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## Challenges in Teaching Computer Science in Public Secondary Schools: Pakistani

### Context

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### Abstract



The aim of this study was to identify the challenges in teaching computer science in public secondary schools of Pakistan. To answer the research questions, a survey questionnaire was constructed for IT Teachers. The population of the study was 244 SSTs (IT) of public secondary schools in District Attock. In total, 125 Secondary School Teachers (SSTs-IT) were selected as sample of the study. The study concludes that IT Teachers are facing several internal as well as external challenges. For instance, lack of IT infrastructure; lack of latest equipment in IT labs which are not up to date due to shortage of funds, IT Teachers have to teach other subjects which, no doubt, affects their prime duty which is teaching of Computer Science, and additional duties like clerical works, online data entry of students and teachers are also given to them in school. External challenges include, lack of professional development opportunities for in-service teachers, lack of student's access to computers at home and minimum support from parental side due to higher illiteracy rate among them. Hence, to conclude, there is a need to provide administrative support and enough resources specifically to the teachers teaching computer science so they may be able to overcome the challenges they face.

**Keywords:** IT Teachers; Computer Science; External Challenges; Professional Development; Public Schools

### Introduction

Information Technologies (IT) has been primarily responsible for the development and competition of globalization since its inception. IT significantly contributed to turning the world into a global village (Laleye & Babafemi, 2019). One of the main factors that all people on the globe share is technology. IT usage has become more widespread, with applications in numerous areas of life (Khapre, 2015). A person who is not proficient in IT will be left behind in a world that is experiencing rapid change. Today, technical expertise is just as essential as other necessities and it is widespread recognition that science and technology, as well as skilled professionals in these fields, are essential for wealth and economic growth. Nearly every area of the global economy has been impacted by these changes, and the education sector has not been exempted either (Lawrence & Tar 2018). Technology and education are the two most important tools for the survival, growth, and progress in this fast-evolving competitive world; in particular, information technology offers some great educational opportunities.

Secondary education has pivotal role in social and economic growth of a country because it serves as the feeder system for higher education. The Government of Pakistan has incorporated 'Computer Science' as a subject at secondary level in schools by acknowledging the value and dire need for science and technology in our lives as well as in the study and research of other subjects. In 2009, it was introduced as a science subject. As a result, the Punjab government established IT labs and provided IT teachers to all public secondary schools. As Compared to other science subjects, teaching of computer science courses such as artificial intelligence (AI), programming and database development are most challenging subjects to teach and learn. Studies have shown that students in programming classes have difficulty in imagining abstract ideas. As per new research on the teaching of programming and artificial intelligence, indeed, in-depth learning can take place conceptually, technically and practically only when students are given the chance of face-to-face teaching/learning process and interact practically in their programming.

The identification of challenges which IT teachers face in the lab and classroom would be a very imperative step toward improvement of quality education. In spite of the initiatives and significant growth of Information Technology in education, IT teachers are still facing so many challenges in teaching computer science. Identifying and diagnosing these problems will certainly provide assistance and information that may be utilized to arrange and manage programs and may make coping with these problems and challenges easier for teachers. Therefore, current study was planned to investigate the challenges in teaching of computer science in public secondary school. For which, following objectives were finalized.

### Objectives of the Study

Following were the study's objectives:

1. To investigate the internal challenges that male and female IT Teachers face in teaching of Computer Science.
2. To find out the external challenges in teaching of computer science faced by male and female IT Teachers.
3. To suggest strategies to manage these challenges so the IT Teachers may teach Computer Science effectively.

Following research questions were formulated to achieve these objectives.

### Research questions

1. What are those challenges that IT teachers face in teaching of Computer Science?
  - a) What are the internal challenges that male and female IT teachers face while teaching Computer Science?
  - b) What are the external challenges faced by male and female IT teachers while teaching Computer Science?
  - c) How are the challenges faced by IT teachers be solved through employing different strategies?

### Literature Review

There are two types of challenges which a computer science teacher face. Internal and external or school bases and society-based challenges. Internal challenges are like limited access to internet, limited technical support in schools, limited availability of time, out of date IT equipment in school labs etc. While external challenges include insufficient technological training, technical support limitation, lack of technical assistance and peer support, gender gap which is a significant issue for female students as well as teachers and cultural barriers (Hamutoglu and Basarmak, 2020).

Zhang et al. (2020) discovered that teachers said the most frequently expressed challenge they have to face was a lack of computers in school computer labs. Guha (2000) found similar results, with many teachers claiming that their classes lacked adequate IT infrastructure, particularly in terms of the number of PCs. Similarly, in the literature, the lack of appropriate training and assistance is the most frequently noted issue. A major issue is a lack of training (Ghavifekr & Athirah, 2015; Ferdig et al. 2020; Huber and Helm, 2020). Adnan and Anwar (2020) were of the view that teachers in Pakistan usually not prepared for incorporation of digital instructional approaches in their curricula.

To overcoming the new educational challenges, teachers should be digitally competent (Gallardo-Echenique et al., 2015). Faculty members who have limited digital competence can not teach their subjects efficiently. Other studies also identified the similar challenge (Kanwal & Rehman, 2017). As developing teachers' digital competence is necessary, so the educational institutions are required to organize training sessions for the purpose.

Technology's use in teaching learning process persistently is influenced by the teachers' intrinsic or extrinsic motivation (Al-Samarraie and Saeed, 2018). To Tosuntaş et al. (2019), the major barriers in the integration of technology in teaching learning process, were low motivation, limited digital competence, and poor infrastructure.

There are various challenges which are same for males and females but at the same time females face some more challenges as compared to males IT Teachers. Due to these challenges females are not competing with their counterparts in this era. Some main challenges are given below: 1- The computers are considered as belonging to the males in the domains of Science, Technology, Engineering and Math (STEM) (Inkpen et al., 2005) while females are undersold in the STEM fields as well as in Computer Science (Jiménez et al. 2019). 2- Computer Software also plays an important role in this scenario because software has been found to have a male favoritism (Ray et al., 2019).

According to Chappell, educational software has been faulted of helping as an access to technology specially computer and gadgets for boys, but not for girls (Jiménez et al. 2019). 3- another well-documented challenge is access to computers for female students as compare to boys and this difference can be seen from a very young age. This form of gender bias and inequality like access, usage and ownership demonstrated in elementary, high schools and in universities can be observed in kindergarten and pre-school learners. Females' time spent on computers for leaning purposes decreases between grades four and eight while males' time spent on computers for learning as well as gaming increases (Cabrera, 2021). 4- Female students' attitudes are comparatively different toward computers. Computers are negatively influenced by a mixture of socialization and a lack of computer access and expertise (Garrido, Rubio & Valle, 2019). Many studies have been reviewed, but not a single study had a sample in which girls expressed more positive emotions and feelings than boys of their age toward computers (Kaarakainen et al. 2018). Female students show higher level of computer anxiety, that definitely causes to reduce their self-efficacy. Resultantly they require greater effort to use CS (Teo, 2014). To many studies, attitude of a student toward CS has a noteworthy impact on his/her academic progress (Kordaki, 2010).

### Population and sampling

The population under the study was 244 IT Teachers working in public secondary schools of District Attock (Pakistan). Sample was selected through Simple Random Sampling technique to get the more accurate representative sample. In total, 125 IT teachers took part in the study. The survey questionnaire was distributed among the selected sample. The response rate was 98%. Hence, analysis was run on the 122 responses.

### Instrument of the Study

In this study, the challenges experienced by IT teachers were investigated by the use a self-constructed questionnaire. The options given in the Likert- type Rating Scale to gauge respondents' levels of agreement or disagreement were; Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, and Strongly Disagree = 1. The developed questionnaire was gone through a rigorous process of validity and reliability. Reliability measures were taken by applying Chronbach Alpha through SPSS. The alpha value of 0.88 showed that the instrument was highly reliable to use in current context. For ensuring its validity, the instrument went through the expert validation process and after checking its face validity as well, it was concluded that the instrument is reliable and valid to be used in current study.

### Results

The data acquired through the survey questionnaire was primarily analyzed by applying descriptive statistics like frequencies, and percentages. It helped in finding the main internal and external challenges faced by the IT teachers. After the primarily analysis, Mann-Whitney test was also applied to examine the differences in male and female respondents' opinions. The final results are presented below.

### Internal challenges

#### Technical Challenges

S. no	ITEM	GENDER	SA	A	UNC	SD	D	Mean	Z
11	Opinion availability of latest IT labs in schools	MALE	6.56%	12.30%	8.20%	9.84%	13.11%	63.01	-0.48
		FEMALE	5.74%	13.11%	8.20%	8.20%	18.85%	59.99	
12	Opinion about supply of PCs and peripherals in IT Labs of schools	MALE	3.28%	14.75%	9.84%	5.74%	16.39%	64.16	-0.86
		FEMALE	2.46%	15.57%	9.02%	6.56%	16.39%	58.84	
13	Opinion about sufficiency of Electricity in IT Labs of schools	MALE	13.93%	20.49%	7.38%	0.0%	8.20%	58.81	-0.88
		FEMALE	15.57%	19.67%	7.38%	0.0%	7.38%	64.1	
14	Opinion about the repairing of PCs and devices IT Labs of schools	MALE	10.66%	18.85%	7.38%	5.74%	7.38%	60.65	-0.27
		FEMALE	13.93%	7.38%	4.92%	4.92%	62.35%	13.93%	

Table 1.1 Internal technical challenges faced by IT teachers

Table 1.1 shows IT labs are not updated and PCs and peripherals are not provided timely but electricity and repairing of PCs and peripherals is made timely. Furthermore Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females.

**Administrative Challenges**

S. no	Item	Gender	SA	A	UNC	SD	D	MEAN RANK	Z
1	Opinion about cooperation of Head Teacher with IT Teachers for effective and smooth teaching of Computer Science	MALE	0.82%	9.02%	0.82%	10.66%	28.69%	65.88	=-1.55
		FEMALE	0.82%	10.66%	0.82%	10.66%	27.05%	57.12	
2	Opinion about available funds for latest PCs and peripherals	MALE	4.10%	10.66%	9.84%	7.38%	18.03%	65.21	=-1.20
		FEMALE	3.28%	11.48%	10.66%	5.74%	18.85%	57.79	
3	Opinion about available funds for repairing PCs and peripherals	MALE	2.46%	8.20%	11.48%	5.74%	22.13%	65.62	=-1.34
		FEMALE	3.28%	10.66%	10.66%	9.02%	16.39%	57.38	
4	Opinion about assistance provided by Head whenever PCs require repairing and maintenance	MALE	2.46%	9.84%	10.66%	5.74%	21.31%	64.67	=-1.06
		FEMALE	3.28%	9.02%	11.48%	9.02%	17.21%	58.33	
5	Opinion about effectiveness of teaching in case of extra duties	MALE	23.77%	13.93%	7.38%	3.28%	1.64%	63.61	=-0.62
		FEMALE	23.77%	13.11%	6.56%	4.92%	1.64%	59.69	
6	Opinion about the capability and availability of alternate teachers to teach computer science in case of leaves	MALE	17.21%	27.05%	2.46%	0.00%	3.28%	61.65	=-0.04
		FEMALE	24.59%	3.28%	0.00%	3.28%	61.35	18.85%	

Table 1.2 Internal administrative challenges faced by IT teachers

Table 1.2 shows Head Teachers have funds for buying and repairing. On the other hand, extra duties and leaves effect on teaching computer science. Furthermore, Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females.

**Teaching Challenges**

S.no	Item	Gender	SA	A	UNC	SD	D	Mean	Z
1	Opinion about effects on prime duty of IT Teacher by other subjects in schools	MALE	16.39%	27.87%	3.28%	0.00%	2.46%	58.33	-1.08
		FEMALE	18.03%	22.95%	5.74%	0.00%	3.28%	64.67	

2	Opinion about the availability of time for instructions or theory work in my school	MALE	7.38%	22.95%	3.28%	0.00%	16.39%	61.71	-0.07
		FEMALE						61.29	
3	Opinion about the availability of time for practical work of computer science	MALE	7.38%	23.77%	2.46%	0.00%	16.39%	59.95	-0.51
		FEMALE	12.30%	20.49%	0.00%	0.00%	17.21%	63.05	
4	Opinion about the difficulties in sharing ideas and getting help about this subject with colleagues in school	MALE	13.11%	22.13%	0.00%	0.00%	14.75%	63.09	-0.53
		FEMALE	22.13%	19.67%	2.46%	0.00%	5.74%	59.91	
5	Opinion about the difficulties in getting instructional support from colleagues in school	MALE	20.49%	18.85%	1.64%	0.00%	9.02%	61.12	-0.12
		FEMALE	18.85%	22.95%	1.64%	0.82%	5.74%	61.12	
6	Opinion about the effects on the performance of students due to the weakness in English language on learning of Computer science	MALE	18.85%	21.31%	1.64%	0.00%	8.20%	61.88	-1.48
		FEMALE	18.03%	27.87%	2.46%	0.00%	1.64%	65.80	
7	Opinion about the difficulties in teaching of complex concepts, syntax and technical terms	MALE	14.75%	24.59%	2.46%	0.00%	8.20%	65.28	-1.23
		FEMALE	12.30%	21.31%	4.92%	0.82%	10.66%	57.72	
8	Opinion about the difficulties for students in learning complex concepts, syntax and technical terms	MALE	10.66%	17.21%	4.92%	0.00%	17.21%	66.08	-1.57
		FEMALE	18.03%	25.41%	0.82%	0.00%	5.74%	56.95	
			14.75%	19.67%	1.64%	0.00%	13.93%		

Table 1.3 Internal teaching challenges faced by IT teachers

Table 1.3 shows IT teachers don't have sufficient time for practical and theory work and teaching supports from colleagues. Teaching and learning of complex concepts, syntax and technical terms is also a challenge for them. Furthermore, Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females.

### External Challenges

#### Teaching Based Challenges

S. no	Item	Gender	SA	A	UNC	SD	D	Mean	Z
1	Opinion about easiness of students	MALE	22.95%	22.95%	3.28%	0.00%	0.82%	60.17	=-0.46

	who have PCs at their homes	FEMALE	21.31%	23.77%	1.64%	0.00%	3.28%	62.83	
2	Opinion about the availability of PCs at homes by Computer Science students	MALE	0.00%	0.82%	13.11%	11.48%	24.59%	59.79	=-0.57
		FEMALE	0.00%	2.46%	13.93%	12.30%	21.31%	63.21	
3	Opinion about academic and effective utilization of PCs by students at home	MALE	0.82%	3.28%	11.48%	8.20%	26.23%	59.49	=-0.63
		FEMALE	2.46%	4.92%	13.93%	11.48%	17.21%	63.41	

*Table 2.1 External teaching based challenges*

Table 2.1 shows that computer science students feel comfortable while doing practical work in IT lab by having PCs at homes and their performance is comparatively good in the subject of Computer Science but majority of the students don't have PCs at their homes and cannot use PCs effectively. Furthermore Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females.

#### **Administrative Challenges**

S. no	Item	Gender	SA	A	UNC	SD	D	Mean	Z
1	Opinion about Induction Training before starting job	MALE	13.11%	18.03%	4.10%	0.00%	14.75%	58.90	-0.95
		FEMALE	13.11%	18.85%	4.10%	0.00%	13.93%	64.10	
2	Opinion about the refresher courses and trainings on regular basis	MALE	31.15%	13.11%	1.64%	1.64%	2.46%	58.62	-0.96
		FEMALE	31.97%	13.93%	0.00%	1.64%	2.46%	64.38	
3	Opinion about Curriculum of Computer Science	MALE	11.48%	31.15%	1.64%	0.00%	5.74%	60.75	-0.27
		FEMALE	13.11%	32.79%	1.64%	0.00%	2.46%	62.25	

*Table 2.2 External administrative challenges*

Table 2.2 shows that IT teachers get induction training before job but no professional development and trainings. Computer Science curriculum does not fulfill the needs of the day. Furthermore Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females.

#### **Society Based Challenges**

S. no	ITEM	GENDER	SA	A	UNC	SD	D	Mean	Z
1	Opinion about the affordances of PCs at home for computer science students	MALE	22.95%	26.23%	0.00%	0.00%	0.82%	59.47	=-0.72
		FEMALE	27.87%	21.31%	0.00%	0.00%	0.82%	63.53	
2	Opinion about the diversion from studies due to PC and internet at home	MALE	4.10%	18.03%	12.30%	0.00%	15.57%	62.91	=-0.46
		FEMALE	4.92%	16.39%	12.30%	0.00%	16.39%	60.09	
3	Opinion about the time available by students for using PC at home	MALE	5.74%	22.13%	15.57%	1.64%	4.92%	53.93	=-2.46
		FEMALE	6.56%	23.77%	12.30%	3.28%	4.10%	69.07	
4	Opinion about IT literacy of parents of students studying computer science	MALE	22.13%	15.57%	3.28%	2.46%	6.56%	60.24	=-0.42
		FEMALE	22.95%	15.57%	3.28%	0.82%	7.38%	62.76	
5	Opinion about the due importance to	MALE	21.31%	18.85%	2.46%	0.00%	7.38%	59.72	=-0.60

6	the computer science given by parents due to their IT illiteracy	FEMALE	22.95%	19.67%	3.28%	0.00%	4.10%	63.28	=-0.70
	Opinion about Community and parents about the importance of IT	MALE	18.85%	23.77%	4.10%	0.00%	3.28%	60.34	
7	Opinion about the performance of students by compelling them opt computer science as subject by Community / parents	FEMALE	20.49%	24.59%	3.28%	0.00%	1.64%	62.66	=-2.00
		MALE	7.38%	35.25%	6.56%	0.00%	0.82%	56.37	
8	Opinion about meeting and visits of Parents or public in IT labs of schools	FEMALE	12.30%	35.25%	1.64%	0.00%	0.82%	66.63	=-1.41
		MALE	9.84%	23.77%	8.20%	0.00%	8.20%	57.21	
9	Opinion about help of Parents in using computers at home	FEMALE	14.75%	21.31%	5.74%	0.00%	8.20%	65.76	=-1.62
		MALE	3.28%	19.67%	2.46%	6.56%	18.03%	56.63	
10	Opinion about physical problems due to the excessive use of computer	FEMALE	7.38%	24.59%	5.74%	0.00%	12.30%	66.37	=-1.42
		MALE	18.85%	17.21%	9.84%	0.00%	4.10%	57.19	
		MALE	18.85%	18.85%	10.66%	0.00%	1.64%	65.81	

Table 2.3 External society based challenges

Table 2.3 shows that many students don't have PCs at home because parents cannot afford PCs, only minority of the students has PCs at home but they distract. Parents neither visit IT labs nor know the importance of IT. Excessive use of compute has physical problems for students. Furthermore Z value between +1.96 and -1.96 indicates that there is no difference between the opinion of males and females. except serial no 339 and 43.

### Discussion

The study found that the majority of IT teachers of public secondary schools reported that they were dealing with a serious challenge of poor or non-existent IT infrastructure; IT labs are not being updated on a regular basis, and the most up-to-date PCs are not available in IT labs. The same challenge was also reported by Silva et al. (2020) and Ng et al. (2020). They said that majority of the teachers reported a lack of pedagogical and technical support.

The majority of respondents said they face administrative obstacles in schools, with head teachers refusing to cooperate in order to teach computer science in an effective and efficient manner. Foulger & Slykhuis (2017) also concluded that lack of technical support from departments and administration is one of the major challenges to ICT integration in secondary schools.

They are also having issues in the classroom; overcrowding affects computer science education, and students who do not have access to computers at home find it difficult to complete practical work in IT labs. As a result, they perform poorly in Computer Science.

Teachers confront numerous external challenges, such as receiving Induction Training before to commencing work but no follow-up refresher courses or professional development training sessions. Care et al., (2018) were of the view that for aligning the education system with 21st Century, teachers need to learn technology skills along with the knowledge of providing technological assistance required to teach and guide students.

Additional duties affect their teaching of Computer Science, computer science students don't have PCs at home, many parents don't have resources to purchase PCs for their children to perform practical work, most of the students don't have time to use PCs at home, many parents are not IT literate therefore they do not give due importance, parents and community does not know the

importance of IT, many parents compel their children to choose subjects of their choice, parents and other community members do not regularly visit the school's IT lab therefore they know nothing about it.

While the aforementioned challenges are the same for both female and male IT teachers, female IT teachers' perspectives on some external challenges differed from male IT teachers. For example, many female IT teachers agreed that girls don't have PCs at home. Furthermore, girls are expected to assist their mothers at home, so if they have computers, they will not spare time to use them for practical works assigned by their teachers.

### Conclusions

Major conclusions drawn from the study:

1. The majority of the IT teachers of Punjab Public Secondary Schools reported that they were dealing with a serious challenge of poor or non-existent IT infrastructure; IT labs were not being updated on a regular basis, and up-to-date PCs were not available in IT labs.
2. The majority of the respondents said that they faced administrative obstacles in schools, with head teachers refusing to cooperate in order to teach computer science in an effective and efficient manner.
3. The majority of the respondents stated that they were also having issues in the classroom. Overcrowded classrooms affect computer science education, and students who do not have access to computers at home, find it difficult to complete practical work in IT labs. As a result, they show poor performance in Computer Science.
4. The majority of IT teachers stated that they confront numerous external challenges, such as receiving Induction Training before to commencing work but no follow-up refresher courses or professional development training sessions. Additional duties affect their teaching of Computer Science. Computer science students don't have PCs at home, many parents don't have resources to purchase PCs for their children to perform practical work. Most of the students don't have time to use PCs at home. Many parents are not IT literate, so they do not know the importance of IT. Many parents compel their children to choose subjects of their choice. Parents and other community members do not regularly visit the school's IT lab; therefore, they know nothing about it.
5. While the aforementioned challenges are the same for both female and male IT teachers but female IT teachers' perspectives on some external challenges differed from their male colleagues, for example, many female IT teachers agreed that girls don't have PCs at home. They were of the view that girls are expected to assist their mothers at home, so if they have computers, they will not spare time to use them for practical works assigned by their teachers.

### Recommendation

On the basis of findings of the study, it is recommended that IT labs should be upgraded regularly. When PCs and peripherals or accessories are required, they should be delivered on time. Furthermore, separate funding should be set aside for the IT lab, so that if the number of students grow, the school can easily purchase more computers and furniture. In the IT Labs, high-speed internet should be available. This service should be made available in remote villages in particular. I.T teachers are required to teach subjects other than computer science. They must maintain track of employees and students, as well as do various administrative tasks that have an impact on their computer science instruction. As a result, the workload should be decreased by appointing/hiring more IT Teachers and providing clerks and Head Teachers with basic IT proficiency. Separate IT teachers should be assigned to elementary and secondary classrooms. Furthermore, IT teachers should be appointed / recruited in accordance with the STR so that overcrowding in classes and long leaves of IT teachers may be easily managed.

It is also suggested that technicians or lab attendants should be recruited in schools to ensure that PCs and other gadgets are repaired and maintained on timely. At least one technician for each Tehsil should be recruited if it is not possible to recruit in every school. Periodic refresher courses and training sessions should be held. This is a simple task that may be accomplished during summer holidays. Curriculum should be revised regularly to ensure that it fulfill the needs of the current era. In order to deal with power outages, electricity / power backup (UPS / generators, etc.) should be accessible in the IT labs at school. Parents and the general public are unaware of the importance of IT and Computer Science therefore seminars and awareness campaigns should be arranged for this goal,



so that parents place a high value on the field of computer technology. Similar studies might be conducted to identify challenges in teaching computer science in Punjab's public schools at the elementary and secondary levels.

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