

Comparative review on information and communication technology issues in education sector of developed and developing countries: a case study about Pakistan

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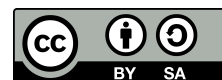
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ABSTRACT

The use of information and communication technology is very beneficial in the education sector because it can enhance the quality of education. However, the implementation of ICT in the education sector of developed and developing countries is a challenging task. This paper explains the comparative study of ICT issues in the education sector of developed and developing countries. In particular, we compare issues between Pakistan and high-tech countries. Our study reveals the fact that the education sector is facing numerous ICT problems that are based on culture, finance, management, infrastructure, lack of training, lack of equipment, teacher's refusal, and ethical issues. At the end of this paper, various issues faced by the implementation of ICT in the education sector of Pakistan have been categorized into various types, namely, infrastructure, lack of IT professionals, lack of high-speed internet and equipment. Our research is based on five key research questions related to ICT issues. We used a mixed approach where the results of this study can be used as a set of guidelines to help make the learning environment technology-oriented, fast, planned, and productive. Future directions are also given at the end of this paper.

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1. INTRODUCTION

Information and communication technology is a series of activities that simplify the electronic presentation of information [1]. Similarly, there is an opinion that ICTs are a mind-blowing and altered arrangement of goods, applications, and administrations used for creating, appropriating, handling, changing information including telecom, television (TV) and radio telecom, equipment and programming, PCs administrations, and electronic media [2]. The connection between computers and the internet used to handle and communicate information for learning purposes is known as information communication technology [3]. According to the

above definition, ICT covers a wide range of elements, including any equipment for communications or applications, such as radio, TV, personal digital assistant (PDA), and personal computer (PC) as well as system tools and programs linked to them. These program designs may be useful for improving human well-being [4]. Information and communication technology are resources, which are used to organize, retrieve and transfer information through various channels of information communication. It is clarified that ICTs are technologies used for communication of information and broadcasting data and handling of data electronically. ICT can beautify teaching by providing and improving advanced knowledge and providing better teaching strategies. It is said that changing education methods is difficult to accomplish. If educators continue to try new strategies, then after a period, modifications with all the beneficial functions of information and communication technology will gradually occur. Information and communication technology (ICTs) helps to provide the latest information for development by using different internet technologies including:

- E-learning: E-learning is an application of learning by using electronic technologies. The context of local area network (LAN), wide area network (WAN), intranet, and internet for course delivery, facilitation, and collaboration, also call it online learning. Web-based education is also a part of E-learning that makes use of an internet browser [5].
- Hybrid learning: Hybrid learning is a mode of learning that combines E-learning solutions with the traditional place-based classroom [6], [7]. For example, a teacher may use different models to facilitate student learning in and out of the classroom.
- Content management system (CMS): A content management system is an application used to describe the procedures in an environment that requires multiple collaboration between different users. Content management system is mostly designed to support the academic courses in education [8]. It allows the teachers to create an online course directory, where course contents and documents can be uploaded in universal formats such as PowerPoint, Word, and portable document format (PDF).
- Learning management system: LMS is an application for the documentation, delivery of educational courses, tracking, development programs, and administration training programs [9]. LMS is also a subset of E-learning tools in hybrid learning environments, and it is frequently used in Web-based education programs.

Teachers are the keystone of the education system. They play an important role in the learning and development of the students. Although there are numerous issues associated with the field of education, yet the most important challenges and barriers faced by instructors are the integration of ICTs in the teaching-learning process [10]. In the modern age of ICT, it is anticipated for every teaching staff to be computer literate. The use of ICT aids in teaching-learning and other educational activities. Unfortunately, in developing countries such as Pakistan, the situation is very pathetic regarding the use of ICT in educational institutions due to several reasons. The major issues hampering the effective use of ICTs include lack of planning, meager financial resources, and a lack of teacher training. Keeping in view the magnitude of the ICTs in the educational system, the present study aimed to review the information and communication technology issues in the education sectors of developed and developing countries with a special focus on Pakistan. A research was conducted by [11] to explore problems by using information and communication technologies in Physics in Pakistan's secondary levels and, using large samples, experiences, observations, and aspirations of teachers and questionnaires and interviews.

Many scholars have explained integration issues in higher education and have put forward suggestions that process teachers and policymakers can participate and play an effective role [12]. Both parties (teachers and policymakers) want to understand how the education system and technology are related to each other. The integration of ICT in education is important because it offers several opportunities. The previous attempts of ICT integration brought some challenges to higher education like the need to create proper intensity layout, sufficient teaching, good strategy, organized planning, and reform the teaching process to take maximum educational benefits. Keeping this in mind, it is important to imagine the education purpose or framework before using or implementing ICT [13]. The dearth of proper planning, financial resources, and a lack of teacher training are the major intertwined issues required to be resolved while determining the overall effect of the use of ICTs in the education sector.

Motivated by the importance of ICT, researchers considered it seriously and discussed ICT issues in different researches. In ICT issues, people have discussed several issues using a variety of technologies. Despite its high breadth, the key research questions related to ICT issues can be expressed simply as:

- What are the major ICT issues faced by developed countries?
- What are the main ICT issues facing developing countries?
- What are the major barriers in the education sector?
- What are the major ICT issues in Pakistan's education sector?
- How can we improve Pakistan's ICT situation?

Our research is based on a comprehensive overview of ICT problems in developed and developing countries, especially the ICT problems faced by Pakistan.

2. CHALLENGES FACED BY THE DEVELOPED COUNTRIES WHILE IMPLEMENTING ICT IN THE FIELD OF EDUCATION

Although the developed countries are technologically very sound as compared to the developing world, even then they are also facing numerous issues in schools related to the ICTs. These issues are because of various factors including teachers' ignorance, school finance, and support, the teachers' work overload, lack of time, lack of technical skills, and insufficient support in the integration of ICT in classes [14]. In this section, we review the ICT issues in developed countries presented in different papers country-wise.

2.1. Australia

A research was conducted in six western Australian schools in order to find the ICT issues, which are being confronted by developed countries like Australia [15]-[17]. They identify following various technological issues in their findings shown in Table 1:

Table 1. Comparison of school-level issues and teachers-level issues in Australia [15]

School Level ICT Issues	Teachers Level ICT Issues
Less interested in the implementation of ICT	Overwork load of the teachers
Lack of funds to purchase technological resources	Has less confidence to operate the technology
	Do not believe on the operation of technology
Less interested in technological training of staff	1. Insufficient facilities
	2. Insufficient support

- The teachers do not have enough prior computing knowledge/background. Most of the teachers do not know the right use of technology, which disturbs the prevailing model of the teaching-learning process.
- Whenever teachers have some technology-related issues, the IT-coordinators of their institute are not available to provide them immediate technical support.
- There is insufficient administrative support to teachers from school heads for the implementation of technologies. They are not provided with such an environment and necessary equipment in classrooms, which can support them for using computer technology in their teaching.
- Various software which is essential in implementing ICT in education, are also not upgraded according to the school values, culture, and students' requirements. Whenever there is a difference between the school values and these new technologies, most school leaders deny the use of new technology in their schools.
- According to researchers, insufficient financial support also creates a big technological issue in the schools of developed countries.

2.2. Canada

In Canada, a study was conducted in Québec English Schools by [18]. It was conducted in seven different Québec English Schools all over Canada. The researcher finds several technological issues in teaching there such as insufficient school leadership support, lack of latest and modern resources and inconsistent equipment investment, insufficient financial help, lack of infrastructure, insufficient technical training of teachers, and insufficient pedagogical support.

2.3. United Kingdom

The issues identified in the schools of the United Kingdom were also not much different from the schools of Australia and Canada. Huffaker [19] researched the United Kingdom and the following are their findings:

- School leaders need a lot of money to provide computers, internet access, and teacher training.
- Teachers may refuse to use technology because they have not been properly trained in using technology, so their confidence in using technology in the classroom decreases. The teachers may feel uncomfortable using technology if their students are competent and have high technological skills. The teachers may have a negative perception of integrating ICTs in the teaching-learning process.
- It is very difficult to implement E-learning with outdated resources such as hardware and software.
- Teachers will find it difficult to track down whether students are cheating or not.
- The schools used filtering software that may not provide the student's requirements or students may feel disparity.

3. ICT ISSUES IN EDUCATION OF DEVELOPING COUNTRIES

The developing countries may have similar kinds of benefits of ICT implementation, but they are suffering from different kinds of ICT implementation issues [20], [21]. The developing countries have different levels of technical expertise, demography, technological culture, economical condition, and school organization. According to the research of various researchers, every school in different countries may have different issues with different intensity depending on its background and culture. In this section, we review various ICT issues in developing countries including Malaysia, Pakistan, and Bangladesh provided by different researchers in their research papers [22]-[25].

3.1. Malaysia

Developing countries are also facing various kinds of information and communication technology issues in classrooms. Similar research is also conducted in Malaysia regarding ICT issues in the education sector [22]. They find that Malaysia is facing several barriers in the integration of ICT. Although, the use of ICT is very beneficial in the education sector, yet several difficulties obstruct these benefits. Malaysia is one of the developing countries that has adopted ICT in schools for the teaching-learning process. Table 2 shows ICT issues confronted by the education sector of Malaysia at various levels.

Table 2. ICT issues in education sector of Malaysia [22]

Type of Issues	Details of Issues
Technical issues	Less number of computer facilities The internet bandwidth problem There are central database issues
Teacher difficulties	Lack of teacher training Lack of confidence to execute program on computer in classrooms lack of technical knowledge
School support issues	The school leaders do not provide the financial support to the teachers to use the technology in the classrooms

3.2. Pakistan

There are so many issues in ICT integration of both developing as well as developed countries. Pakistan is also one of the developing countries facing numerous obstacles in various practical fields, such as technical training and development, which unfortunately leaves the country behind in the technologically wise development race. A study was conducted at various secondary schools in Punjab province, which studied the main issues of ICT integration from three levels: teachers, educational institutions and government [23]. The study revealed many obstacles in the integration of information and communication technology in this province [24]. These issues or barriers are presented in Table 3.

The researchers conducted another research about the implementation of ICT in teacher education programs in the Punjab and Khyber Pakhtunkhwa provinces of Pakistan. Firstly, in 2010-2011 sessions, "ICT in education" course was deployed for associative degree education (ADE)/B. Ed program (elementary). In this state, it was essential to explore the success of this course implementation in pioneer organizations, to provide basic information to further improve the process of implementation. This study focused on; 1) how was "ICT in Education" course implemented?; 2) what is the scope of course outline useful which the educator teachers are going to follow and implement? in this study, seven educator-training institutions, 3 from Punjab and 4 from Khyber Pakhtunkhwa) were taken as the target population. The total number of samples was 240 (200 students and 40 teacher educators) from seven different training institutions. In research design, a mixed-method was

used for analysis. Data was collected from the surveys for teachers, heads, and interviews with teachers. In this analysis, in only a few classrooms, the different activities/experiences proposed in one unit were correctly implemented. This is because of a lack of power supply, IT tools, and ICT applications knowledge. The content of the instructor following the instruction becomes another part that helps to realize the technology [25].

Table 3. ICT issues exposed at different levels in Pakistan [23]

Level of Issues	Details of Issues at Different Levels
Teachers Level	Teachers have a lot of task to do. They do not have enough time to learn and implement ICT. Most of the teachers are not familiar with the use of ICT. Teachers are less motivated and felt embarrassed for advanced learning. In most of the cases, they belong to an illiterate family. The English Language is also a barrier for learning ICT. Lack of training. Lack of financial and economic resources.
Educational Institution Level	Constant training and motivational sessions are missing at educational institutional level. Ineffective examination system. Lack of hiring skillful professionals Master trainer of ICT is not available in every institution. There is a lack of interesting courses on the use of ICT. Lack of provision of uninterrupted electricity.
Government Level	Lack of financial support from Government. Lack of the provision of better/alternate internet connections to schools and students. Lack of enhancing awareness at mass level. Lack of the training of teachers at large. Unable to provide good connections of Internet in most of the parts of Pakistan. Unable to control load-shedding of electricity.

3.3. Bangladesh

Bangladesh is also a developing country with a 62.5% literacy rate. Information technology is bringing incredible change in the education sector in Bangladesh. The integration of ICT in the education sector makes learning student-centered. Since the nations are rapidly moving towards Information Technology and digital media. Like other developing countries, Bangladesh also faces several problems in implementing ICT in the education sector [24]. Some important issues are presented in Table 4 as per the study of [24].

Table 4. ICT issues in education of Bangladesh [24]

Strategic Issues	Some of other Issues
Lack of infrastructure and ICT support	Lack of skills and knowledge
Financial problem	Teacher's belief and attitude about ICT
Proper vision and planning issues	Lack of Time
Cultural, political and social issues	Lack of connection of education and technology

4. ICT BARRIERS IN EDUCATION SECTORS

In this section, we review ICT barriers in the education sector. A study based on integrating information and communication technology issues into the classroom is given in [26]. Some of the analyses were conducted based on inclusive reviews of other research [27]. The major problems in these studies were the lack of confidence and knowledge. The author points out that not all teachers have sufficient technical background, which may make the learning process a bit difficult [28]. According to the author, technical foundation courses are not planned for teaching policy and may be based on proficiency and skills [29]. The British News Agency pointed out that trust plays an important role in the successful use of information, communication, and technology [14]. Researchers also pointed out that lack of confidence and skills make it difficult to use ICT [30]. Another problem is the lack of training [26], [31]. For training purposes, an appropriate career development policy is urgently needed [28]. Some researchers pointed out that there is a lack of training for lecturers in the areas of guidance and education [27]. Finally, the UK agency reviewed that less technical training guided the use of lower-level ICT [14]. Several issues were associated with beliefs and attitudes. The disbelief about the correctness of using ICT in teaching has led to small-scale integration of ICT [26]. It was also pointed out that teachers showed a negative attitude towards the use of computers [31]. Belief is essential for successful ICT integration and that it is very important to deal with existing systems [26]. In this regard, the British Agency

pointed out that if the direct link with the benefits of ICT integration is not maintained, the use of ICT will decrease.

Lack of support could also prove an issue to the use of ICT. The lack of leader's support among administrators and teachers harmed the integration of ICT in education [26]. The British Agency noted that if the instructors were not given time to learn technical skills and especially for ICT use, they would be reluctant in using them [14], [27]. There is also a lack of leader support for the ICT implementation [26]. Related to the issue of support, there was a lack of proper access [30]. In particular, it has been found that lack of computer hardware and software access is an obstacle to the adoption of ICT [26], [28]. Lack of access to the use of computer hardware in the appropriate location is difficult [31]. The British Agency pointed out that the access level is directly communicated to the usage level, and the defective equipment or improper access leads to a decrease in the usage rate [14].

Finally, one of the most important issues of integrating ICT is resistance to change [26], [31]. It has been pointed out that teachers are not provided with appropriate incentives to learn new things and adopt innovations, and schools, policymakers, and teachers need to work together for the positive change in the education sector [29]. Finally, it is worth noting that even if they wish to change and learn ICT, they must face problems when teachers are not interested in adopting the change. Table 5 summarizes some obstacles and problems that researchers have found when adopting and using ICT.

Table 5. Summary of ICTs issues identified from various researchers

RESEARCHERS	DOMAIN OF ISSUES
[32]	Issues of instructor collaboration, educational support and insufficient experience among instructors.
[33]	Insufficient expertise for managing training materials.
[34]	Lack of acknowledgment, timely encouragement and useful ICT use.
[35], [36]	Poor administration and Institutional support.
[37]-[41]	The insufficient exact knowledge of technology and how existing system to connect with it.
[42]-[45]	The insufficient teachers' training on the ICT use.
[46]	Without definite and explicit ideas about how integration of technology into instructions will develop the student knowledge.
[47], [48]	Inadequate knowledge and practice of ICT in learning environment.
[49]	Access to ICTs.
[50]	Teachers knowledge and beliefs are barriers for the integration of technology in the education sector.
[51]	The shortage of educational programs/software.
[41], [51]	The absence of tangible resources.
[41]	The absence of appropriate instructional programs and course contents.

5. COMPARISON OF ICT ISSUES OF PAKISTAN AND HIGH-TECH COUNTRIES

In this section, we will compare the ICT problems faced by Pakistan and high-tech countries by discussing the ICT development index of high-tech countries with Pakistan. The ICT development Index is a comprehensive index that is used as a measurement benchmark by combining eleven indicators. This is an important factor in monitoring and comparing the development of information and communication technology between different countries. This globally recognized tool can measure and compare the use of ICT and other technologies among different countries of the world. IDI consists of 11 ICT indicators including; the percentage of households in a country/region that have a computer, the percentage of households in a country/region that can access the Internet, the international bandwidth available to each Internet user, the percentage of the population of the country covered have at least 3G or LTE/WiMAX mobile networks, the population of every 100 fixed broadband users, the percentage of countries that use the internet, the percentage of popular users with active mobile broadband subscriptions, the mobile broadband internet traffic per mobile device, the average education of broadband users years, total enrollment rate, and total enrollment rate of technical secondary school and higher education. ICT indicators are divided into three categories: skills, access, and use. Following are the main objectives of IDI:

- IDI is used to evaluate and check the level of ICT development of a country.
- It is used to calculate the difference in ICT development between developing and developed countries.
- IDI is used as a digital divide, which compares the level of ICT development of different countries.
- It is used as the development potential of information and communication technology, and to a certain

extent, the use of ICT in the context of existing capabilities and skills in countries to promote growth and development.

- Since it compares countries around the world, it is possible to build reasonable confidence in different levels of development on a limited data set.

According to a report by the international telecommunications unit released in 2017, the overall ICT rank of Pakistan is 148 out of 172 countries in the world as shown in Table 6. IDI values consist of all three categories of ICT: skills (20%), ICT access (40%), and ICT use (40%) [52]. The overall ICT rank of Australia, South Korea, Canada, United Kingdom, Japan, and United States, which are developed countries, is 8.24, 8.85, 7.77, 8.65, 8.43, and 8.18 respectively. The overall ICT rank of Malaysia and Bangladesh, which are developing countries, is 6.38, and 2.53 respectively. Pakistan's IDI score is 2.41 and Pakistan ranks 143rd in the access sub-index, 151st in the skills sub-index, and 152nd and the use sub-index. According to IDI and the sub-index report 2017, Pakistan lags in all three categories, namely, ICT access, ICT use, and ICT skills, and all 11 ICT indicators than the high-tech countries and even than the developing countries. Pakistan's ICT development index ranking is far as shown in the average IDI score. Since Pakistan lags far behind high-tech countries in all the characteristics of ICT i.e., ICT access, ICT use, and ICT skills, this means that Pakistan is facing more serious ICT problems than developed countries [53].

Table 6. ICT development index (IDI) values along-with the ranking of various countries in 2017

Countries	Year	IDI value	Ranking
Pakistan	2017	2.41	148
Japan	2017	8.43	10
United States	2017	8.18	16
South Korea	2017	8.85	2
Israel	2017	7.88	23
Germany	2017	8.39	12
Russia	2017	7.07	45
United Kingdom	2017	8.65	5
Canada	2017	7.77	29
China	2017	8.61	6
Finland	2017	7.88	22

6. RECOMMENDATIONS

Our research focuses on the plight of ICT use in the education sector of Pakistan. We highlighted several ICT issues in the education sector of Pakistan published in various research papers. At the end of the study, we put forward some suggestions at the educational institution and government levels to improve the use of ICT in the education sector of Pakistan, is being as:

- The instructors need to hone their ICT skills to create a digital learning environment. Appropriate training should be provided to teachers to improve the learning and teaching of ICT in the education sector.
- ICT-based updated software should be installed in the institutional information technology laboratories.
- Educational institutions can provide teachers with incentive programs for using ICT.
- The government should provide financial support to public sector educational institutions to maintain IT laboratories and purchase new equipment.
- IT-administrator should be appointed in all educational institutions.
- The government should take serious actions in the provision of cheap and fast Internet facilities for students and teachers, especially those in remote areas because the Internet is the gateway to benefit from ICT.
- The government should open IT centers throughout the country and can seek help from non-governmental organizations (NGOs) in this regard.
- Government should provide the latest technology to well-equipped IT laboratories in educational institutions for digital education.
- Every school should install smart whiteboards, bulletin boards, gold and silver boards, and multimedia projectors with laptops.
- The government should take special actions to improve the syllabus through ICT integration to make full use of the advantages of ICT in education.

- The government should adopt sound telecommunications policies in the education sector.
- The government should encourage the establishment of inter-school cooperation between the public and private education departments.
- Every institution should establish a virtual classroom. These virtual classrooms should be equipped with the latest equipment such as LED projectors, LCD screens, and computers.
- Teachers should use studios to teach, and all lectures should be spread to all virtual classrooms in different cities of the country.
- Smart classrooms integrated with ICT should be developed in secondary schools in the public sector to improve teaching effectiveness.
- Every educational institution in Pakistan must have a computer teacher who can provide training on using ICT in the classroom. These teachers can work as master trainers and can provide training to all faculty members of their respective schools.
- It is also suggested that the most of the teacher training institutions in the country should also offer “Information and Communication Technologies in Education”, along and “Introduction to Information Technology” courses. These courses could be taught by the faculty members of the Department of Education and the Department of Computer Science respectively. This means that future teachers will receive adequate training and there will no longer be any barriers to using the technology in classrooms in the future.

7. CONCLUSION OF THE CASE STUDY AND FUTURE WORK

In this section, we revisit the research question of our comparative study. Our research is based on these research questions. The answers to these questions are our contribution.

What are the major ICT issues faced by developed countries? We have already discussed it in detail in section 2. The ICT issues faced by developed countries is because of various factors including teachers’ ignorance, school finance, and support, the teachers’ work overload, lack of time, lack of technical skills, insufficient support in the integration of ICT in classes.

What are the main ICT issues facing developing countries? We have thoroughly discussed this in section 3. Developing countries are facing several ICT problems in the education sector, namely, level of technical expertise, demography, technological culture, economical condition, and school organization.

What are the major barriers in the education sector? We have already discussed major barriers in details in section 4. The major ICT issues in the education sector are inadequate knowledge and practice of ICT in education, lack of confidence to use the computer in the classroom and lack of skills make ICT difficult to use in education, insufficient teacher’s training on the ICT use, lack of time of teachers for ICT use, lack of original software and shortage of educational programs, poor administration, and institutional financial support, lack of access to the use of computer hardware inappropriate location, lack of teacher’s trust, and attitude and beliefs make the use of ICT difficult in the education sector.

What are the major ICT issues in Pakistan’s education sector? Pakistan is also facing various ICT issues in the education field. We have discussed it in detail in section 3.2. Pakistan’s ranking in the IDI 2017 report also supports our statement (see section 5). The severity of ICT issues is quite serious as compared to the issues confronting developed countries.

How can we improve Pakistan’s ICT situation? We have already put forwarded several suggestions at the educational institution and government levels to improve the use of ICT and to resolve these issues associated with ICT in the education sector in Pakistan in detail in section 6.

Both developed and developing countries are facing these issues with different intensity. It is also a bitter fact that developing countries are experiencing more difficulties than developed countries in this regard. The education sector of Pakistan is facing several issues related to ICT infrastructure. Most public and private educational institutions do not have the essential hardware, software, network, and firmware necessary to use ICT. The education sector of Pakistan is also facing ICT issues related to IT professionals. Most of the teachers of public and private institutions are not familiar with the use of ICT. IT professionals are also not available in most of the public and private educational institutions of Pakistan to assist and train teachers in ICT use. High-speed internet is very essential for using ICT, which is also not available throughout the country especially in remote areas. In most of the remote areas of Pakistan even, slow internet is also not available. For all these reasons, the conditions of ICT use in Pakistan are very pathetic.

In section 6, we put forward several effective suggestions at the government and educational institution levels to solve various ICT problems in various categories, such as infrastructure, lack of professionals, and lack of high-speed Internet and equipment in Pakistan's education sector. The results of this study can be used as a set of guidelines to help make the learning environment technology-oriented, fast, planned, and productive in the education sector of Pakistan. The research will also help to open up new avenues for the innovative use of modern technology in an appropriate way and help resolve issues related to the effective and practical use of ICT, especially in the education sector in Pakistan.

The future directions of this work be in comparing the information and communication technology problems faced by public educational institutions and private educational institutions in specific countries at different levels, ICT issues can be studied from different perspectives. We can also compare the ICT issues in the higher education sector with the secondary education sector in a particular country. To better understand the role of ICT in Pakistan's educational environment, further research can be conducted, perhaps starting from the obstacles found in this research. The possibilities specifically for Pakistan include: increasing the number of learning schools (including private schools), adding quantitative elements, providing in-depth qualitative analysis, researching specific technologies, conducting a needs analysis to promote professional development, understanding the impact of learners, and paying attention to success obstacles.

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