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ICT Adoption in TVET Sector of Pakistan

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Abstract
This research examines the challenges that impede the adoption of Information and Communication Technology (ICT) in the field of Technical Education and Vocational Training (TVET) accredited institutions in the Punjab, Pakistan and explores the potential of ICT to improve the TVET sector and alleviate poverty. The study employs a descriptive survey design, which is a type of research used to identify current conditions, processes, and relationships, as well as to determine the key characteristics of variables of importance in each context. The focus of the study is to analyze the adoption rates of ICT in TVET institutions and to validate the Technology Organization Environment (TOE) framework for the TVET sector, which aims to incorporate ICT. The scope of this research is to identify challenges that hinder the adoption of ICT, assess the levels of availability and usage of ICT, and determine what is needed by TVET-accredited institutions to overcome these challenges. With the aid of ICT, everyone who interacts with TVET institutions can process, store, retrieve, and transfer information, which can improve the quality of education and help alleviate poverty in Pakistan.
Keywords: ICT Adoption in TVET, Technical Education and Vocation Training, Poverty Alleviation through TVET

1. Introduction

Education is the one of the best way for the advancement and progress in economy. Education in all its forms, including TVET and mainstream programs, aids in the economy's ability to pass on knowledge, information, morals, and skills from one generation to the next. By encouraging our minds to think of new, improved ways to do tasks, it also significantly contributes to the development of our intellectual potential (Nooruddin, S. (2017). Training and skill development are essential components of human resource development since they significantly impact an individual's ability for productivity (Shah, Rahman and Hamidullah, 2011; Javied and Hyder, 2009; Audi et al., 2021).

ICT is mainly used in communication and general administration to process, store, retrieve, and transfer information between those who interact with the institution. The implementation of Information and Communication Technology in TVET institutions is critical for reducing knowledge, technical, and economic gaps between this region and the rest of the world. ICT can be applied in various aspects, ranging from the administration of students to resource administration (Krishnaveni, 2010).

The importance of ICT in influencing change cannot be overstated, as various researchers have shown that ICT infrastructure is vital for the rapid development of developing economies and has become increasingly important to organizations worldwide. The adoption of ICTs is critical for organizational survival, as it improves the efficiency of business processes and presents new ways to realize and maintain a competitive advantage. Additionally, ICT provides a vital component in the client-firm relationship, improving client satisfaction and commitment (Iniesta-Bonillo et al., 2013; Audi et al., 2022).

TVET is a learning pathway that aims to equip individuals with the knowledge, competencies and skills required for a specific profession in the labor market to make available employment chances for workers and output for enterprises (Ahmed, Z., Alwi and Akhtar, 2022). Information & Communication Technology is applied to various educational disciplines, the study on effective ICT adoption in the field of TVET is limited and requires further assessment to highlight the level of TVET needs for ICT integration (Ahmed, Z., Alwi and Akhtar, 2022).

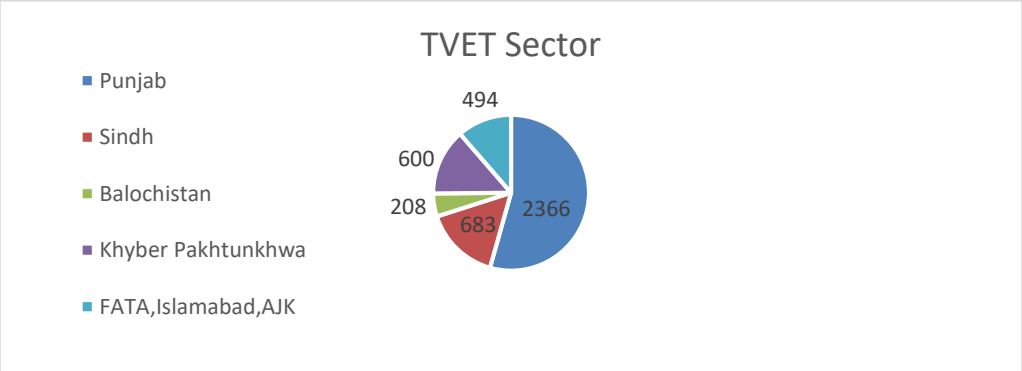

Figure 1: TVET Institutes in Pakistan (Chart Representation)

In Pakistan, TVET sector is the second largest sector which providing education through middle-level colleges. It is offering courses ranging from secondary education to degree-level programs. The majority of this kind of education has been provided through conventional methods. The TVET sector in Pakistan has more than 4350 technical and vocational

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institutes, including both government-owned and private sector institutions (http://www.skillingpakistan.org/tvet-landscape). Overall, TVET plays key role in providing vocational skills to workforce, which contributes to the country's economic growth and development.

There is no research or studies have dealt with the adoption of ICT in the management and administration of TVET-accredited institutes, which warrants further exploration. The objectives of this study are i. to determine the major challenges that are affecting the adoption of ICT by TVET institutions, ii. to evaluate the current level of ICT adoption in TVET institutions iii. to validate the T.O.E framework as a useful tool for understanding the adoption of ICT in TVET institutions. The results of this study will be valuable to government officials in formulating policies that align with Pakistan's Vision 2030 goals, where the education sector plays a crucial role. Assumptions and limitations of the study include the assumption that certain factors influence the adoption of ICT to the organize TVET institutions and that respondents would provide honest information. This study is limited to the acceptance of ICT by TVET institutions accredited by TVETA within the Punjab.

2. Literature review

Numerous studies have explored the means and motives behind the adoption of various innovations by individuals and organizations. The decision to adopt a particular technology and the necessary timeframe has been a subject of research in many disciplines. Innovation is defined as a new idea, object, or practice that an individual perceives as novel, whether it is actually new or not. Innovation can be either abstract, such as an idea, or concrete, such as technology (Straub, 2009). In this study, the focus is on ICT as a specific type of innovation of interest.

Adoption, as described (Rangaswamy and Gupta 2000), refers to the decision made by individuals or organizations to use an innovation. In the context of this study, adoption refers to TVET-accredited institutions' decision to acquire and use ICT in their administration and management. Innovation is used similarly to refer to any new ICT being adopted.

Diffusion refers to the extent to which technology's general use and application spreads across the functional areas of an entity, while integration relates to the acceptance and transparency of technology within the user environment.

Previous studies on ICT adoption in Pakistan have mainly focused on adoption in secondary schools and tertiary institutions. In their study (Nchunge et al., 2013), noted that the rate of ICT adoption in both public and private secondary schools was significantly affected by a lack IT literacy, insufficient technical readiness and poor policy guidelines. According to a study (Kiptoo etal, 2014) on the adoption of MIS in institutions of higher education. The aim of the study was to establish the relationship that existed and impinged on the adoption of computer-based information systems in those institutions. The study found out that external factors such as government policies and private enterprise support do not significantly influence adoption. However, it was notable that funds from external sources, government policies and support, and donor organizations' support significantly influenced the adoption of ICT.

Some researchers focused their study on individual and other factors that were most likely to positively affect behavior in the usage of ICT by students in tertiary institutions (Macharia and Pelser, 2014). In their findings, it was apparent that the environment in which an institution existed, the available technology, the structure of the organization, and individual factors was significant determinants of ICT adoption.

In another study on factors that determine ICT adoption in state-owned higher education institutions in Nigeria, it was evident that these universities were not fully utilizing the potential of ICT solutions in their processes (Eze et al. 2013). The executives of Nigerian institutions were reluctant to make decisions that involved radical operational variations. Additionally, the pace of adoption varied among schools, with ICT relative advantage and readiness being influenced by factors such as energy availability, training, expert skills, technical support, institutional support, corruption, managerial agility, incentives, and size. Regulatory policies and government support in the form of requirements for adoption, legal protections, tax laws and funding are necessary for implementation of ICT among institutes.

The goal of the study is to identify disparities in ICT use, skill, and adoption based on demographic variables such age, gender, and educational attainment. The researcher discovered through data analysis that there are differences in ICT skill, use, and adoption based on age and educational level. As of now, there is no difference in terms of respondent gender (Kusumaningtyas, N., and Suwarto, 2015).

In various studies investigating the adoption, acceptance, and usage of innovations, numerous theoretical models have been utilized, as highlighted by a researcher (Davis et al. 1989). These models include but are not limited to: (i) Technology Acceptance, (ii) Theory of Acceptance and Use of Technology, (iii) Theory of Reasoned Action, (iv) Theory of Planned Behavior, (v) Diffusion of Innovations Theory, and (vi) Technology Organization and Environment, as proposed by Tornatzky and Fleischer (1990).

This theory is an organization-level model that highlights three key elements that shape the decision to adopt ICT. These elements are the technology itself, the adopting organization, and the external environment in which the organization operates. Unlike other models, the TOE model considers both internal and external organizational characteristics as crucial factors in the technology adoption process. It emphasizes that organizational factors, including both formal and informal structures and communication processes, play a significant role in determining the readiness of an organization to adopt technology. Additionally, environmental factors, such as infrastructure and government regulations, influence the pace of technology uptake. Moreover, the availability and cost of technology also affect the implementation of technology by organizations (Mingaine, 2013).

The rationale for employing the TOE as a theoretical framework is multifaceted. Firstly, the study's research framework consists of meaningful constructs that align with the three dimensions of the TOE framework, making it a suitable analytical tool to comprehend the critical factors that can hinder the adoption and usage of ICT by TVET institutions in

administration. Secondly, the TOE framework is a well-known and widely used theory of organizational innovation adoption since its inception (Baker, 2012). Thirdly, TVET Sector has not previously utilized it in examining the adoption and use of ICT. Importantly, the TOE framework provides an organizational perspective rather than an individual perspective.

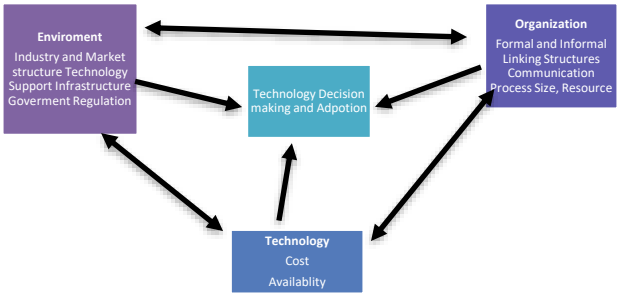

Figure 2 Technology, organization, and environment framework

3. Methodology

3.1. Research Design

The design used in this study was descriptive survey type of design also called known experimental research, Descriptive research is used to identify present conditions, beliefs, processes, relationships and point out needs. This type of study determines the key characteristics of the variables of importance in a context (Sekeran, 2003). This type of research is used to gather data of the prevailing conditions with the purpose of interpreting (Dr. Y.P. Aggarwal, 2008). In this case, to identify challenges that influence adoption of ICT, identify levels of availability and usage of ICT and point out what is needed by TVETA accredited institutions.

3.2. Research Method

The research was designed to assess the key challenges that affect ICT adoption at TVET Sector in the Punjab. The focus was on the Principals / Heads of the institutions. There are about two thousand three hundred sixty-six accredited institutions in the Punjab. The sample size was 250 institutions (Male and Female) from all over the Punjab which were determined using formulae with a margin error of 5% (Krejcie R.V and Morgan D.W 1970).

3.3. Target Population

Population of study is defined as finite elements from which inferences can be made (Cooper, & Schindler, 2008). The sample size is a finite part of the population (Orodho & Kombo, 2002). Target population was two hundred and fifty TVET institution's principals and head of departments who provided information required for the research. Simple random sampling was used.

3.4. Data Collection

Data was gathered using interviews with the purpose of gathering information from the Principals of the institutions. The interviews were intended to investigate the usage of ICT by the management of the TVET institutions. Interviews were chosen since they improve the understanding and credibility of the study. They are known to provide more understanding of the topic under study in this case the adoption and usage of ICT on management of TVET institutions.

Observations were be made to ascertain the presence of physical ICT infrastructures such as computers, servers, networks and Application / Software currently used in the management of TVET institutions. The information obtained through observation was current. This method of study is known to be independent of respondents' willingness to respond. Research instruments used were questionnaires which were divided into three parts. Part one was used to capture the demographic data of the institution while part two which was based on the Likert scale type of questions was used to analyze the three main TOE model constructs Technology, Organization and Environment. Part three had semi structured questions designed to capture usage of ICT by the institutions.

Based on the conceptual framework, the first set of questions focused on the relative advantage and trialability of ICTs in the technological construct. This was intended to provide the answer to the research question on the challenges that impede adoption of ICT in the management of institutions. On the organization construct the questions related to top management support and ICT expertise. The third set questions focuses on the environmental factors which included availability of service providers, competition from other institutions and government regulations. A pilot survey was initially carried out before the tool was used. The purpose of the piloting was to bring out to light weakness of the questionnaires and also of the survey method.

4. Results and Discussions

4.1. Response Rate

The study had targeted a total of 250 respondents, however owing to study limitations 214 responded. This response rate was 85.6%, which was considered good for the study. According to Gay (1995) a response rate of 50% is adequate and therefore that of 85.6% was adequate for data to be analyzed and interpreted.

4.2. Highest Education Qualification Attained and Length of Service

The respondents were asked to show their highest education qualification attained and length of service. As Table 1 indicates majority of the respondents 65% had attained education up to postgraduate level and 24.8% had attained up to degree level while 4.7 had completed Doctorate while only 5.6 % was at secondary level. This meant that majority of those working in the institutions had attained education up to university level and therefore they were appropriate for responding to the study questions. From the table, 6.58% indicated that they had been in the institution for less than year. This could be explained by the fact that some of the institutions were relatively new. It can be observed that 11.2% of the respondents indicated a period of between 2 and 4 years, 8.4% indicated a period between 4 and 6 years while 74.8% indicted that they had worked for over 6 years.

Table 1: Demographic Data

Education Level	Qualification	Percentage
	Secondary School	5.6
	Undergraduate	24.8
	Post Graduate	65.0
	Doctorate	4.7
Length of Service	Period	Percentage
	Less than 1 Year	9.65
	Between 1 and 2 years	35.24
	Between 3 and 5 years	29.35
	More than 5 years	25.76

4.3. Technological Factors

Table 2 shows an analysis of the respondents' opinion on the Technological factors that affect ICT adoption in their institutions. Based on the analysis, the total mean and standard deviation were 4.11 and 0.956 respectively. From this analysis, it can be deduced that respondents were in agreement with the technological factors attributes as stated.

The attribute on ICT adoption and use raises the quality of Training in TVET Sector scored a mean of 4.10 and standard deviation of 1.052 which concluded that the respondents agreed with the statement. However, on I have had the opportunity to evaluate and implement latest ICT software in my organization scored a mean of 3.63 and standard deviation of 1.159. However, on I have had the opportunity to evaluate and implement latest ICT software in my organization scored a mean of 4.28 and standard deviation of 0.927. However, on ICT adoption and use facilitates to complete task quickly scored a mean of 4.30 and standard deviation of 0.830. However, on My job performance is enhanced by ICT adoption and utilization scored a mean of 4.24 and standard deviation of 0.897. However, on I am aware of where I can try out various ICT applications satisfactorily scored a mean of 3.93 and standard deviation of 0.939. However, on ICT oriented TVET can earn a living for the youth of Pakistan scored a mean of 4.31 and standard deviation of 0.888.

Table 2: Descriptive Statistics of Technological Factors

Item Statistics			
Statement	Mean	Std.Dev	N
ICT adoption and use raises the quality of Training in TVET Sector.	4.10	1.052	214
I have had the opportunity to evaluate and implement latest ICT software in my organization.	3.63	1.159	214
ICT adoption and use facilitates to complete task quickly.	4.28	0.927	214
ICT adoption and utilization help me be more productive.	4.30	0.830	214
My job performance is enhanced by ICT adoption and utilization.	4.24	0.897	214
I am aware of where I can try out various ICT applications satisfactorily.	3.93	0.939	214
ICT oriented TVET can earn a living for the youth of Pakistan	4.31	0.888	214
Overall Mean	4.11	0.956	

Reliability of the tool used in collection of data, the questionnaire was tested by Cronbach's alpha. The computed value was 0.730 which was greater than the recommended level of 0.70. This shows that the instrument used for the study was reliable enough.

4.4. Organizational Factors

Table 7 shows an analysis of the degree to which respondents strongly agreed or disagreed with organizational factors that affect ICT adoption in their institutions. Based on the analysis, the total mean and standard deviation were 4.11 and 0.887 respectively.

From this analysis, it can be deduced that respondents were in agreement with the organizational factors attributes as stated. The attribute on Support and commitment from top management scored a mean of 3.95 and SD of .984 which meant that the respondents were in agreement that Support and commitment from top management has an effect on the adoption of ICT in their institutions. However, the respondents were neutral on whether policy guidelines, budgetary allocation and skilled manpower affected ICT adoption.

The reliability statistic in table 3 indicates that they were total of 7 items. To calculate the reliability of the factors, the researcher computed Cronbach's alpha (p) of 0. 817, which is coefficient of reliability and it suggests that the measures are acceptable.

Table 3: Descriptive Statistics of Organizational Factors

Statement	Mean	Std. Dev
Support and commitment from top management promotes adoption and implementation of ICT.	3.95	.984
Regarding the adoption of ICT, there must be clear policy rules and guidelines.	4.12	.901
The top management must set forth enough money in the budget for ICT adoption and implementation.	4.14	.855
ICT adoption and use in TVET Sector depend heavily on the availability of skilled manpower.	4.14	.907
It is crucial for ICT adoption and implement that technical support is available.	3.92	.929
ICT based TVET Organization is essential for career development of an individual.	4.21	.834
Socio-Economic development cannot be achieved without poverty alleviation program like IT oriented hi-tech courses in TVET Sector of Pakistan	4.26	.797
Overall Mean	4.11	0.887

4.5. Environmental Factors

Table 4 shows an analysis of the degree to which respondents strongly agreed or disagreed with organizational factors that affect ICT adoption in their institutions. Based on the analysis, the total mean and standard deviation were 3.89 and 0.942 respectively. From this analysis, it can be deduced that respondents different views regarding Environmental aspects as stated. The attribute on none availability of specialized ICT services providers affects ICT adoption and use scored a mean of 3.72 and Standard Deviation of 0.937 which implied that the respondents were neutral. The attribute on the The adoption and use of ICT depends on the level of customer service offered by the ICT providers scored a mean of 4.00 and SD of 0.937 which meant the respondents were in agreement the Environmental attributes as stated.

The reliability statistic in table 3 indicates that they were total of 8 items. To compute the reliability of the factors, the researcher computed Cronbach's alpha (p) of 0.836, which is coefficient of reliability and it suggests that the measures are acceptable.

Table 4: Environmental Factors

Statement	Mean	Std.Dev
ICT adoption and utilization are impacted by a lack of specialized ICT service providers.	3.72	.937
ICT adoption and utilization are influenced by competition from other institutions.	4.03	.863
Adoption and use of ICT depend heavily on the availability of suitable technologies and applications.	3.77	.970
Government laws have an impact on ICT adoption and use.	3.75	.909
Stakeholder pressure is a major factor in the adoption and use of ICT.	3.90	.866
The adoption and use of ICT depends on the level of customer service offered by the ICT providers.	4.00	.937
Lack of ICT involvement in TVET policy can increase unemployment	4.04	.983
TVET Sector has a long way in reducing poverty and crime rate among the unemployed youth in the society	3.87	1.071
Overall Mean	3.89	0.942

4.6. ICT Usage by TVET Institutions

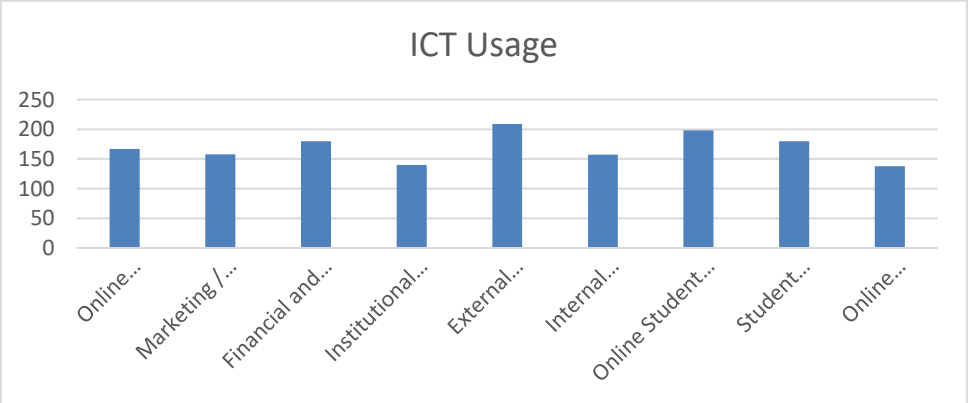

Figure 3: ICT Usage by TVET Institutions

The study revealed that most of the institutions used ICT for external communication mostly through email and in registration of students. It can be observed that 93.93% of the institutions used ICT for internal communication while one hundred ninety representing 90.19% used ICT for marketing purpose. One hundred eighty institutions that account for 84.11% used ICT for inventory control while one hundred forty accounting for 65.42% used ICT in planning of the institutions activities.

Table 5: ICT Usage levels by TVET Institutions

ICT Usage	Level in %
Online Admission Campaigns	78.04
Marketing / Advertisement	73.83
Financial and Inventory management	84.11
Institutional Management and Planning	65.42
External Communication (Email System)	97.66
Internal Communication	73.36
Online Student Enrolment and Registration System	92.52
Student Traceability System	84.11
Online Procurement / E-Procurement	64.49
Overall Mean	79.28

The overall mean for all the functional areas on ICT usage was 79.28 which show that all the functional areas contribute to some extent towards ICT usage. Based on Table 4.5 we conclude that ICT has become a necessary tool for accomplishing various administrative tasks by TVET institutions. Based on this study it is evident that TVET institutions usage levels of ICT were lower in Institutional Management and Planning at 65.42% and in the Online Procurement / E-Procurement at 64.49%. It can be observed that the levels of ICT usage for online admission campaign, Financial and Inventory management, Marketing / Advertisement and student traceability system were more than 70%.

This clearly points out that the usage of ICT in administration of TVET institutions has wider scope and more need to be done to cover all functional areas. From the ICT usage levels, it shows that ICT has become a crucial for accomplishing the administrative tasks.

The study found that there was transformation taking place in advancement of technology in the education sector. This is taking place mainly in the areas of student registration and external communication. The extent of usage for general administrative activities is comparatively less.

4.7. Discussion

4.7.1. Results Linkage to the Research Problem

The study sort to find the challenges that affected adoption of ICT in the management of TVET institution in the Punjab. The study also sought to find out the challenges that influence ICT adoption and evaluate levels of adoption using TOE framework. The results revealed that most of the respondents were of the opinion ICT adoption increased productivity and improved operational efficiency with a mean score of 4.30 and 4.05 respectively, this concurred with a researcher who argued that use of ICT increased workforce productivity and improved communication efficiency (Akom, 2016).

As Table 3 shows, the respondents were of the opinion that top management support and ICT expertise were the main challenges affecting ICT adoption at the organization level. This supports who argues that in middle level institutions due to limited human resource, which is the case with TVET institutions, critical decisions are made by the Principals (Erind 2015). This supports the TOE framework whereby on the organizational construct, the main factors that affect ICT adoption are the top management support and availability of ICT expertise of an institution. Competition from other institutions, lack of appropriate systems and customer service provided by the ICT providers were the main environmental factors that affected ICT adoption. This contradicts argument that industrial pressure (competition) is not a major factor in adoption of ICT but concurs with Low, that competitive pressure is a key factor for adoption ICT.

On the usage of ICT, the result of the study revealed that, contrary to the general perception that the usage of ICT in administration is low in TVET institutions, the majority (93.02 %) of respondents indicated positive. All the institutions used ICT to communicate externally mainly through emails and were also using ICT in registration of students. However, the usage for Institutional Management and Planning and Student Traceability System were low at 64.86% and 69.93% respectively. This could be attributed to the size of the institutions of which most were small.

4.7.2. Results Link to the Research Framework

Similar to prior studies done by results of the analysis indicate that the Technological variables relative advantage and trialability, Organizational variables top management support and ICT expertise, and Environmental variables education sector characteristics and stakeholder interest are the significant variables to discriminate between the ICT adopters from non-adopters (Rogers, 2003). The empirical results indicate that there are significant determinants in each context. The results imply that the determinants of ICT adoption in TVET institutions should include the Geographical, organizational and environmental characteristics. This is consistent with the Technology, organization and environment framework (Tornatzky and Fleischer 1990) and hence justifies the use of the framework.

5. Conclusion and Recommendations

5.1. Research Findings

The broad objective of this research was to establish the factors that affect adoption of ICT in management of TVET institutions. Specifically, the objectives set out for the study were as follows:

Objectives 1: Determine challenges that hinder adoption of ICT by TVET institutions.

Based on the findings, we conclude adoption and use of ICT in TVET Sector is positively influenced by the factors in the three constructs of the TOE framework. These factors are Relative advantage, Trialability, Top Management support, ICT expertise, Stakeholders interest, and Education sector characteristics. All the six factors were found to be significant determinants and they are successful facilitators of ICT adoption in TVET institutions.

Objectives 2: Evaluate levels of ICT adoption in TVET institutions.

It can be observed from table 4.15 that the overall ICT adoption in TVET institutions stood at 79.28%. However, the adoption levels were highest in External Communication (Email System) and Online Student Enrolment and Registration System at 97.66% and 92.52% respectively. This could be improved if the factors affecting adoption were addressed by all concerned parties.

Objectives 3: Validate TOE framework for ICT adoption by TVET institutions.

The research findings further confirmed the value of the TOE framework in understanding technology adoption, and how the TOE framework can be applied in the studies relating to ICT adoption. This shows that the TOE framework remains useful in providing researchers and practitioners with model for innovations adoption studies.

5.2. Conclusion

This study established that there was a significant relationship between Technological Organizational and Environmental factors and ICT adoption in management of TVET institutions. The study also established that the levels of usage were low in other functional areas other than in online registration of students and external communication.

5.3. Limitations

The first limitation was due to the fact that the sample size was limited to Government Owned Institutes i0n only one Province (the Punjab) rather than the whole country. Although the empirical results gave significant understanding, the sample of the study was constricted. The study would have been richer if it had covered TVET institutions from different province of Pakistan. To extrapolate the findings nationally a sample size covering several province would have been preferred. In addition, the targets of this study were the Principals of the TVET institutions. The study would have been improved by including other users of ICT in TVET institutions.

5.4. Recommendations

This study adopted TOE framework with exploratory factor analysis technique so as to identify the factors that affect ICT adoption in TVET institutions. It is recommended that such other studies are conducted in other institutions not limited to TVET and expand the scope to include other Provinces.

This study is of great significance to Policy makers, Academicians and ICT practitioners as it contributes to the body of knowledge on how ICT adoption relates to Technological Organizational and Environmental factors and how this can improve the adoption and usage of ICT when improved.

The study further recommends that the Head of the TVET institutions, the TVET Authority and other stakeholders jointly work together in order to improve factors that affect ICT adoption and usage. This will assist Pakistan to meet her vision 2030 goals where education sector is crucial to the success of the vision.

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