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Utilization of Information Technology Laboratories in Secondary Schools: Perceptions of IT Teachers and Available Facilities in Malakand Division, Pakistan

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Abstract
The paper has explored the use of Information Technology (IT) laboratories and how IT teachers perceive its effectiveness in secondary schools in Malakand Division, Khyber Pakhtunkhwa, Pakistan. The study was quantitative in nature, descriptive, and cross-sectional. Stratified random and purposive sampling methods were used to sample a sub-population of 220 teachers (including all 55 IT teachers and 165 randomly selected Secondary School Teachers (SSTs) in English, Mathematics and Science subjects) in two purposely selected districts (Dir Lower and Malakand). Data were collected with the help of structured questionnaires and an interview schedule and processed with the help of descriptive statistics in SPSS version 20. The results found to be dire shortages in IT laboratory facilities. The labs were being used at 60-65 percent of the minimum possible capacity and there was a dire lack of computers, laptops, multimedia equipment, headphones, servers, tablets, software licenses, UPS systems and internet connectivity to students. There was also a lack of staffing, qualified IT teachers and lab attendants. The negative attitude of the IT teachers to the current conditions in the labs was also observed as they indicated that the lack of resources is a major problem in the lack of effective teaching-learning processes and the acquisition of digital skills in the students. The report concludes that the current IT laboratories are not well equipped to facilitate current IT education. Hardware and software upgradation, improvement in power backup, internet connectivity and improvement in human resources to ensure these labs are effective and functional are some of the urgent measures that are recommended to be taken.
Keywords: IT lab, secondary school, education technology, access to resources, teacher attitudes, Malakand Division, Pakistan.

Introduction
The accelerated growth of information and communication technologies (ICT) has essentially relegated the way education is delivered in the world, making

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technology a key element of the successful teaching and learning in the 21 st century. Secondary education especially, is an important phase of preparing learners with digital literacy, problem-solving skills and higher order thinking skills that allow them to engage in a knowledge-based economy. In this regard, the Information Technology (IT) laboratories in schools have become essential pedagogical environments which serve experiential learning, student engagement and allow integrating theoretical knowledge with practical use (UNESCO, 2023; OECD, 2022).

The incorporation of IT laboratories in teaching-learning processes does not only require the presence of technological tools, but also a lot depends on the perceptions, competencies, and willingness of the teachers to embrace technology-enhanced pedagogies. A teacher is one of the key agents who convert technological resources into effective educational experiences. The positive attitudes of IT teachers towards the use of IT labs have been noted to increase the instructional innovation, student motivation, and collaborative learning conditions, but negative/hesitant attitudes tend to impede the successful use (Tondeur et al., 2021; Scherer et al., 2021). Thus, the perception of teachers is the key to assessing the real efficiency of the use of IT laboratories in schools.

In addition to the teacher related factors, the quality and sufficiency of IT laboratory facilities is a major factor in determining the impact they have on education. Basic conditions to make efficient use of IT labs are functional hardware, the updated software, and the reliable internet connection, as well as the maintenance. Nevertheless, in most developing countries, e.g., Pakistan, schools may struggle with such issues as poor resources, obsolete equipment, lack of technical support, and unequal access to digital infrastructure (Pakistan Ministry of Federal Education, 2022; World Bank, 2023). These constraints do not only make it difficult to integrate the use of ICT in classroom practices, it also leads to an increase in digital divide among students.

The efficient application in the field of IT laboratories in the context of Pakistan and specifically Malakand Division is a field of under-researched studies. Although national education policies focus on incorporating ICT in education, the application at the school level is quite different because of the contextual factors like geographic differences, institutional capacity and resource distribution. The past research has been mainly conducted on general ICT integration with little emphasis on the particular role of the IT laboratories and perceptions of the IT teachers who are the ones who directly deal with their implementation.

With this background, the current research will examine the use of IT laboratories in secondary schools of Malakand Division, by addressing two important dimensions; (1) the attitudes of the IT teachers towards the use of IT labs in the teaching-learning process, and (2) the facilities available in IT labs and the identification of other resources needed to make them effective. By answering these questions, the research aims at giving empirical data that can be used in policy formulations, better resource allocation, and assist in developing strategies of successful ICT integration in secondary schools. In conclusion, this study is significant to the general discussion on technology-enhanced education as it has brought out the interaction between teacher perceptions and infrastructural preparedness, especially in a developing country setting. The results should inform educational stakeholders on how to maximize the utilization of IT laboratories in enhancing the quality of teaching and learning

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outcomes among students in secondary schools.

Literature review

Theorizing, ICT Integration and IT Laboratories in Education

The adoption of Information and Communication Technology (ICT) in the educational sector has been well-known as a revolutionary aspect that improves teaching processes and learning results among the students. ICT promotes interactive and student-centered learning experiences and helps learners access, process, and apply information in new, innovative ways (UNESCO, 2023; OECD, 2022). In this larger context, IT laboratories can be seen as organized spaces that allow students to have direct experiences, cultivate digital skills, and put theoretical knowledge into practice.

IT labs play an important role especially at the secondary school level where students start acquiring high level cognitive and technical abilities. Studies have shown that well-outfitted IT labs can aid in better academic results, greater problem-solving skills, and student motivation (World Bank, 2023; Voogt et al., 2021). The availability of IT labs however does not necessarily mean that they are being utilized effectively but instead the effects they have on pedagogical practices is determined by the way they have been incorporated.

Teacher Perceptions And Use Of Technology

Perceptions of teachers are crucial in dictating the success of ICT integration in education. The Technology Acceptance Model (TAM) shows that perceived usefulness and perceived ease of use are important factors that affect the intention of teachers to use technological tools (Scherer et al., 2021). Teachers are more likely to integrate IT laboratories effectively in their teaching practice when they feel that it is beneficial and manageable.

Empirical research has shown over time that positive attitudes of teachers towards ICT correlate with greater classroom innovation and collaboration with learning as well as student engagement (Tondeur et al., 2021; Instefjord and Munthe, 2022). On the other hand, the barriers of effective utilization are represented by negative perceptions, which are usually a result of the lack of training, technical support, or confidence (Gudmundsdottir and Hatlevik, 2020). Moreover, IT instructors, especially, play a key role as facilitator and technicians. Their perceptions not only affect their own instruction, but the wider usage of IT resources in the institution. Research on developing countries shows that IT teachers are likely to be burdened with work, lack professional development opportunities, and institutional support, negatively affecting their attitudes and use of IT labs (Alharbi and Drew, 2022; Khan et al., 2023).

Accessibility of IT Laboratory Facilities and Infrastructure

Availability and quality of infrastructure is a critical factor that determines the effectiveness of IT laboratories. Basic requirements are functional computers, updated software, good internet connectivity, proper sitting facilities, and proper maintenance facilities. A shortage of these facilities poses a substantial limitation to the potential of IT labs to assist in teaching and learning (World Bank, 2023; Asian Development Bank, 2022).

Schools in most developing environments such as in Pakistan tend to have poor ICT infrastructure. The problems identified in studies include obsolete equipment, the inadequate number of computers, unavailability of the internet, and inconsistent electricity supply (Pakistan Ministry of Federal Education, 2022;

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Malik and Mahmood, 2022). These issues bring about inequality in access to digital learning opportunities and impede the successful implementation of ICT in education.

Furthermore, the issue of the so-called digital divide is also one of the critical ones. Resource-constrained schools commonly lack access to acquiring the necessary digital skills and consequently expand the disparity between urban and rural schools (World Bank, 2023; van Dijk, 2020). Infrastructural deficiencies are thus important in providing equal access to quality education.

Effectiveness of IT Laboratories in Teaching-Learning Processes

The use of IT laboratories has been associated with a number of good learning results. The studies show that students who actively work in technology-facilitated learning settings are better at critical thinking, creativity, and academic success (Voogt et al., 2021; Zhao et al., 2022). IT labs can help teachers to implement new instructional methods like project-based learning, simulation-based learning and problem-solving. The success of IT labs, however, depends on their integration into pedagogy. Learning outcomes cannot be greatly improved merely by using computers in simple tasks, but rather meaningful integration to meet the goals of the curriculum is needed (Ertmer and Ottenbreit-Leftwich, 2020). To successfully use the IT labs in teaching, the teachers should not just have technical skills but also pedagogical skills. Also, the IT laboratories should be maximized with the help of continuous professional development and institutional support. Research indicates that schools that invest in teacher training and offer continuous technical assistance have a larger percentage of ICT integration and better student results (Instefjord and Munthe, 2022; Tondeur et al., 2021).

ICT Integration in Pakistan and Regional

The adoption of ICT in learning has received growing interest over the last few years in Pakistan, and national policies have focused on the significance of digital learning. Nonetheless, implementation is not uniform especially in rural and underdeveloped areas like Malakand Division. Studies suggest that IT laboratories have been set up in certain schools, although they are not frequently used because of the infrastructures, the untrained staff, and the absence of monitoring systems (Malik and Mahmood, 2022; Khan et al., 2023). Regional inequalities are also another cause of ICT integration problems. Other challenges in schools in isolated districts include insufficient funds, technical skills and socio-cultural restrictions which influence the use of technology in education. These issues bring up the importance of context-based research that will look at the teacher perceptions in addition to infrastructural realities.

Research Gap

Even though, much research has been carried out on the ICT integration in education, there are no empirical studies that specifically cover the use of IT laboratories in the secondary school level in Pakistan, especially in the Malakand Division. Furthermore, little focus has been on the joint analysis of the perceptions of the IT teachers and the access to laboratory facilities. The majority of the current research is general in its approach to ICT use or deals with infrastructural issues without considering the perceptions of the teachers. Thus, the current research is aimed at bridging this gap by offering an in-depth

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examination of both human (perceptions of teachers) and material (IT lab facilities) factors that may affect the successful use of IT laboratories in secondary schools.

Objective

1. To find out the perceptions of IT teachers about the use of IT labs in teaching learning processes in secondary schools.
2. To find out the available facilities in IT Labs at secondary school and investigate the facilities needed for making these IT Labs more effective.

Research Question

1. What are the available physical and human resources at the school's IT lab?
2. What are the physical and human resources at schools required in IT labs?

3.1 Nature of the Study

The research design that was used in this study was quantitative. Quantitative research is a process that tends to collect and analyze numerical data to test theories, analyze relationships between variables, and describe or predict phenomena of interest. The current research took a descriptive method of demonstrating the availability and use of IT facilities in secondary schools and the perception of various stakeholders with regards to the facilities. The study was cross-sectional in nature in terms of time dimension because it was the data collected at one point in time.

3.2 Population of the Study

The study population was all teachers in government secondary schools (including higher secondary schools) in the Malakand Division, Khyber Pakhtunkhwa, Pakistan. The Education Management Information System (EMIS) data on the year 20182019 indicates that the division had 526 secondary schools and 11597 teachers. Table 3.1 shows the distribution district-wise.

Table 3.1: ***District-wise Statistics of Secondary Schools and Teachers in Malakand Division***

S. No.	Name of District	No. of Secondary Schools	No. of Higher Secondary Schools	Total Schools	No. of Teachers	No. of IT Teachers	No. of English, Maths & Science Teachers
1	Bunir	59	25	84	1,536	27	81
2	Chitral	55	10	65	1,331	16	48
3	Dir Lower	77	31	108	2,602	38	114
4	Dir Upper	43	18	61	1,350	17	51
5	Malakand	43	7	50	1,169	17	51

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S. No.	Name of District	No. of Secondary Schools	No. of Higher Secondary Schools	Total Schools	No. of Teachers	No. of IT Teachers	No. of English, Maths & Science Teachers
6	Shangla	42	8	50	951	16	48
7	Swat	78	30	108	2,658	38	114
Grand Total		**397**	**129**	**526**	**11,597**	**169**	**497**

Source: EMIS/E&SE Department KP (2018–2019)

3.3 Sample and Sampling Technique

Stratified random sampling was utilized in this study to select districts, which were then purposively selected. The delimitation of the study purposely selected two districts Dir Lower and Malakand out of the total seven districts in the Malakand Division.

The sample size was all 55 IT teachers that worked in the chosen districts (census of the available IT teacher population). Also, 165 Secondary School Teachers (SSTs) three teachers (one of each English, Mathematics, and Science) of each of the 55 schools were randomly chosen to cross-verify the data.a. This gave a total of 220 teachers as the sample size. Table 3.2 provides details of the sample.

Table 3.2: ***Sample Statistics of Teachers***

S. No.	Name of District	Total Schools	Accessible Population (Teachers)	Sample: No. of IT Teachers	Sample: No. of English, Maths & Science Teachers	Total Sample
1	Dir Lower	108	2,602	38	114	152
2	Malakand	50	1,169	17	51	68
Grand Total		**158**	**3,771**	**55**	**165**	**220**

Source: EMIS/E&SE Department KP (2018–2019)

Data Collection Tools

Two primary data-gathering tools designed by the researcher and properly tested were used to collect data:

1. Structured Questionnaires: Two different questionnaires were employed one was among IT teachers, and the other was among general secondary school teachers (SSTs).. They both included several-choice and close-ended questions.

2. Structured Interview Schedule: This was administered to students to gather the data. These instruments helped the researcher to obtain data about the availability, use and perception of IT laboratories among various stakeholders

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(IT teachers, general teachers and students).

Data Analysis

Data were collected, then coded and inputted into the Statistical Package for Social Sciences (SPSS version 20.0). There were no missing values. Data were analyzed by descriptive statistics by giving frequencies, percentages, means and standard deviations. The findings are provided in the form of tables, with frequencies and percentages, and their explanations.

Table 4.1.6 (a): ***Available and required facilities at IT Lab***

No	Item and Accessories	Available (In Number)	Needed (In Number)
1	Computer	8	12
2	Laptop	0	12
3	Multimedia	2	4
4	Headphone	0	As per computer
5	Printers	5	8
6	Speakers	3	8

There were 8 computers available in number while the need of the required numbers was 12. There is no laptop available, while the need of the required numbers was 12. There were 2 multimedia setups available, while the need of the required numbers was 4. There was no headphone in the IT Lab while the headphone is a compulsory part of the PC and needed as per the numbers of the computer. The number of printers available was 5 and the overall requirement of the printers was 8. There were 3 speakers available in IT Lab while the need for the required numbers was 8.

Table 4.1.6 (b) : ***Available and required facilities at IT Lab***

No	Item and Accessories	Available (In Number)	Needed (In Number)
7	Main Screen / Server	20	20
8	Interactive Board	02	04
9	Tablet	00	20
10	USB	10	40
11	Portable Hard Disk	02	10
12	Internet Facility	Available	Not applied

There were only 8 main screen servers available in IT Lab while the need for the servers would be around 12 in number. There was no tablet available in the IT lab for students while the need for the tablets would be around 12 in numbers for students learning. There were 10 USBs available and the need for one IT Lab would be around 14 in number. IT Lab possess 2 portable hard disks that are used by students and they are in need of additional portable hard disks that would help students. Internet facility is provided in the IT Lab, but not utilized among students studying.

Table 4.1.6 (c): ***Available and required facilities at IT Lab***

No	Item and Accessories	Available (In Number)	Needed (In Number)
13	Office for IT Teacher	02	04

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14	Stock/ Store for IT gadgets	01	01
15	Lab-Attendant	01	03
16	Lab-Assistant	01	03
17	CT-IT	01	03
18	SST-IT	01	02

IT teachers could only have 2 offices. The number of IT teacher offices is required is 4 as compared to 3 in previous years. They have one stock/store of IT gadgets and they require an additional gadget to students. They employ 2 Lab attendants and they desperately need more lab attendants to monitor lab activities and help students. IT gadget store is not in an ideal condition and needs to be revamped. There would be approximately 3 CT-IT available and the requirement of CT-IT by students would be 3. The 1 SST-IT available and the need for SST-IT for students would be around 2 in numbers. Information is not available on the solar system.

Table 4.1.6 (d): *Available and required facilities at IT Lab*

No	Item and Accessories	Available (In Number)	Needed (In Number)
19	Windows/System (Software)	08	12
20	Program/Operating (Software)	08	12
21	Antivirus (Software)	05	10
22	Solar System	01	02
23	UPS	02	06

The IT lab possesses 2 UPS and students need 2 additional UPS to engage in learning regularly. UPS is valuable to conserve energy and illuminate when required. There were 2 antivirus software available in the IT Lab and 8 more Antivirus software. They need to install an antivirus to safeguard the system from glitches. IT Lab has 8 Windows system software. They will have to install 12 windows system software. IT Lab has 8 programs operating software. They have to install 12 running software.

Findings

The IT lab is plagued by acute shortage of resources which renders effective teaching and learning to be very difficult. The major gaps could be listed as follows:

Hardware and perishals: There are only 8 computers on hand when a 12 is required (1/3 shortage), and no laptops (when 12 are needed). Multimedia configurations (2 vs. 4), audio (speakers) (3 vs. 8), printing (5 vs. 8), and headphones (0 vs. 12) are fundamentally inadequate. Servers (8 vs. 12), tablets (0 vs. 12), USBs (10 vs. 14), and portable hard disks (only 2 available) are also inadequate. There is internet facility available but not student friendly.

Human Resources and Infrastructure: There are only 2 offices where IT teachers can work (4 should be occupied). There is 1 CT-IT (vs. 3 required) and 1 SST-IT (vs. 2 required). The number of lab attendants is only 2 and more are urgently needed. The IT gadget store is in deplorable shape and needs to be revamped.

Software and Power Backup Only 2 antivirus licenses (8 more required), 8 windows operating systems (vs 12) and 8 program software (vs 12) are installed. There are only 2 UPS units and another 2 badly needed to maintain continuous

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power supply.

The IT lab is in general being utilised at approximately 60-65 percent of the minimum capacity. Such deficits limit practical experience, personalized learning, and acquisition of the necessary digital skills, undermining the quality of IT education. The immediate hardware, software, staffing, and infrastructure upgrades are needed to streamline the lab up to the current educational standards.

Discussion

All these resource gaps in the IT lab, such as the lack of hardware (e.g. 8 computers and 0 laptops when there should have been 12 computers and 12 laptops), insufficient peripherals, lack of software licenses, unreliable power backup system, and understaffing have a devastating impact on practical and student-centered IT training. Such loopholes lead to overcrowded classes, limited practice, and use of digital tools, which directly affects the acquisition of key computational and digital literacy. Proper computer access and use benefits the academic performance of students as exemplified by Simoes et al. (2022) through a mediating role of both home and school settings, but inadequate infrastructure results in reduced motivation and academic performance results. The education system in Pakistani setting is not unique in its infrastructure deficits but is indicative of greater systemic issues. Rehman et al. (2025) emphasize that the scarcity of resources, specifically the absence of modern technology, laboratories, and other supporting equipment in schools limits the provision of practical STEM learning experiences by teachers and increases inequities, particularly in under-resourced schools. These effects are compounded by the non-utilisation of the accessible internet connectivity to student learning, which further isolates the lab to the current digital pedagogies. All of these shortcomings put the IT lab at about 60-65 percent capacity of what is needed to serve an equal number of students, educators, and the development of 21 st century skills. The lab is unable to meet its mission of equipping students with a technology-driven future without purposeful interventions, including hardware refresh, software updates, and increase in staffing. These results highlight why there is a pressing necessity to allocate resources at the policy level in order to fill the gap that exists between what is provided and what is needed in the curriculum.

Conclusion

The IT lab in question is grossly understaffed and runs at a maximum of 60-65 percent of the capacity that is necessary. Serious gaps in computers, laptops, peripherals, servers, tablets, software licenses, UPS systems, and qualified teaching and support staff have significantly limited access of students to practical and hands-on IT education. Such shortcomings restrict personalized education, group work, and acquisition of the necessary digital and computing skills of the 21 st century. This case does not only deter the instant quality of instruction and learning, but it also increases the disparity between what is required in the curriculum and what is present in the classrooms in the Pakistan education system. Unless the lab is improved quickly, it will remain unprepared to equip students to work in a technology-driven future. To respond to these challenges, urgent measures need to be taken, such as supplying missing hardware and peripherals, licensing of sufficient software, improving power

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backups, improving internet access, and hiring more qualified IT teachers and lab attendants. It is also necessary to revamp the gadget store and provide more office space to teachers. To conclude, it is crucial to address the identified gaps in the resources to make the IT laboratory an effective and functional learning environment. Investment in IT infrastructure and human resources will not only enhance the outcomes of education, but also play a key role in creating a digitally competent generation of students.

Recommendations

Following the discussion and findings, the following is a practical recommendation that can be made to curb the critical shortage of resources in the IT laboratory:

1. Short-term Hardware Upgradation: 4 more desktop computers, 12 laptops, 2 multimedia setups, 12 headphones, 3 printers, 5 speakers, 4 servers and 12 tablets will be procured to achieve the minimum capacity required. Additional portable hard disks and USBs should as well be supplied as an emergency measure.
2. Software and Security Improvement: Purchase 8 additional antivirus licenses and make sure 12 fully licensed windows operating systems and application software is present on each workstation.
3. Power and Connectivity Reliability: Add 2 extra UPS to ensure continuity of power supply. Enhance and open the current internet resource to allow full access by the students during lab sessions.
4. Human Resource Development: Hire 1 more CT-IT, 1 more SST-IT and at least 2 more lab attendants. Reserve 2 additional offices of IT teachers to enhance planning and student mentoring.

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