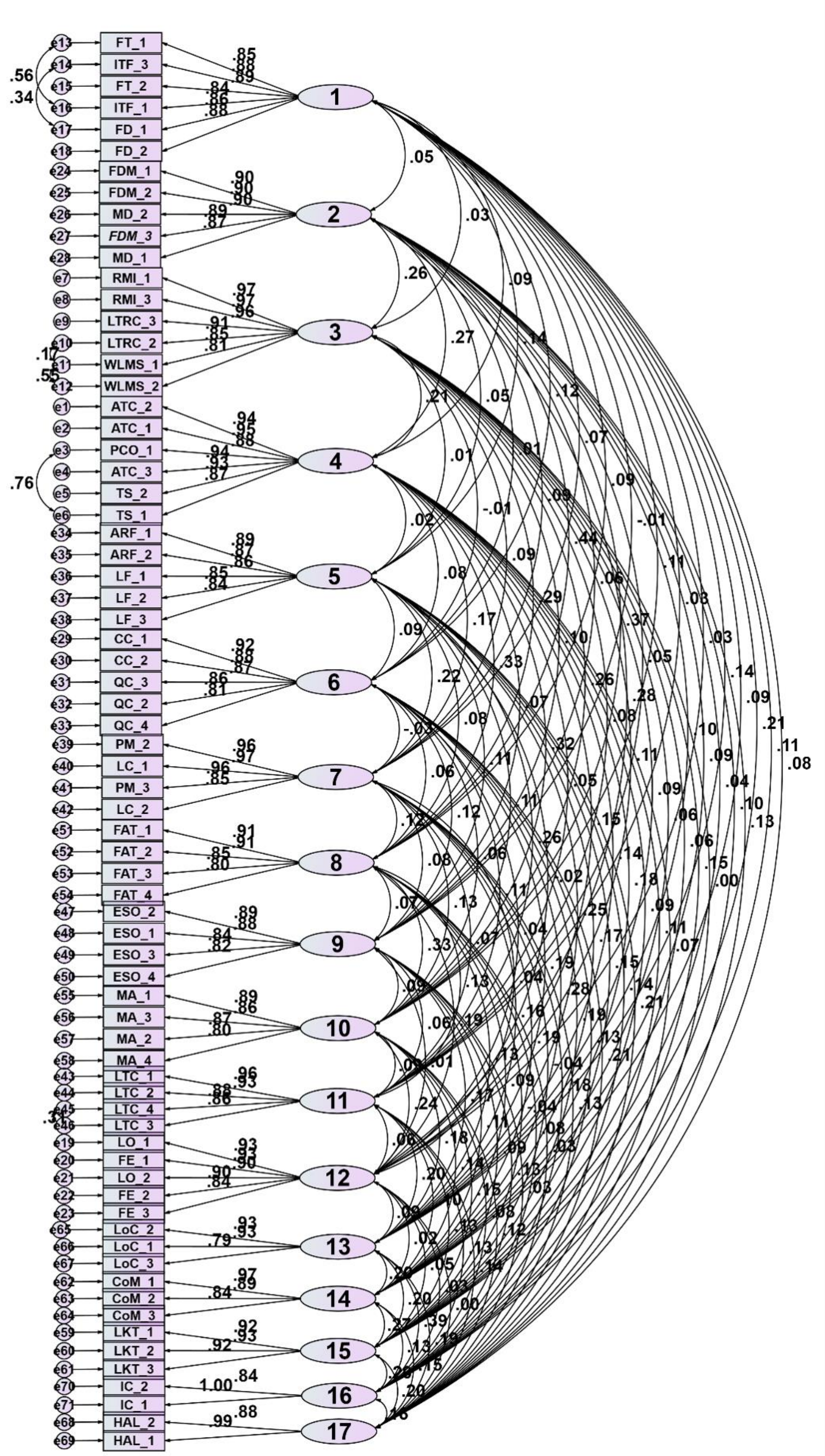

Figure P3.2 Structural Model of 17 Extracted Factors – CFA

All criterion that are required to achieve a goodness-of-fit have been fulfilled. Hence, there is an approximate probability of above 95% (as the p-value <0.05) for getting the similar fit with the current model. The validated questionnaire items will make the decision-making process easier, to predict barriers related to pedagogical aspects in future E-learning implementation projects.

6.8 Discussion

In this paper the Pedagogical E-learning barriers presented by Ali et al. (2018) were empirically validated, from the student perspective, which led to a reduction in the number of factors from 28 to 17. Eight (8) of these seventeen (17) factors consists of two or more factors from original theoretical TIPEC Framework (see table P3.6), we called them compound themes / factors. Such compound factors (presented below) allow us to gain a better understanding of the factors that student perceive to be critically important in hindering the implementation of IS based learning. The compound themes are defined as follows:

1. Faculty Training and Development (FTD) – question items for FD (Faculty Development), FT (Faculty Training) and ITF (Faculty having weak IT skills) loaded as a single factor. The compound factor "Faculty Development (FD)" refers to the effort required by faculty members to learn and develop new technical and system skills to develop effective E-learning content. Without effective training of staff, learning content cannot be created.

2. Delivery Mode (DM) – Original FDM (Flexibility in Delivery Mode) and MD (Mode of Delivery) TIPEC factors cross loaded. Hence question items were combined to form a single factor, i.e., DM which combines delivery mode type and level of flexibility. Clearly the mode of delivery is perceived as being important, but flexibility is a ubiquitous consideration.

3. Deficiency in E-learning System Functionality (DSF) – Original TIPEC barriers WLMS (Weak Learning Management System), RMI (Reliability of Online Measuring Instrument), and LTRC (Less Focus on Technical Requirements of Course) were combined to consider deficient E-learning functionality. All of these issues are related to a functional weakness of the E-learning system (as defined in TIPEC), and were loaded together as depicted in data analysis.

Hence, a compound theme combining WLMS and RMI was named Deficiency in E-learning System Functionality (DSF).

4. Learner Orientation, Communication, and Support (LOCS) – ATC (Additional Time Needed to Communicate with Students), PCO (Pre-course Orientation) and TS (Tutor Support Counselling Sessions) were combined, into a new single factor i.e., LOCS, which demonstrates how poor initial and ongoing student support can negatively impact the student's ability to study.

5. Poor Feedback (PF) – Original LF (Lack of Feedback) and ARF (Absence of real-time feedback) TIPEC factors, which relate to respectively late and limited feedback loaded together. As such, a new factor, entitled "Poor Feedback (PF)" was created to represent the student perspective view that feedback issues should be considered together.

6. Quality Course Content (QCC) – QC (Quality Content) and CC (course content) where combined to ensure consideration of more generic course content quality.

7. Customised Pedagogical Structure (CPS) – PM (Pedagogical Model) and LC (Localisation of content) cross-loaded. The newly formed "Customised Pedagogical Structure (CPS)" refers to the adaptation of teaching methodology and course content to represent local and/or student specific pedagogical support provision.

8. Faculty Motivation (FM) – Faculty Effort (FE) and Lack of Ownership (LO) were combined to represent the combined need for faculty members to take ownership of module delivery. "Faculty Motivation (FM)" factor was formed as faculty ownership was perceived by students as a distinct pedagogical barrier to obtaining E-learning content.

Table P3.6 - TIPEC Original Theorised Factors vs Validated Factors after EFA and CFA

Pedagogical Factors- TIPEC Framework (Ali et al., 2018)		Pedagogical Factors- Validated Current Study (2022)	
1	Faculty Development (FD)	Factor 1	Faculty Training and Development (FTD)
2	Faculty Training (FT)		
3	IT Skills of Faculty Members (ITF)		
4	Flexibility in Delivery Mode (FDM)	Factor 2	Delivery Mode (DM)
5	Mode of Delivery (MD)		
6	Weak Learning Management System (WLMS)	Factor 3	Deficiency in E-learning System Functionality (DSF)
7	Reliability of Online Measuring Instrument (RMI)		
8	Less Focus on Technical Requirements of Course (LTRC)		
9	Additional Time Needed to Communicate with Students (ATC)	Factor 4	Learner's Orientation, Communication, and Support (LOCS)
10	Pre-course Orientation (PCO)		
11	Tutor Support Counselling Sessions (TS)		
12	Lack of Feedback (LF)	Factor 5	Poor Feedback (PF)
13	Absence of Real-time Feedback (ARF)		
14	Quality Course Content (QC)	Factor 6	Quality Course Content (QCC)
15	Course Content (CC)		
16	Pedagogical Model (PM)	Factor 7	Customised Pedagogical Structure (CPS)
17	Localisation of Content (LC)		
18	Faculty Effort (FE)	Factor 8	Faculty Motivation (FM)
19	Lack of Ownership (LO)		
20	Faculty's Acceptance of E-learning Technologies (FAT)	Factor 9	Faculty's Acceptance of E-learning Technologies (FAT)
21	Engaging Students Online (ESO)	Factor 10	Engaging Students Online (ESO)
22	Material Accessibility (MA)	Factor 11	Material Accessibility (MA)
23	Lack of Top – level Commitment (LTC)	Factor 12	Lack of Top- level Commitment (LTC)
24	Lack of Credibility (LoC)	Factor 13	Lack of Credibility (LoC)
25	Cost of Multimedia Learning Materials (CoM)	Factor 14	Cost of Multimedia Learning Materials (CoM)
26	Level of Knowledge of Teacher (LKT)	Factor 15	Level of Knowledge of Teacher (LKT)
27	Insufficient Computers (IC)	Factor 16	Insufficient Computers (IC)
28	Hard to Access Digital Libraries (HAL)	Factor 17	Hard to Access Digital Libraries (HAL)

Table P3.6 presents the alignment mapping between the 28 original pedagogical theoretical factors, presented in Ali et al. (2018), and the 17 compounded factors proposed in our empirical student-focused model. Our results mirrored Basir et al. (2021) and demonstrated, in context of pedagogical factors: i) that student data allows identification of a reduced list of compound pedagogical factors, ii) that the empirically validated list of compounded pedagogical factors incorporate all original pedagogical TIPEC factors, and iii) there was no need to remove or significantly manipulate the TIPEC framework pedagogical dimension; thus, validating the mapping of the original theoretical TIPEC model with literature.

Although current data is unable to tell us whether the compounding of theoretical pedagogical TIPEC factors is due to the use of student perspective data, or just overly fine granulation of factors within the original TIPEC model, it is clear that the compounded pedagogical factors closely align to the structure and intention of the original theoretical TIPEC framework. Additional validation, from alternative stakeholder perspectives is needed, however, before more specific comments can be made concerning the reason for the cross-loading of pedagogical factors.

The empirically validated question items (see appendix P3.A) can now be practically used by the E-learning project team, to practically, yet pro-actively, highlight student concerns regarding E-learning implementation. Although gaining student feedback on E-learning plans may require the strategic inclusion of additional stakeholders and/or implementation steps, the ability to identify failure barriers in advance is important. Highlighting pedagogical barriers concerning system design, systems configuration, delivery of material, staff motivation and training, support and feedback structures, assessment and feedback structures, etc. allows the project team to flag risk barriers in advance; allowing plans to be reconsidered before costly errors occur.

6.9 Conclusion

Technology facilitated education is being adopted around the globe to support a wide range of self-paced E-learning solutions. This technology revolution offers considerable potential for transformation in the methods used within teaching and learning (Elliot et al., 2014), however, the success rate of E-learning system implementation, and the level of subsequent student adoption of E-learning systems, is low when compared to traditional face-to-face teaching models (Uppal et al. 2018).

The TIPEC framework, developed by Ali et al. (2018), conceptualised E-learning system implementation barriers into four categories, i.e., Technology, Individual, Pedagogical and

Enabling Conditions. Ali et al. (2018) recommended development of validated question items to i) empirically link statement feedback to the existence of certain failure factors, and ii) practically utilise the TIPEC framework in E-learning projects. Highlighting the existence of pedagogical issues in E-learning implementation is key to student adoption of tools, continuance in use, and satisfaction of outcomes (Kong, 2021). Moreover, the development of a validated instrument can help practitioners, IS implementors, and the educational organisations, in identifying barriers that students perceive to be significant.

This paper extends the work of Ali et al. (2018) and Basir et al. (2021) and provides i) a validated understanding of pedagogical barriers that impact the student stakeholder, and ii) a validated instrument, consisting of seventy-one (71) structured questionnaire items, which can be used to understand the barriers that exist (in advance) and/or arise during E-learning solution implementation. The consolidated instrument will not only support measurement and identification of failure barriers within real-world projects, but will, by measuring pedagogical issues from the student's perspective, support education providers in the improvement of existing E-learning solutions, and/or develop new E-learning systems, teaching modes, interaction methodologies, and learning content. The authors believe that, if applied systematically, this offers implementation practitioners the opportunity to consider, and address, the barrier before student and / or staff resistance becomes significant.

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Ethics Statement

Guidelines of the ethics committee of University of Reading, UK, were followed and current study was systematically piloted, checked and carried out in line with University of Reading ethical rules. Participation in the study was voluntary, consent was obtained from participants, however, it was clearly described that participants had the right to withdraw from the study at any point. Participants were required to read an information sheet, describing the purpose of the study before participating in the study, and the information sheet clearly described the participants' right to withdraw from the study at any time.

Conflict Of Interest

There are no potential conflicts of interest.

6.10 References

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6.11 Appendix P3.A

Factor (Question Item)	
1. FACTOR 1	
Universities being unable to provide convenient time for training of faculty, is a barrier for E-learning. (FT_1)	**0.89**
Faculty not trained in pedagogical aspects of E-learning, is a barrier for E-learning. (FT_2)	**0.87**
Faculty's lack of basic technology skills for adapting technology in teaching and learning, is a barrier for E-learning. (ITF_1)	**0.86**
Lack of IT skills of Faculty members to access the essential E-learning system hinders in learning (ITF_3)	**0.88**
Lack of administrative support to use technology for teaching and learning, is a barrier for E-learning. (FD_1)	**0.86**
Faculty members not being able to utilise E-learning system to full extent is a barrier for E-learning. (FD_2)	**0.86**
2. FACTOR 2	
Teachers not using multiple modes to deliver lectures, is a barrier for E-learning. (MD_1)	**0.82**
Course not having distinctive features to deliver lectures, is a barrier for E-learning. (MD_2)	**0.86**
E-learning system's incompatibility across different devices, is a barrier for E-learning. (FDM_1)	**0.86**
Course content not suitable for synchronous and asynchronous learning, is a barrier for E-learning. (FDM_2)	**0.86**
E-learning system not having flexibility for students to take exams on desired medium, is a barrier for E-learning. (FDM_3)	**0.84**
3. FACTOR 3	
Technical faults with E-learning system, is a barrier for E-learning. (LTRC_2)	**0.91**
Layout of E-learning system not being aligned with course content, is a barrier for E-learning. (LTRC_3)	**0.93**
Lack of timely results of assignments, is a barrier for E-learning. (RMI_1)	**0.95**
Unclear exam questions and assignments in E-learning system, are a barrier for E-learning. (RMI_3)	**0.94**
Lack of sharing, discussion or support in E-learning system with others, is a barrier for E-learning. (WLMS_1)	**0.85**
Technology does not fit well for the courses, is a barrier for E-learning. (WLMS_2)	**0.82**
4. FACTOR 4	
Faculty member is only accessible through email, is a barrier for E-learning. (ATC_1)	**0.91**
Lack of timely reply from faculty member, is a barrier for E-learning. (ATC_2)	**0.93**
Lack of use of other communication features of E-learning system by faculty member, is a barrier for E-learning. (ATC_3)	**0.89**
Lack of guidance to help in E-learning when needed, is a barrier for E-learning. (TS_1)	**0.88**
Unable to access faculty member when consultation is required, is a barrier for E-learning. (TS_2)	**0.89**
Faculty not giving the comprehensive orientation before the course, is a barrier for E-learning. (PCO_1)	**0.90**
5. FACTOR 5	
Faculty not encouraging the interaction and participation in lessons and discussions is a barrier for E-learning. (ARF_1)	**0.87**
Faculty not providing quick and efficient feedback to student's educational needs and questions is a barrier for E-learning. (ARF_2)	**0.86**
Faculty not giving timely feedback after submitting assignments is a barrier for E-learning. (LF_1)	**0.85**
Students not getting in touch with professors through online virtual classes is a barrier for E-learning. (LF_2)	**0.83**
Being unable to get in touch with professors other than class, is a barrier for E-learning. (LF_3)	**0.79**
6. FACTOR 6	
Outdated E-learning material, is a barrier to E-learning. (CC_1)	**0.91**
The course content having inappropriate degree of breadth, is a barrier for E-learning. (CC_2)	**0.87**
E-learning not being rich enough to make up for absence of face-to-face classes, is a barrier for E-learning. (QC_2)	**0.84**
Presenting lessons in the form of electronic content in a dull and ineffective manner, is a barrier for E-learning. (QC_3)	**0.86**
Facing difficulty to understand and follow the content is a barrier for E-learning. (QC_4)	**0.80**
7. FACTOR 7	
E-learning system not giving space to explore local environment, is a barrier for E-learning (LC_1)	**0.95**
E-learning content not being suitable according to my culture, is a barrier for E-learning. (LC_2)	**0.82**
Faculty unable to make full use of technology to fully prepare and research materials for lessons, is a barrier for E-learning. (PM_2)	**0.95**
Universities not providing faculty members trainings to develop innovative pedagogical approaches for E-learning is a barrier for E-learning. (PM_3)	**0.94**
8. Faculty's Acceptance of E-learning Technologies (FAT)	
Faculty's lack of time to adopt E-learning system, is a barrier for E-learning. (FAT_1)	**0.86**
Faculty's fear of using E-learning system, is a barrier for E-learning. (FAT_2)	**0.85**
Faculty's perception that E-learning system is difficult to use, is a barrier for E-learning. (FAT_3)	**0.80**
Faculty's perception using the E-learning system will not increases productivity, is a barrier for E-learning. (FAT_4)	**0.72**
9. Engaging Students Online (ESO)	
Faculty perception that classroom management is more difficult when using technology, is a barrier for E-learning. (ESO_1)	**0.87**

My fear of using technology, is a barrier for E-learning. (ESO_2)	**0.89**
Being unable to get in touch with my professors through E-learning systems, is a barrier for E-learning. (ESO_3)	**0.83**
Faculty not encouraging students to ask questions, is a barrier for E-learning. (ESO_4)	**0.81**
10. Material Accessibility (MA)	
Difficult access to course content and auxiliary material, is a barrier for E-learning. (MA_1)	**0.85**
Limited access to course materials, is a barrier for E-learning. (MA_2)	**0.81**
Lack of availability of material for study anywhere and anytime, is a barrier for E-learning. (MA_3)	**0.79**
The course materials not available when required, is a barrier for E-learning. (MA_4)	**0.78**
11. Lack of Top – level Commitment (LTC)	
Lack of technical support for technology by institution, is a barrier for E-learning. (LTC_1)	**0.93**
Absence of clear vision and policy for E-learning development, is a barrier for E-learning. (LTC_2)	**0.92**
Lack of high-level policies for productive implementation of E-learning system, is a barrier for E-learning. (LTC_3)	**0.87**
Lack of commitment in administration to implement E-learning system, is a barrier for E-learning. (LTC_4)	**0.87**
12. FACTOR 12	
Faculty's perception that technology being used for E-learning is unreliable is a barrier for E-learning. (LO_1)	**0.92**
Faculty's lack of interest in using technology in teaching and learning is a barrier for E-learning. (LO_2)	**0.89**
Teachers with little or no confidence in using devices in their work will be a barrier for E-learning. (FE_1)	**0.91**
Poor readiness of academic staff to use E-learning system is a barrier for E-learning. (FE_2)	**0.89**
Instructor not following up student problems in order to find out solution via E-learning is a barrier for E-learning. (FE_3)	**0.82**
13. Lack of Credibility (LoC)	
The perception that taking E-learning courses will not help me to achieve my career goals, is a barrier for E-learning. (LoC_1	**0.88**
The perception that taking E-learning courses has less chances of me getting employed, is a barrier for E-learning. (LoC_2)	**0.90**
The perception that E-learning degree is not credible enough, is a barrier for E-learning. (LoC_3)	**0.76**
14. Cost of Multimedia Learning Materials (CoM)	
Lack of adequate financial support to develop technology- based activities, is a barrier for E-learning. (CoM_1)	**0.94**
High cost of quality E-learning materials, is a barrier for E-learning. (CoM_2)	**0.83**
Faculty members unable to develop quality E-learning material, is a barrier for E-learning. (CoM_3)	**0.81**
15. Level of Knowledge of Teacher (LKT)	
Teacher not having grip on the course content, is a barrier for E-learning. (LKT_1)	**0.90**
Teacher being unable to deliver lectures concept clearly, is a barrier for E-learning. (LKT_2)	**0.89**
Teacher's limited knowledge related to course, is a barrier for E-learning. (LKT_3)	**0.88**
16. Insufficient Computers (IC)	
Frequent long waiting to use E-learning system on-campus, is a barrier for E-learning. (IC_1)	**0.79**
Less number of available E-learning devices in university, is a barrier for E-learning. (IC_2)	**0.96**
17. Hard to Access Digital Libraries (HAL)	
Difficulty in accessing digital libraries to acquire information, is a barrier for E-learning. (HAL_1)	**0.84**
Lack of access of off-campus digital libraries to acquire information, is a barrier for E-learning. (HAL_2)	**0.97**

Chapter 7
Conclusion

7.1 Introduction

This chapter i) provides a summary of the work undertaken in this thesis, ii) reflects on the contributions made to E-learning implementation barriers literature, and iii) draws a holistic conclusion in light of the findings. Moreover, the reviews and comments received from information system (IS) experts during the peer-review process are incorporated in the practical application of the TIPEC framework dimensions developed and tested in chapters 4 to 6. The contributions of the current research, future research directions, possible avenues for further research and limitations are addressed in the later sections.

It is evident from the extensive body of research (see Chapter 2 – Challenges of E-learning) that the benefits of E-learning can never be fully realised if significant obstructions (i.e., challenges / barriers / issues) are not effectively considered or resolved. Theoretical models / studies in reality exist to make sense of tacit knowledge. The process of carrying out this research has presented a unique opportunity to explore, bridge and contextualise the gap between E-learning challenges in theory, and existence of student facing barriers in practice. The TIPEC framework conceptualises an extensive list of barriers (see Figure 1.1) that have been seen in literature to have occurred whilst implementing E-learning IT / IS. If the barriers / challenges / issues within the theoretical TIPEC framework dimensions (Technological, Individual, Pedagogical and Enabling Conditions) could be identified in practice, then this would support the practical application of the TIPEC framework in a range of different E-learning environments. If such identification of E-learning barriers were possible, then it would offer IT / IS implementers with a tool to allow them to focus on contextually relevant barriers and / or problems; potentially prior to systems implementation. Accordingly, the research question was defined as "*How can E-learning practitioners identify, prioritise and manage the challenges / barriers / issues which hinder the implementation of IT based learning solutions? Furthermore, what are the possible challenges and their categorisation that hinder the IT based learning?* ", with the primary aim to develop an understanding of challenges / barriers /

issues faced in using technologies in learning; i.e., so IS / IT implementors can strategically manage these challenges / barriers / issues.

The focus of study is set by sub-categorising the question into three research objectives (see Chapter 1), subsequently exploring through detailed and structured review of literature (see Chapter 2) presents the justification of the problem and formulated the research question. Afterward, for the practicability of the model three experiments were designed (see Chapter 3) and lastly three papers are presented to achieve the set objectives (see Chapters 4, 5, and 6). Achieving these objectives will help answer the proposed question. Chapter 4 (Paper 1) considers research objective 2.1 (RO2.1) and "T" in the TIPEC framework, discussing and validating the importance of technological factors that hinders the E-learning (IS) implementation. Research objective 2.2 (RO2.2) is addressed in chapter 5 (paper 2) with theoretical and empirical justification of Individual "I" barriers resulting in a structured instrument. Pedagogical "P" barriers are accounted for whilst aiming to achieve research objective 2.3 (RO2.3) in chapter 6 (Paper 3). Instrument development and validation of process followed in chapters 4 and 5 was also adopted for research objective 2.3 i.e., chapter 6, to highlight the challenges related to teaching methodology in an E-learning environment.

7.2 Research Summary and Conclusion

This study was conducted with the aim to develop a better understanding of student facing barriers / challenges / issues related to IT / IS based E-learning solutions implementation. As technology facilitates education, effective incorporation of the technology components offers considerable opportunities to transform the methods used for knowledge dissemination (Elliot et al., 2014). Compared to traditional face-to-face education approaches, E-learning has the key advantages of being low cost, ubiquitous, and self-paced learning. On the other hand, the success rate of E-learning system implementation, and the student adoption of E-learning, is low when compared to traditional face-to-face teaching models (Uppal et al. 2018). Due to low success rates and higher student / learner dropout, higher education institutes (HEI) have been sceptical about implementing the IT / IS based learning solutions.

Chapter 1 provides the critical discussion concerning what motivated the researcher to investigate i) reasons behind the IT / IS based solutions not being able to deliver the promised benefits, ii) assessment of the highlighted / reported factors causing blockade during implementation of the IT / IS based learning solutions iii) methods supporting in the identification and strategic management to remove the highlighted reasons of causing hinderance. With this in mind, the researcher focused this thesis on development of a diagnostic tool to enable the identification of factors hindering success of technology-based solutions; with the hope that identification will support effective management and/or removal of critical issues.

Discussion in Chapter 2 provided the critical discussion and in detail synthesis of literature concerning the barriers or factors of E-learning implementation. In-depth review helped the researcher deduce the need for a structured approach to develop understanding of E-learning barriers / challenges / issues in a project environment, i.e., as a theoretical underpinning of the barriers / challenges is necessary to design a reliable quantitative measuring instrument. Literature synthesis identified the existence of TIPEC framework, i.e., an extensive model summarising the research on the barriers to IT implementation in learning (Ali et al., 2018). Based on twenty-six years (26) of literature on E-learning implementation challenges, Ali et al., (2018) grouped sixty-eight barriers into four categories Technological (T), Individual (I), Pedagogical (P) and Enabling Conditions (EC).

The following research question was defined: "*How can E-learning practitioners identify, prioritise and manage the challenges / barriers / issues which hinder the implementation of IT based learning solutions? Furthermore, what are the possible challenges and their categorisation that hinder the IT based learning?* ".

Existence of TIPEC framework aligned well with the posed research question, since the authors of TIPEC framework (Ali et al., 2018) developed the model to channelise the efforts to recognise E-learning challenges / barriers by providing theoretical foundations. To provide the answer to the hypothesised question, and in light of the TIPEC model structure, three (3) research objectives were proposed, which were: i) the development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to technological component of E-learning, ii) the development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to user / student / learner / individual of E-learning, iii) the development, quantitative validation, comparison, and finalisation of an instrument aiding the identification of barriers related to teaching methodology of E-learning.

Chapter 3 explained the selection of methodological approaches used to achieve the established research objectives in the subsequent chapters - i.e., Paper I, II, & III. The researcher utilised positivist paradigm in a cross-sectional time frame. Moreover, a quantitative survey questionnaire method was used as an instrument approach to gather responses. Papers I, II, and III addressed respectively research objectives 2.1, 2.2 and 2.3; by designing and testing a validated set of survey questionnaire items to identify, from the student perspective, the barriers / challenges / issues related to technological component issues, users/individual issues, and pedagogical teaching issues.

Paper I considers "T" in the TIPEC framework which incorporates technological barriers / challenges related to E-learning systems. Barriers related to the technological component, faced by users i.e., students of the E-learning, include seven factors (Ali et al., 2018) i) Technology infrastructure, ii) Technical support, iii) Bandwidth and connectivity, iv) Software interface and Design v) Compatible technology, vi) Poor Quality of Computers and vii) Virus Attacks. Utilising the instrument development approach (see Chapter 3 – Instrument Development) the researcher designed 31 question items survey questionnaire. The final survey instrument, i.e., after the initial testing, was used to capture data from 382 respondents. Employing the factors analysis techniques, and using structural equation modeling, results showed that there are twenty-three (23) statistically significant question items instead of thirty-one (31). Furthermore, only six (6) technological barriers were identified from student data, i.e., as opposed to seven (7) originally theorised within TIPEC framework (See Table P1.6). "Virus Attack" and "Poor Quality of Computer" conceptual themes were compounded in student data as barriers entitled "Device Quality and Security". Six statistically validated factors provide a simplified and quantifiable understanding of the barriers related to IT / IS components used in E-learning. Technological instrument items (presented in Appendix P1.A) will enable the practitioners and E-learning system implementors in the identification and subsequent removal of challenges related to i) developing an E-learning solution which is easy to use, ii) compatible across platforms, and iii) allow the project team to manage current IT / IS infrastructure shortcomings.

Paper II presents the experiment to achieve the research objective 2.2. A detailed review of literature highlighted deduced i) the importance of understanding individual / user barriers, and ii) how identification of individual barriers will help content providers focus on contextually relevant challenges / barriers / issues, directly effecting the E-learning users / student experience. After expounding the literature concerning student / learner related E-learning system barriers / challenges, the paper describes the "I" Individual category within the TIPEC framework, which presents a simplified list of user related challenges. Subsequent sections provide the critical analysis of twenty-six (26) student / learner related challenges / barriers / issues (see Table 3.2). Based on literature review, and the definitions of individual category of barriers provided by Ali et al. (2018), seventy-three (73) question items were developed - by employing instrument development process – and linked to twenty-six (26) constructs. These question items were designed, tested, and validated using EFA and CFA analysis, which showed that, from the learner's perspective, there are sixteen (16) distinct and measurable barriers to E-learning use; including nine (9) compound factors (see Table P2.5). Appendix P2.A presents the statistically validated and confirmed set of questionnaire items related to sixteen (16) user / student / learner related barriers / challenges in E-learning. The consolidated instrument not only supports measurement and identification of failure barriers / factors within real-world projects – as the questions can be used in practice - but will also help higher education institutions in the management of individual difficulties that students / users face – e.g., peer-pressure, counselling needs, cultural issues etc.

Lastly, Paper III is presented in Chapter 6, which addresses the research objective 2.3; i.e., *"Development, quantitative validation, comparison and finalisation of an instrument aiding the identification of barriers related to teaching methodology of E-learning"*. 'P' in the TIPEC framework provides a structured list of challenges / barriers / issues of teaching approaches applied in IT based learning modules / programs. A detailed review of the twenty-eight (28) Pedagogical barriers (see Table 3.2) is described to outline the existing literature on the topic. Similar to the strategy adopted in the Paper I and II, this paper also uses an instrument development process to create survey items. After following the instrument development guidelines described in Chapter 3 (section 3.8.2), eighty-three (83) question items were used for full scale data collection. Structural equation modeling a quantitative validation approach of instrument testing was implemented after the receiving the responses. Results of confirmatory and exploratory factor analysis resulted in seventy-one (71) question items relating to seventeen (17) student-facing pedagogical barriers (originally 28). Eight (8) of these seventeen (17) factors are compounded themes comprised of two or more barriers taken from the original theorised TIPEC framework (see Table P3.6).

Researcher hopes that the developed questionnaires (see Appendix P1.A, P2.A, and P3.A), which have been developed and validated through empirical approaches to consider student-facing TIPEC barriers (i.e., Technology component issues, Individual user issues, and pedagogical and teaching methodology issues) will be of considerable practical assistance to IS/IT practitioners / implementors, instructors, course developers and education institutes in the i) design of quality online learning content, ii) management of user expectations, iii) design of a user-friendly solution, and iv) design of solutions that support cross-platform compatibility.

7.3 Implications and Contributions

7.3.1 Synthesis of Literature

To increase the success of E-learning implementations, it is important that the project team try to understand and remove technical, individual, and pedagogical factors / barriers / challenges / issues that negatively impact student acceptance, adoption, and use of E-learning solutions. Review of the existing studies has highlighted the extensiveness and significance of numerous challenges, and that many of these barriers to E-learning solution success have been identified since the advent E-learning learning solutions. Removal and subsequent strategic management of E-learning barriers is thus of importance to make technology work in education. Resultantly, researchers and academics have been working effortlessly to present success factors, theoretical frameworks and working models to increase the likelihood of successful implementation. Accordingly, there is a need to critically review such theoretical frameworks, models, and studies in IS / IT implementation barriers / challenges / issues to support practicability and use. For the purpose of ascertaining the strengths and weaknesses of the reviewed models, all the models were critically compared by taking into account the extensiveness, categorisation, measuring instrument, recency and quantifiability (i.e., significance and insignificance).

The synthesis of literature provided in this thesis suggests there are numerous studies in literature concerning IT / IS implementation in learning and teaching domain (see Chapter 2), however, a fundamental shortcoming is either the lack of i) framework consolidation and/or ii) a measuring instrument for practical application. Andersson & Grönlund (2009) and Ali et al. (2018) studies were extensive in terms of categorisation and encapsulation of barriers / challenges / issues impacting E-learning implementation. However, the TIPEC framework - by Ali et al. (2018) - is more recent and it aims to extend and incorporate the work of Andersson & Grönlund (2009). Moreover, the TIPEC framework provides a detailed review of E-learning literature articles published in peer reviewed journals from 1990 – 2016 and consolidates a conceptual / theoretical framework for sixty-eight (68) IS implementation barriers relating to four (4) categories Technological / Individual / Pedagogical / Enabling Conditions. Unfortunately, however, the thematic conceptualisation of this framework is limited by its restricted practicability; since no quantitative validation of the TIPEC categories or factors has been conducted to affirm whether or not TIPEC has value in a real-world practical setting.

26 years (i.e., 1990 – 2016) of E-learning implementation barriers were consolidated into the TIPEC framework. In the current research, three dimensions have been validated using primary data. Thus, contributing to literature by providing the empirical validation of an extensive body of E-learning literature spread over multiple decades. Researchers now have access to a structured and quantitatively validated set of questionnaires survey items that can be used to i) support further theoretical and empirical studies in this area, an ii) help identification of student facing E-learning barriers in practice. Although the researcher is confident that most barriers have been considered, if over time the factors impacting E-learning change, then the researcher encourages the redesign / extension and/or validation of the proposed model to incorporate new concepts / variables and / or new relations between the current constructs.

7.3.2 Extension in E-learning Barriers Implementation Literature

In addition to quantitative validation of conceptual framework of E-learning implementation barriers, this study contributes by suggesting empirical grouping of the barriers, previously categorised theoretically. Originally, Ali et al. (2018) applied thematic content analysis and identified i) seven (7) barriers related to the Technological category, ii) twenty-six (26) barriers related to the Individual category, iii) twenty-eight (28) barriers related to the Pedagogical category and iv) seven (7) barriers related to Enabling Conditions - a total of sixty-eight (68) conceptual barriers.

Supplementing the empirical explanation of the E-learning barriers literature, this study validates grouping of barriers within each category i.e., Technological, Individual, and Pedagogical barriers using statistical measures. The validated model presents six (6) Technological barriers (see Paper I, Chapter 4), sixteen (16) Individual barriers (see Paper II, Chapter 5) and seventeen (17) Pedagogical barriers (see Paper III, Chapter 6); i.e., in contrast to seven (7), twenty-six (26) and twenty-eighty (28) respectively, proposed in the theoretical TIPEC framework (see Figure 7.1).

This revised framework contributes to the E-learning barriers literature by providing a tested and validated framework that allows practitioners to identify the student facing factors that limit E-learning system implementation. Moreover, this quantitative consolidation has resulted in the development of eighteen (18) compound themes / barriers, which provide a broader (yet clearer) definition and scope with respect to the related category. These compound themes / barriers are:

i. *Device Quality and Security (DeQS)* a compound theme/barrier in the Technological category that encapsulates Poor Quality of Computers (PQ) and Virus Attack (VA). DeQS describes problems related to vulnerable E-learning systems due to poor quality, which was considered in the TIPEC framework using separate themes. Paper I appreciate the categorisation of E-learning barriers / challenges / issues related technological component through quantified findings and empirical instrument.

ii. The revised individual category contains nine (9) compound themes/barriers which summarises nineteen (19) original separate factors (see Table P2.5). 9 compounded themes are: i) *Support by Peers & Society (SPS)* compounded the definition of Students Support (StSu) and Social Support (SoSu) providing a single theme appreciating the problems arising due to lack of support from the people around; ii) *Computer Anxiety and Technophobia (CATP)* comprised of problems considered separately by Technophobia (TP) and Computer Anxiety (CA), now providing a single construct for challenges related to anxiety and fear towards the E-learning; iii) similarly, *Reduced Face to Face interaction (RFI)* captures the hinderance in E-learning arising due less physical interaction was previously considered through separate themes Sense of Isolation due less Face to Face Interaction (SI) and Social Loafing (SL); iv) *Students Finances (SF)* contain Student's Economy (SE) and Cost of Using Technology (CUT) describing the problems related to funds; v) *Conflicting Priorities based on Commitments (CPC)* broadly explains all personal constraints of students / users of E-learning, considered separately before as Family Commitments (FC), Work Commitment (WC), and Conflicting Priorities (CP); vi) *Student Readiness (SR)* which is a broader construct describing self-perceptions now encapsulates Student Readiness (SR) along with Response to Change (RC), vii) Student's Technical Capability (STC) encapsulates Technological Difficulty (TD) and Technology Experience (TE) describing student / users ability and skills to use and handle the E-learning system; viii) *Computer Literacy (CL)* explains the problems in E-learning adoption due to lack of skills and knowledge to use the system, formerly two separate themes were considered to explain Computer Literacy (CL) and Lack of ICT Skills (LICTS); and viii) *Academic and Experiential Relevance (AER)* which is the compound theme stating challenges related to Prior Knowledge (PK) and Academic Confidence (AC). Categorisation of barriers / challenges / issues concerning the user / student is now updated, confirmed and validated. Thus, providing empirical evidence of grouping of individual related barriers.

iii. Similarly, nineteen (19) theoretical Pedagogical barriers are grouped into eight (8) broader themes/barriers are: i) *Faculty Training and Development (FTD)* consolidate barriers Faculty Development (FD), Faculty Training (FT) and IT Skills of Faculty Members (ITF) into a single barrier, providing a broader theme exhibiting challenges arising due to faculty skills to use and create content compatible with E-learning system; ii) *Delivery Mode (DM)* broadly explains challenges in delivery mode type and level of flexibility, previously considered as Flexibility in Delivery Mode (FDM) and Mode of Delivery (MD); iii) *Deficiency in E-learning System Functionality (DSF)* originally considered as Weak Learning Management System (WLMS), Reliability of Online Measuring Instrument (RMI), and Less Focus on Technical Requirements of Course (LTRC), combined in single concepts highlighting issues related to a functional weakness of the E-learning system; iv) *Learner's Orientation, Communication, and Support (LOCS)* which demonstrates the poor initial and ongoing student support can negatively impact the student's ability to study was formerly conceptualised into three themes; Additional Time Needed to Communicate with Students (ATC), Pre-course Orientation (PCO) and Tutor Support Counselling Sessions (TS); v) *Poor Feedback (PF)*, as the name suggests, captures the challenges arising as result of feedback issues, Lack of Feedback (LF) and Absence of Real-time Feedback (ARF) were considered separately to capture the feedback challenges. Quality Course Content (QC) and Course Content (CC) were considered separately, however, the quantitative validation states these are indeed considered as a single theme, vi) *Quality Course Content (QCC)* consideration of challenges related to course content quality; vii) *Customised Pedagogical Structure (CPS)* which captures original themes Pedagogical Model (PM) and Localisation of Content (LC) that appreciate the challenges arising due to teaching methodology lacking local context or student provisions; viii) *Faculty Motivation (FM)* which considers faculty members not taking ownership of module delivery, previously two separate themes were considered as Faculty Effort (FE) and Lack of Ownership (LO).

E-learning literature pertaining to barriers / challenges / issues have now been extended by providing a quantified/validation ontology of barriers /challenges/issues proposed, thus producing the most comprehensive, yet practically useful, model relating to E-learning implementation barriers (Basir et al., 2021).

Also, the consolidated and compounded themes/barriers provide a simpler, broader, and better understanding to the readers, researchers, practitioners, policymakers, and project managers of the learners perceive to be most critically important in hindering the experience of IS based learning.

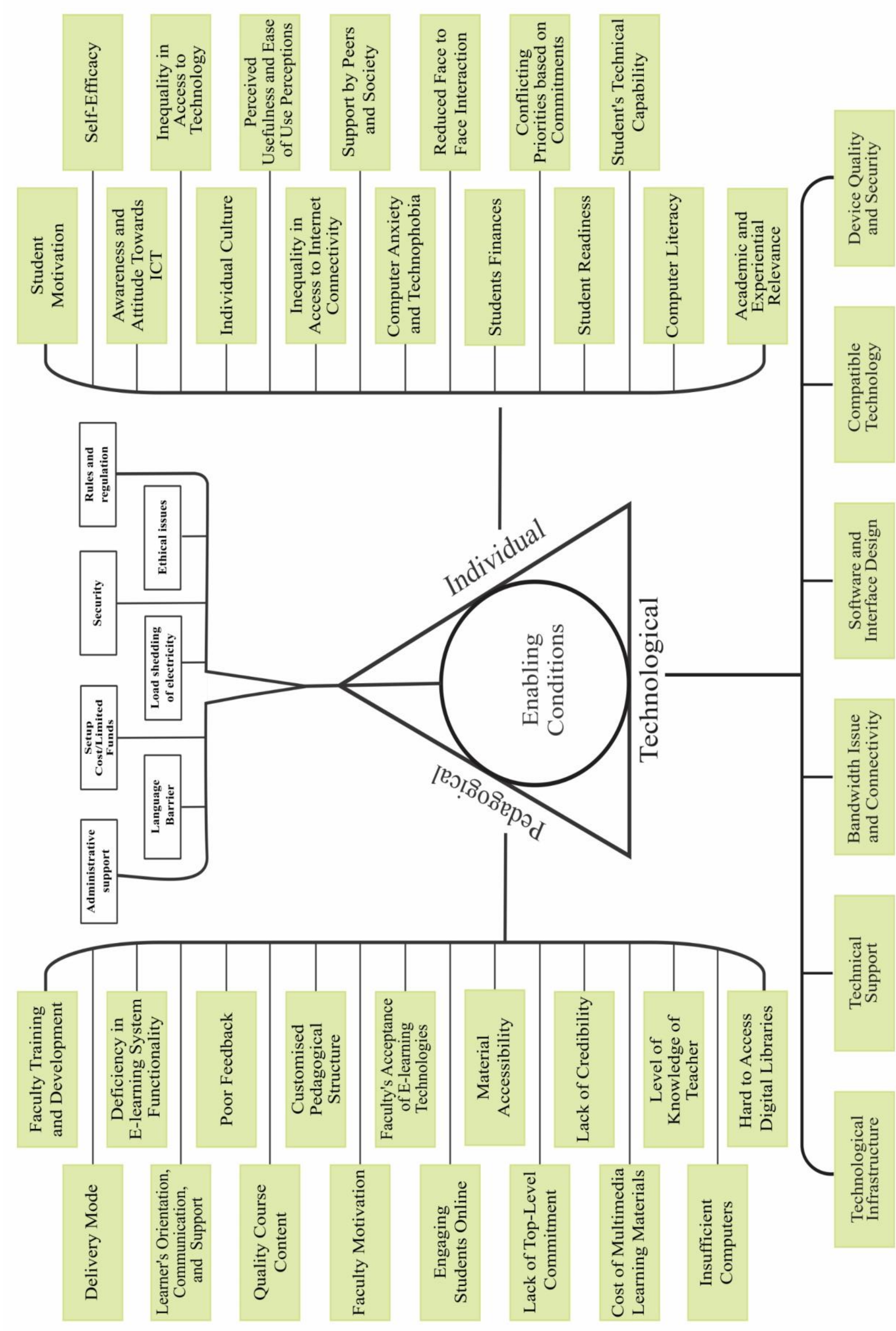

Figure 7.1 Validated TIPEC framework (46 Barriers / Challenges / Issues)

The dimensions validated in this thesis (see figure 7.1) are supported by three new scales that are developed and tested for the constructs: Technological barriers (issues related to the "E" component in E-learning), Individual barriers (issues related to the individual/student/end-user dimension of E-learning) and Pedagogical barriers (issues related to teaching methodology experienced by the learner / student). These three scales of measurement have been presented in Appendix **P1.A**, **P2.A** and **P3.A** respectively, will help the researchers, policymakers, and practitioners in the practical application of the TIPEC framework; aiding identification of prevalent challenges in their respective project/contextual environment.

7.3.3 Managerial and Practical Implications

COVID-19 has shown that despite all the issues and shortcomings of E-learning, the benefits of E-learning systems cannot be neglected and ignored. Higher education Institutions across the world are seeking to provide their student with the highest quality education solutions. These HEIs remained resolute on use of technologies content to support content dissemination (Almaiah, et al., 2020); accordingly, E-learning is not going away post covid. Institutes trying to ensure their survival, despite not having the required infrastructure, overnight had to accept and adopt use of online modules to support off-campus classes. Moreover, teachers had to adjust and update the teaching content to ensure the compatibility with the technological component (Fontenelle-Tereshchuk, 2021). This adoption was perhaps forced, but the factors hindering the success of E-learning solutions are still present (Daultani et al., 2021). Lie, students not having good internet, cost of buying new devices, lack of availability of online assessment tool, lack of infrastructure, and many other similar issues (see Chapter 2). These limitations require particular attention now more than ever! The research question this thesis aims to assist decisionmakers and E-learning practitioners in strategic management of the barriers currently faced in current projects or can face in future projects.

Practical Implications of Technological Factors (Paper I)

Panda and Mishra (2007) mention that technology infrastructure, support, reliability, and connectivity issues are the predominant challenges in any E-learning environment. Moreover, technical barriers are the most frequent when considering online learning (Gutirrez-Santiuste et al., 2016), and accessibility to technology remains a key issue, especially in developing nations (Davies & West, 2014). Since use of technology is critical to the E-learning experience, not considering learner perspective technical limitations is a key component leading to project failure.

There have been numerus studies concerning technological components in learning and teaching e.g., user interface (Uppal et al. 2017; Ofosu-Asare, 2019,), features of E-learning systems, technology acceptance (Venkatesh et al., 2004; 2012), E-learning success factors (DeLone & McLean, 2002), etc. Studies, to date have investigated factors including, but not limited to, useability, intentions, system design requirements, success factors, quality of learning, and determinants of behaviours. These studies have been conducted to understand relationship amongst different variables i.e., intentions determinants, design components, factors affecting user behaviour, etc. To the best of our knowledge, however, a structured approach to support the identification of technological limitations that hinder student experience of learning have not been previously developed and/or validated. Appendix P1.A lists twenty-three (23) statements developed and validated with the help of E-learning experts' consultation and statistical testing, which can help practitioners to determine the technical issues that learners face. Resultantly expanding the explanation of user expectations and feedback from the E-learning system.

The use of these statements, i.e., facilitating the identification of the existence of technological factors, will aid practitioners / decisionmakers as a tool to identify barriers / issues that they effectively need management and/or solve as part of the project scope; thus, meeting objective RO 2.1 and reducing the likelihood of ultimate project failure. Survey instrument items stakeholder awareness of prevalent challenges in their E-learning experience and allow appropriate planning and management of identified barriers / issues.

The identification of technological challenges will allow the institutes and implementors in the design of more robust learning system solutions. Systems robustness is clearly dependent upon its ease of use; i.e., since technology that is easy and simple to interact with attracts more users and is more quickly adopted. Using the technological instrument will allow the implementors to plan and design a system that is more user-friendly, but also works better across multiple devices. Furthermore, in an environment where a system is not able to achieve its full potential, it will allow the practitioners to ask questions like i) is the system complex to use? ii) is the system compatible across platforms? iii) do the users have access to the internet? etc. Answering these questions will highlight additional prominent challenges that limit the success of the final solution.

An easy and remotely accessible technological learning solution, which is not compatible with the contents of the course/module, is destined to fail. Compatibility of the system with the course content, module design, and/or module objectives, is thus as important as achieving usefulness and availability. Enabling practitioners to align technological solutions with the learning module needs will increase the chance of a successful E-learning implementation. This alignment can also be achieved with the use of the developed instrument, since the tool will allow the investigation of the problem considering another facet of the technological domain i.e., infrastructure and/or support. Be it marketing or IT, customer / user support is given for satisfaction and continuous usage. Practitioners can also use the results gained from the application of this instrument for user feedback, i.e., to consider the assistance required for users; since timely support can improve user perception and subsequent usage of the system (Baig et al. 2021). Moreover, this will also make practitioners more aware of the strength and weaknesses of the current IT infrastructure. Checking that IT facilities are sufficient for every user, and available everywhere on campus, brings considerable assurance at the start of the E-learning system implementation.

Practical Implications of Individual Factors (Paper II)

End-user is the key stakeholder whose opinion and experience determine the end quality / success of the product. In the case of E-learning the end-user is primarily the student, and his / her perception, expectation, and feedback is of primary importance to system acceptance and use. Andersson and Grönlund (2009), who proposed a framework on which TIPEC framework was built, highlighted the importance of this fact. Andersson and Grönlund (2009) proposed a framework covering four types of issues that exist in E-learning implementations, i.e., Technological issues, Individuals related issues, Pedagogical / course related issues, and context related issues. Most number of barriers / challenges / issues identified within their framework were defined as being linked within the Individual category. Individual related barriers are of significance and need to be addressed in order to manage end-user expectations and needs. The second paper of this thesis developed a survey instrument to highlight the existence of the challenges related to the individual issues impacting E-learning success. The fifty-one (51) item structured survey instrument developed in this paper (see Paper II – Chapter 5) will aid in the identification of the prominent individual / student related barriers in E-learning implementation. By utilising the validated individual / student barriers instrument practitioners and implementors will be able to understand the existence of the user expectations, limitations, required training, and support needs etc.

Unlike traditional learning, E-learning being a student / learner approach where ultimate outcome of success is determined by student / user feedback. Technological solutions can be improved by investing in the development of top-notch systems for E-learning. However, understanding student / users' needs should be considered whilst designing or implementing an IT based learning solution (Stark & Stoeckel, 2019). Students / users in different contexts and institutions might have different requirements, e.g., personalised learning, availability of funds and cultural differences. Employing Fifty-one (51) question items of structured survey instrument will allow the implementors to pinpoint such problems.

Attitude and student perception influence the implementation of E-learning systems. Users / students challenges instrument will help identification of the student perception towards the technological components as well as the E-learning experience. In addition to the perception students might have different requirements towards the E-learning, for instance in a student might be skilled in the using IT based learning solution but is facing learning challenges due to personal commitments. So, appreciating the individual category of barriers will help the implementors to manage and resolve such user / student related challenges / barriers /issues to ensure the success of E-learning based systems. Table P2.5 provides the detail of the barriers / challenges individuals might face and Appendix P2.A describes the question items to manage those barriers.

Practical Implications of Pedagogical Factors (Paper III)

During a pandemic, learners / instructors were essentially turned into involuntary telecommuters, highlighting the importance of IS based E-learning solutions and/or the world of online learning. Learning and teaching methodologies have been updated (Sharma & Sharma, 2022) and use of IS quickly integrated to meet the extraordinary circumstances of the pandemic. However, the dynamics and methodologies use in teaching face-to-face and/or with IT / IS based solutions are arguably poles apart. A system which is not able to incorporate the learning and teaching requirement and/or unable to deliver the intended knowledge will cause problems. The third paper of this study developed a survey instrument that addresses the challenges related to the teaching and learning methodology; known as pedagogy. By utilising the seventy-one (71) questions related to seventeen (17) barriers / challenges / issues practitioners will be able to evaluate the learning shortcoming of the system when it comes to teaching methodology (see Appendix P3.A). As a result of question item results, it should be possible to solve the problems that are related to quality of content used for online learning in terms of interactivity, instructors' expertise (concerning both use of IT system and/or ability to deliver lecture material). Moreover, access to the resource to complete assignments and projects will also be highlighted with the help of this instrument.

7.4 Limitations & Future Research

This study provides a systematic understanding of barriers / challenges / issues hindering the success of E-learning solutions in learning. Utilising the instruments developed supports the management of prevalent student facing issues / problems impacting the technological component (T), the user expectations (I), and the limitation of teaching / pedagogic methodology (P). The current research is unique as it has contributed to the existing E-learning literature, i.e., by providing a set of instruments to test for the existence of barriers to implementation success in a project environment.

The findings were drawn by assessing from the viewpoint of arguably the most important key E-learning system stakeholder (i.e., the student); however, future assessment could be made by gathering responses from other stakeholder groups, e.g., instructors, administrators, or project managers. Furthermore, the significance and generalisability of the instrument mean that the instrument can equally be implemented in any HEI setting and context, irrespective of country or culture. It would be interesting to consider the significance of the challenges in and across different countries, e.g., in developing v developed nations) and the researcher believes that a number of follow-up studies could be completed to draw conclusions based on a comparison with the current study data.

Another avenue for future research, which can be explored with the extension of the current study, is the validation of the non-student facing fourth category, entitled enabling conditions (EC). This category was not explored in the current study as these factors are not student facing and are more related to contextual and support services. An exploration of these factors in different HEI contexts would hopefully shed more light on the supportive barriers and/or how EC factors impact technological, individual, and pedagogical categories.

Researchers are still a long way from removing / avoiding all challenges faced during E-learning implementations, but the researcher believes that this thesis has supported a significant step forward. As new advances are made, and new understandings gained, I hope that there will be a continuous updating of both the item to identify more specifically barriers / challenges / issues from a range of stakeholder perspectives, but also an increasing appreciation of solutions to technology, user individual, and learning methodology issues. By updating the categories, hopefully practitioners will be increasingly aware of new and advanced challenges; many of which may (as yet) not be contained in the current list. To further check the strength and implications of the current instruments a longitudinal study can be conducted. Such studies will enable a better understanding of the effect of factors in pre and post analysis. Thus, providing more structured knowledge for other researchers and practitioners about the change in existence of barriers / challenges / issues with experience and time.

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Appendices

Appendix 1A

Definitions of Technological Barriers (Ali et al., 2018)

BARRIERS	DESCRIPTION
1. Technology infrastructure	Refers to the hardware, software, facilities, and network capabilities within the college/institution.
2. Technical support	Unavailability of technical staff and lack of facilities to perform various activities (installation, operation, maintenance, network administration and security).
3. Bandwidth Issue And Connectivity	Slow speed of Internet and high internet traffic during E-learning experience.
4. Software and interface design	Less user friendly software and interface design during E-learning experience.
5. Compatible technology	Incompatibility of content with a variety of learning management systems / technology.
6. Poor quality of computers	Low quality computers that freeze frequently and outdated computer systems.
7. Virus attacks	Virus attacks on e-learning systems during E-learning experience.

Appendix 1B

Definitions of Individual Barriers (Ali et al., 2018)

BARRIERS	DESCRIPTION
1. Prior knowledge	Student having background knowledge related to course.
2. Student Motivation	Students' Motivation on the basis of their skills, attitudes, interest, behaviour and activity.
3. Technological difficulty	Students facing technological difficulty in using E-learning technologies.
4. Technology experience	Students lacking technology experience in solving problems and accomplishing basic tasks.
5. Awareness and attitude towards ICT	Students lacking awareness of internet skills and reluctance of students in taking responsibility for their own E-learning.
6. Computer literacy	Lack of computer literacy in students.
7. Perceived usefulness and ease of use perceptions	Students' intentions to carry on E-learning lifelong and his/her usage behaviour of ICTs.
8. Students Support	Support provided by students in successful implementation of E-learning system.
9. Computer anxiety	Students' early misperceptions about the ease of use of an E-learning system.
10. Sense of isolation due less face to face interaction	Absence of face to face/social interaction between individual learner and instructor endorsing sense of isolation.
11. Conflicting priorities	Time devoted to E-learning makes individual's priorities conflict.
12. Social support	Support from family and employers for E-learning, conducive environment and devoid of distraction during E-learning sessions.
13. Social loafing	Students working less diligently because of the relative absence of instructor- learner and learner-learner interaction.
14. Student's economy	Financial difficulty for taking up E-learning courses.
15. Academic confidence	Academic experience and qualification of student.
16. Self-efficacy	Student's confidence in using E-learning technologies and believe in completion of E-learning course.
17. Lack of ICT skills	It includes training in multimedia related skills and Impact of technology on learning.
18. Family commitments	Family commitments taking up most time and resources of the e-learners

19. Work commitment	E-learners giving excuse of their work commitments for skipping exams, assignments etc.
20. Student readiness	Students possessing inconsistent E-learning readiness over time, among institutions or instruments.
21. Response to change	Students' slow response to changing E-learning.
22. Inequality in access to internet connectivity	Inequalities in access to the internet & few people have internet connection.
23. Inequality in Access to technology	Inequality of access to the technology itself by all the students.
24. Technophobia	Students' having afraid of operating E-learning systems/technologies.
25. Cost of using technology	Students facing high cost of using technologies.
26. Individual Culture	Student's overall individual culture distresses attitude towards distance learning. Each individual have different learning style and expectation, which should be consider while designing E-learning.

Appendix 1C

Definitions of Pedagogical Barriers (Ali et al., 2018)

BARRIERS	DESCRIPTION
1. Faculty effort	Lack of effort and support being put by faculty members in use of E-learning.
2. Faculty development	Lack of training and development in faculty and limited change in teaching methodology of faculty in response to ICT developments.
3. Lack of ownership	Faculty not taking ownership of successful implementation of E-learning technologies and lack of interest in meeting E-learning challenges.
4. Lack of feedback	Faculty putting little effort in giving feedback, making students drop out or fail.
5. Quality Course Content	Course content having less quality in terms of interactivity.
6. Engaging Students Online	Faculty facing difficulty in engaging students online.
7. Pedagogical model	Use of instructor / learner centred approach in teaching.
8. Localization of content	Lack of Customisation/Adaptability of course content according to local culture, language and religious beliefs.
9. Flexibility in delivery mode	Lack of student empowerment concerning the decisions related to taking exam, selection of medium of content delivery, etc.
10. Course content	Lack of relevance, accuracy of course content and misalignment of course content with future employers' need.
11. Faculty Training	Lack of teaching material and courses for teachers in the fields of learning technology.
12. Lack of Credibility	Less likely to hire someone with a TBL certificate unless provided by an accredited institution.
13. Additional time needed to communicate with students	Increased communication time principally on e-mail.
14. Insufficient computers	Few computers available as compared to the number of students.
15. IT skills of Faculty members	Weak IT skills of faculty members.
16. Hard to access digital libraries	Problems faced in having access to digital libraries.

17.	Cost of multimedia learning materials	Cost of producing high quality multimedia learning materials.
18.	Mode of delivery	Barriers related to mode of delivery selected for E learning.
19.	Weak Learning Management System	Learning management systems lack interactivity and have vague features.
20.	Reliability of online measuring instrument	Lack of reliability of online assessment process.
21.	Lack of top-level commitment	Insufficient support from top-level management.
22.	Material accessibility	Reach of student to material.
23.	Pre-course orientation	Lack of Pre course orientation sessions by instructor.
24.	Tutor support counselling sessions	Lack of support/counselling sessions conducted by instructor.
25.	Absence of real-time feedback	Students lacking immediate/prompt response from instructors to get answer of the query.
26.	Less focus on technical requirements of Content	Technical requirements of course content available online (e.g. size of web pages, font, colours, quality of images) are not met.
27.	Faculty's acceptance of E-learning technologies	Teachers' lacking Technology Acceptance.
28.	Level of knowledge of teacher	Teachers lacking grip on course content while delivering an E-learning session.

Appendix 1D

Definitions of Individual Barriers (Ali et al., 2018)

BARRIERS	DESCRIPTION
1. Administrative support	Lack of administrative support in crafting E-learning related policies, incentives and resources. Institutional policy and organisational culture are crucial to the way E-learning is adopted or embedded in universities.
2. Setup Cost/Limited Funds	High cost of setting up the E-learning system and unavailability of low-cost ICT alternatives.
3. Security	Openness of E-learning systems challenging security of personal information of students/staff/faculty.
4. Language Barrier	Lack of conversion of E-learning content in other languages.
5. Rules and regulation	Surety that all relevant laws are taken into consideration while crafting policies related to E-learning to prevent government regulations. Limitations in national and institutional policies and management practices.
6. Load shedding of electricity	Problems related to Power cuts, power fluctuations and Power distribution while having E-learning experiencing.
7. Ethical barriers	Lack of written permission from participants and absence of maintaining confidentiality by the E-learning services providers.

Appendix 2A – Technological Barriers Questionnaire

Research Questionnaire

Please take a few minutes to complete this survey. The purpose of this survey is to explore the barriers of E-learning. Please note that this is not a student evaluation of the instructor, but an attempt to understand which barriers cause more difficulty while using technology for education.

For each statement, please tick (✓) the appropriate choice to show the extent to which you perceive it is important for your E-learning experience. This survey is anonymous and the information will be used only for research purposes. Thank you in advance for participating in the survey.

D_1. Gender

- ☐ Male
- ☐ Female

D_2. Age

- ☐ 15-20
- ☐ 21-25
- ☐ 26-30
- ☐ 31-Above

D_3. What degree program are you enrolled in?

- ☐ BBA Honors
- ☐ MBA
- ☐ EMBA
- ☐ Engineering
- ☐ BSc Sciences
- ☐ Other _______________

D_4. What is your monthly household income?

- ☐ Below Rs. 20,000
- ☐ Rs. 20,001 to Rs. 50,000
- ☐ Rs. 50,001 to Rs. 100,000
- ☐ Above Rs. 100,000

Please carefully read the below mentioned statements and tick (✓) only one option for each statement which you seems is the most appropriate, according to the following mentioned scale.

Completely Disagree	**Mostly Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely Agree**
CD	MD	SD	N	SA	MA	CA
1	**2**	**3**	**4**	**5**	**6**	**7**

Statements		CD	MD	SD	N	SA	MA	CA
		1	2	3	4	5	6	7
1	**Technology Infrastructure**							
TI_1	No access to a computer/device hinders E-learning	☐	☐	☐	☐	☐	☐	☐
TI_2	Slow/old computers/devices hinder in E-learning	☐	☐	☐	☐	☐	☐	☐
TI_3	Limited or lack of access to technology and devices is a barrier in E-learning	☐	☐	☐	☐	☐	☐	☐
TI_4	Too many IDs and login passwords are a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
TI_5	Infrastructure inefficiencies are a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
2	**Technical support**							
TS_1	Unavailability of technical support staff (i.e. lab attendant, computer technician) hinders in E-learning	☐	☐	☐	☐	☐	☐	☐
TS_2	Late response (turn-around) time from administration/technical staff is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
TS_3	Facing difficulty in taking prints of assignments and materials hinders in E-learning	☐	☐	☐	☐	☐	☐	☐
3	**Bandwidth Issue and Connectivity**							
BC_1	Slow internet connectivity hinders E-learning at university campus	☐	☐	☐	☐	☐	☐	☐
BC_2	Slow internet connectivity hinders E-learning at home	☐	☐	☐	☐	☐	☐	☐
BC_3	Slow internet connectivity hinders E-learning at work	☐	☐	☐	☐	☐	☐	☐
BC_4	Slow internet connectivity hinders mobile E-learning	☐	☐	☐	☐	☐	☐	☐
BC_5	Slow Browsing speed hinders E-learning	☐	☐	☐	☐	☐	☐	☐
4	**Software and Interface Design**							
SI_1	Overly complex Screen design or User Interface hinders in E-learning	☐	☐	☐	☐	☐	☐	☐

SI_2	Non user friendly system interface/design is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
SI_3	Poor E-learning system interface design (i.e. Website, LMS) is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
SI_4	Difficult navigation on the Website or LMS is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
5	**Compatible Technology**							
CT_1	Inconsistency of course material is a barrier to E-learning on my device	☐	☐	☐	☐	☐	☐	☐
CT_2	Course material format does not always run/open on my device	☐	☐	☐	☐	☐	☐	☐
CT_3	Outdated E-learning system is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
CT_4	I need subject specific technology devices to fulfil the requirement of the subject	☐	☐	☐	☐	☐	☐	☐
CT_5	Technology devices should be up to date and consistent with the Course material	☐	☐	☐	☐	☐	☐	☐
6	**Poor Quality of Computers**							
PQ_1	Outdated and poor quality of computers hinders in E-learning	☐	☐	☐	☐	☐	☐	☐
PQ_2	Local computer faults have results in my loosing work	☐	☐	☐	☐	☐	☐	☐
PQ_3	Device speed negatively impacts the presentation of E-learning content	☐	☐	☐	☐	☐	☐	☐
PQ_4	Computer/device which freezes frequently is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐
7	**Virus Attacks**							
VA_1	Virus and malware attacks hinders in E-learning	☐	☐	☐	☐	☐	☐	☐
VA_2	I have lost my tasks due to virus attacks on more than one time	☐	☐	☐	☐	☐	☐	☐
VA_3	Vulnerability of E-learning system to virus attack is a barrier to E-learning	☐	☐	☐	☐	☐	☐	☐

Appendix 2B – Individual Barriers Questionnaire

Research Questionnaire

Please take a few minutes to complete this survey. The purpose of this survey is to explore the barriers of E-learning. Please note that this is not a student evaluation of the instructor, but an attempt to understand which barriers cause more difficulty while using technology for education.

For each statement, please tick (✓) the appropriate choice to show the extent to which you perceive it is important for your E-learning experience. This survey is anonymous and the information will be used only for research purposes. Thank you in advance for participating in the survey.

D_1. Gender

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- ☐ 26-30
- ☐ 31-Above

D_3. What degree program are you enrolled in?

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- ☐ BSc Sciences
- ☐ Other _______________

D_4. What is your monthly household income?

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- ☐ Rs. 20,001 to Rs. 50,000
- ☐ Rs. 50,001 to Rs. 100,000
- ☐ Above Rs. 100,000

Please carefully read the below mentioned statements and tick (✓) only one option for each statement which you seems is the most appropriate, according to the following mentioned scale.

Completely Disagree	**Mostly Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely Agree**
CD	MD	SD	N	SA	MA	CA
1	**2**	**3**	**4**	**5**	**6**	**7**

	Statements	CD	MD	SD	N	SA	MA	CA
Prior knowledge								
1	Do you think less/no prior knowledge hinders in E-learning?	□	□	□	□	□	□	□
2	Do you think having no background knowledge related to the course content would hinder in E-learning?	□	□	□	□	□	□	□
Student Motivation								
1	If the course content being taught in the class is irrelevant, it would demotivate you and hinders in E-learning	□	□	□	□	□	□	□
2	If you dislike learning through E-learning technologies in the class, it would demotivate you and hinder in E-learning	□	□	□	□	□	□	□
3	If the E-learning class is not interesting, it would demotivate you and hinder interest in E-learning	□	□	□	□	□	□	□
4	If you have little or no motivation towards E-learning, it would hinder use of E-learning	□	□	□	□	□	□	□
Technological difficulty								
1	Difficulty in operating E-learning systems hinders intention to use E-learning	□	□	□	□	□	□	□
2	High complexity in E-learning technology hinders use of E-learning	□	□	□	□	□	□	□
Technology experience								
1	Limited experience of using technology hinders use of E-learning	□	□	□	□	□	□	□
2	Lacking of technology experience will stop me completing E-learning tasks	□	□	□	□	□	□	□
3	Being unable to solve technical problems might hinder use of E-learning	□	□	□	□	□	□	□
Awareness and attitude towards ICT								
1	Having a negative attitude towards E-learning would hinder E-learning	□	□	□	□	□	□	□
2	Absence of awareness towards E-learning systems, hinders E-learning use	□	□	□	□	□	□	□
3	If interaction with an E-learning system is not a fun experience, it would hinder use of E-learning	□	□	□	□	□	□	□
Computer literacy								
1	Inadequate computer literacy, whilst receiving/delivering education, will hinder the E-learning experience	□	□	□	□	□	□	□
2	Little or no knowledge about computers will hinder the E-learning experience	□	□	□	□	□	□	□

Perceived usefulness and ease of use perceptions								
1	The use of an E-learning system within a module improves my learning performance	□	□	□	□	□	□	□
2	Using E-learning improves the effectiveness of learning	□	□	□	□	□	□	□
3	Using the E-learning system will allow me to accomplish learning tasks more efficiently	□	□	□	□	□	□	□
4	It is easy for me to become skillful at using the E-learning system	□	□	□	□	□	□	□
5	I find it easy to get the E-learning system to do what I want it to do	□	□	□	□	□	□	□
Students Support								
1	I get enough support via E-learning systems to manage my student affairs	□	□	□	□	□	□	□
2	Not being able to send requests or suggestions about lectures hinders my use of E-learning	□	□	□	□	□	□	□
3	Inability to contact instructors when necessary, hinders my use of E-learning	□	□	□	□	□	□	□
4	No support from fellow students will hinder use of E-learning	□	□	□	□	□	□	□
Computer anxiety								
1	Nervousness about using E-learning is a barrier to use of E-learning	□	□	□	□	□	□	□
2	Anxiety of making a mistake, leading towards hesitation to use E-learning, is a barrier to E-learning	□	□	□	□	□	□	□
3	E-learning systems being intimidating is a barrier to E-learning	□	□	□	□	□	□	□
4	Misperceptions about the ease of use of an E-learning system hinders E-learning use	□	□	□	□	□	□	□
Sense of isolation due less face to face interaction								
1	Absence of Physical meetings with instructor is a barrier to E-learning use	□	□	□	□	□	□	□
2	Absence of social interaction between learners is a barrier to E-learning use	□	□	□	□	□	□	□
3	Feeling of isolation during E-learning sessions hinders E-learning use	□	□	□	□	□	□	□
Conflicting priorities								
1	Conflictions in time, i.e. between E-learning course deadlines and personal commitments, can hinder E-learning use	□	□	□	□	□	□	□
2	Conflicts in an individual’s priorities, due to undertaking an E-learning course, hinders E-learning use	□	□	□	□	□	□	□

Social support								
1	Lack of support from people, whose opinion I value and listen to, may hinder me in using E-learning	◻	◻	◻	◻	◻	◻	◻
2	No organizational support towards E-learning hinders use of E-learning	◻	◻	◻	◻	◻	◻	◻
3	Having non-conducive environment during E-learning sessions hinders use of E-learning	◻	◻	◻	◻	◻	◻	◻
4	Distraction during E-learning sessions hinders E-learning	◻	◻	◻	◻	◻	◻	◻
Social loafing								
1	Does having less or no interaction between student and teacher hinder E-learning	◻	◻	◻	◻	◻	◻	◻
2	Does having less or no interaction amongst students hinder E-learning	◻	◻	◻	◻	◻	◻	◻
3	Inadequate interaction - both instructor to learner and learner to learner, hinders the E-learning experience	◻	◻	◻	◻	◻	◻	◻
Student's economy								
1	Does financial cost of undertaking the E-learning course hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
2	Having limited funds would hinder my access to E-learning	◻	◻	◻	◻	◻	◻	◻
Academic confidence								
1	Not having relevant academic qualification hinders adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
2	Having no academic experience related to the E-learning course would hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
Self-efficacy								
1	If you expect to do worse than other students doing the class, it would hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
2	If you are certain that you will not understand the ideas taught in the E-learning course, it will hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
3	If you are sure that that you will not be able to complete the tasks assigned for the E-learning classes, it will hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
4	If you think that you will not receive a good grade in the class, it will hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
Lack of ICT skills								
1	If you do not possess adequate computer skills, it will hinder adoption of E-learning	◻	◻	◻	◻	◻	◻	◻

2	Does having less or no skills to operate technology hinder E-learning	◻	◻	◻	◻	◻	◻	◻
Family commitments								
1	Does family commitment take up most of your time and resources, which hinders use of E-learning?	◻	◻	◻	◻	◻	◻	◻
2	Family commitments can get in the way of E-learning exams and coursework assignments	◻	◻	◻	◻	◻	◻	◻
Work commitment								
1	Does Work commitment hinder your use of E-learning?	◻	◻	◻	◻	◻	◻	◻
	Statements	**CD**	**MD**	**SD**	**N**	**SA**	**MA**	**CA**
2	Absence from the exam, due to job commitments, can hinder your use of E-learning	◻	◻	◻	◻	◻	◻	◻
3	Late submission of assignments, due to office commitments, hinders use of E-learning	◻	◻	◻	◻	◻	◻	◻
Student readiness								
1	Unwillingness to learn through E-learning, hinders adoption E-learning	◻	◻	◻	◻	◻	◻	◻
2	If you are not ready for an E-learning course, it hinders your adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
Response to change								
1	Reluctance in using new technologies of E-learning, hinders use of E-learning	◻	◻	◻	◻	◻	◻	◻
2	Resistance to change, e.g. from the existing educational system to the new tools of E-learning, hinders adoption of E-learning	◻	◻	◻	◻	◻	◻	◻
Inequality in access to internet connectivity								
1	Does problems accessing the internet hinder E-learning.	◻	◻	◻	◻	◻	◻	◻
2	If limited people have internet connection this hinders E-learning	◻	◻	◻	◻	◻	◻	◻
3	Low bandwidth internet connection hinders E-learning	◻	◻	◻	◻	◻	◻	◻
Inequality in Access to technology								
1	Does limited access to use of technology hinder E-learning	◻	◻	◻	◻	◻	◻	◻
2	Unavailability of the required E-learning technologies hinders adoption	◻	◻	◻	◻	◻	◻	◻

3	Students using outdated technology can hinder E-learning	☐	☐	☐	☐	☐	☐	☐
Technophobia								
1	Feeling afraid of operating new systems hinders use of E-learning	☐	☐	☐	☐	☐	☐	☐
2	Feeling scared of working with the latest technologies hinders use of E-learning	☐	☐	☐	☐	☐	☐	☐
Cost of using technology								
1	Does high cost of technology hinder use of E-learning	☐	☐	☐	☐	☐	☐	☐
2	If the cost of technological components required in E-learning is high, it will hinder E-learning	☐	☐	☐	☐	☐	☐	☐
Individual Culture								
1	Do you think that student's personal expectation hinders E-learning?	☐	☐	☐	☐	☐	☐	☐
2	If E-learning system does not align to your learning style, it will hinder use of E-learning	☐	☐	☐	☐	☐	☐	☐
3	Providing E-learning solutions that do not consider the student's cultural values hinders use of E-learning	☐	☐	☐	☐	☐	☐	☐

Appendix 2C – Pedagogical Barriers Questionnaire

Research Questionnaire

Please take a few minutes to complete this survey. The purpose of this survey is to explore the barriers of E-learning. Please note that this is not a student evaluation of the instructor, but an attempt to understand which barriers cause more difficulty while using technology for education.

For each statement, please tick (✓) the appropriate choice to show the extent to which you perceive it is important for your E-learning experience. This survey is anonymous and the information will be used only for research purposes. Thank you in advance for participating in the survey.

D_1. Gender

- ☐ Male
- ☐ Female

D_2. Age

- ☐ 15-20
- ☐ 21-25
- ☐ 26-30
- ☐ 31-Above

D_3. What degree program are you enrolled in?

- ☐ BBA Honors
- ☐ MBA
- ☐ EMBA
- ☐ Engineering
- ☐ BSc Sciences
- ☐ Other _______________

D_4. What is your monthly household income?

- ☐ Below Rs. 20,000
- ☐ Rs. 20,001 to Rs. 50,000
- ☐ Rs. 50,001 to Rs. 100,000
- ☐ Above Rs. 100,000

Please carefully read the below mentioned statements and tick (✓) only one option for each statement which you seems is the most appropriate, according to the following mentioned scale.

Completely Disagree	**Mostly Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely Agree**
CD	MD	SD	N	SA	MA	CA
1	**2**	**3**	**4**	**5**	**6**	**7**

	Statements	CD	MD	SD	N	SA	MA	CA
Faculty Effort								
1	Teachers with little or no confidence in using devices in their work will be a barrier for E-learning	□	□	□	□	□	□	□
2	Poor readiness of academic staff to use E-learning system is a barrier for E-learning	□	□	□	□	□	□	□
3	Instructor not following up student problems in order to find out solution via E-learning is a barrier for E-learning	□	□	□	□	□	□	□
Faculty Development								
1	Lack of administrative support to use technology for teaching and learning, is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty not trained in pedagogical aspects of E-learning, is a barrier for E-learning	□	□	□	□	□	□	□
Lack of Ownership								
1	Faculty's perception that technology being used for E-learning is unreliable is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty's lack of interest in using technology in teaching and learning is a barrier for E-learning	□	□	□	□	□	□	□
Lack of Feedback								
1	Faculty not giving timely feedback after submitting assignments is a barrier for E-learning	□	□	□	□	□	□	□
2	Students not getting in touch with professors through online virtual classes is a barrier for E-learning	□	□	□	□	□	□	□
3	Being unable to get in touch with professors other than class, is a barrier for E-learning	□	□	□	□	□	□	□
Quality Course Content								
1	Less informative and difficult to understand E-learning content is a barrier for E-learning	□	□	□	□	□	□	□
2	E-learning not being rich enough to make up for absence of face-to-face classes, is a barrier for E-learning	□	□	□	□	□	□	□
3	Presenting lessons in the form of electronic content in a dull and ineffective manner, is a barrier for E-learning	□	□	□	□	□	□	□
4	Facing difficulty to understand and follow the content is a barrier for E-learning	□	□	□	□	□	□	□
Engaging Students Online								
1	Faculty perception that classroom management is more difficult when using technology, is a barrier for E-learning	□	□	□	□	□	□	□
2	My fear of using technology, is a barrier for E-learning	□	□	□	□	□	□	□
3	Being unable to get in touch with my professors through E-learning systems, is a barrier for E-learning	□	□	□	□	□	□	□
4	Faculty not encouraging students to ask questions, is a barrier for E-learning	□	□	□	□	□	□	□
Pedagogical Model								
1	Faculty members not getting training in technological skills is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty unable to make full use of technology to fully prepare and research materials for lessons, is a barrier for E-learning	□	□	□	□	□	□	□

3	Universities not providing faculty members trainings to develop innovative pedagogical approaches for E-learning is a barrier for E-learning	□	□	□	□	□	□	□
Localization of Content								
1	E-learning system not giving space to explore local environment, is a barrier for E-learning	□	□	□	□	□	□	□
2	E-learning content not being suitable according to my culture, is a barrier for E-learning	□	□	□	□	□	□	□
3	E-learning content not being suitable according to my religion, is a barrier for E-learning	□	□	□	□	□	□	□
Flexibility in Delivery Mode								
1	E-learning system's incompatibility across different devices, is a barrier for E-learning	□	□	□	□	□	□	□
2	Course content not suitable for synchronous and asynchronous learning, is a barrier for E-learning	□	□	□	□	□	□	□
3	E-learning system not having flexibility for students to take exams on desired medium, is a barrier for E-learning	□	□	□	□	□	□	□
Course Content								
1	Outdated E-learning material, is a barrier to E-learning	□	□	□	□	□	□	□
2	The course content having inappropriate degree of breadth, is a barrier for E-learning	□	□	□	□	□	□	□
3	Inappropriate contents covered in course, is a barrier to E-learning	□	□	□	□	□	□	□
Faculty Training								
1	Universities being unable to provide convenient time for training of faculty, is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty not trained in pedagogical aspects of E-learning, is a barrier for E-learning	□	□	□	□	□	□	□
3	Faculty not receiving trainings to develop innovative pedagogical approaches for E-learning, is a barrier for E-learning							
Lack of Credibility								
1	The perception that taking E-learning courses will not help me to achieve my career goals, is a barrier for E-learning	□	□	□	□	□	□	□
2	The perception that taking E-learning courses has less chances of me getting employed, is a barrier for E-learning	□	□	□	□	□	□	□
3	The perception that E-learning degree is not credible enough, is a barrier for E-learning	□	□	□	□	□	□	□

Additional Time Needed to Communicate with Students								
1	Faculty member is only accessible through email, is a barrier for E-learning	□	□	□	□	□	□	□
2	Lack of timely reply from faculty member, is a barrier for E-learning	□	□	□	□	□	□	□
3	Lack of use of other communication features of E-learning system by faculty member, is a barrier for E-learning	□	□	□	□	□	□	□
Insufficient computers								
1	Frequent long waiting to use E-learning system on-campus, is a barrier for E-learning	□	□	□	□	□	□	□
2	Less number of available E-learning devices in university, is a barrier for E-learning	□	□	□	□	□	□	□

IT skills of Faculty members								
1	Faculty's lack of basic technology skills for adapting technology in teaching and learning, is a barrier for E-learning	□	□	□	□	□	□	□
2	Lack of IT skills of Faculty members to access the essential hardware hinders in E-learning, is a barrier for E-learning	□	□	□	□	□	□	□
3	Lack of IT skills of Faculty members to access the essential E-learning system hinders in learning	□	□	□	□	□	□	□
Hard to Access Digital Libraries								
1	Difficulty in accessing digital libraries to acquire information, is a barrier for E-learning	□	□	□	□	□	□	□
2	Lack of access of off-campus digital libraries to acquire information, is a barrier for E-learning	□	□	□	□	□	□	□
Cost of Multimedia Learning Materials								
1	Lack of adequate financial support to develop technology- based activities, is a barrier for E-learning	□	□	□	□	□	□	□
2	High cost of quality E-learning materials, is a barrier for E-learning	□	□	□	□	□	□	□
3	Faculty members unable to develop quality E-learning material, is a barrier for E-learning	□	□	□	□	□	□	□
Mode of Delivery								
1	Teachers not using multiple modes to deliver lectures, is a barrier for E-learning	□	□	□	□	□	□	□
2	Course not having distinctive features to deliver lectures, is a barrier for E-learning	□	□	□	□	□	□	□
Weak Learning Management System								
1	Lack of sharing, discussion or support in E-learning system with others, is a barrier for E-learning	□	□	□	□	□	□	□
2	Technology does not fit well for the courses, is a barrier for E-learning	□	□	□	□	□	□	□
3	E-learning system having high down time, is a barrier for E-learning	□	□	□	□	□	□	□
Reliability of Online Measuring Instrument								
1	Lack of timely results of assignments, is a barrier for E-learning	□	□	□	□	□	□	□
2	Th perception that online evaluation system is unsecure, is a barrier for E-learning	□	□	□	□	□	□	□
3	Unclear exam questions and assignments in E-learning system, are a barrier for E-learning	□	□	□	□	□	□	□
Lack of Top-Level Commitment								
1	Lack of technical support for technology by institution, is a barrier for E-learning	□	□	□	□	□	□	□
2	Absence of clear vision and policy for E-learning development, is a barrier for E-learning	□	□	□	□	□	□	□
3	Lack of high-level policies for productive implementation of E-learning system, is a barrier for E-learning	□	□	□	□	□	□	□
4	Lack of commitment in administration to implement E-learning system, is a barrier for E-learning	□	□	□	□	□	□	□
Material Accessibility								
1	Difficult access to course content and auxiliary material, is a barrier for E-learning	□	□	□	□	□	□	□
2	Limited access to course materials, is a barrier for E-learning	□	□	□	□	□	□	□

3	Lack of availability of material for study anywhere and anytime, is a barrier for E-learning	□	□	□	□	□	□	□
4	The course materials not available when required, is a barrier for E-learning	□	□	□	□	□	□	□
Pre-course Orientation								
1	Faculty not giving the comprehensive orientation before the course, is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty not helping students to adjust to E-learning environment, is a barrier for E-learning	□	□	□	□	□	□	□
Tutor Support Counselling sessions								
1	Lack of guidance to help in E-learning when needed, is a barrier for E-learning	□	□	□	□	□	□	□
2	Unable to access faculty member when consultation is required, is a barrier for E-learning	□	□	□	□	□	□	□
3	Difficulty in getting help when I have a question, is a barrier for E-learning	□	□	□	□	□	□	□
Absence of Real Time Feedback								
1	Faculty not encouraging the interaction and participation in lessons and discussions is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty not providing quick and efficient feedback to student's educational needs and questions is a barrier for E-learning	□	□	□	□	□	□	□
Less Focus on Technical Requirement of Content								
1	Faculty not focusing on technical requirement of course in lectures, is a barrier for E-learning	□	□	□	□	□	□	□
2	Technical faults with E-learning system, is a barrier for E-learning	□	□	□	□	□	□	□
3	Layout of E-learning system not being aligned with course content, is a barrier for E-learning	□	□	□	□	□	□	□
4	Course content not using multimedia tools to present the material, is a barrier for E-learning	□	□	□	□	□	□	□
Faculty's Acceptance of E-learning Technologies								
1	Faculty's lack of time to adopt E-learning system, is a barrier for E-learning	□	□	□	□	□	□	□
2	Faculty's fear of using E-learning system, is a barrier for E-learning.	□	□	□	□	□	□	□
3	Faculty's perception that E-learning system is difficult to use, is a barrier for E-learning	□	□	□	□	□	□	□
4	Faculty's perception using the E-learning system will not increases productivity, is a barrier for E-learning	□	□	□	□	□	□	□
Level of Knowledge of Teacher								
1	Teacher not having grip on the course content, is a barrier for E-learning	□	□	□	□	□	□	□
2	Teacher being unable to deliver lectures concept clearly, is a barrier for E-learning	□	□	□	□	□	□	□
3	Teacher's limited knowledge related to course, is a barrier for E-learning	□	□	□	□	□	□	□