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Information and Communication Technology and Academic Performance: A Comparative Study of Public and Private Secondary Schools in Quetta, Pakistan

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Abstract

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This study examined ICT availability and use and their associations with academic performance among Grade 9 and 10 students in public and private secondary schools in Quetta, Pakistan. A quantitative, non-experimental, cross-sectional design was used. Questionnaire data were obtained from 285 students in five private and four public schools using a researcher-developed instrument (overall Cronbach's $\alpha = .842$), together with cumulative academic records where available. Descriptive statistics, independent-samples t-tests and Pearson correlations were analyzed in SPSS. The mean ICT availability index (0–8) was 2.89 in public schools and 6.88 in private schools. Reported sector differences in ICT availability, use, perceived academic performance and academic record scores were statistically significant (all $p < .001$). ICT use correlated positively with perceived academic performance ($r = .642$, $p < .01$) and academic record scores ($r = .563$, $p < .01$). Mean documented scores were 64.32% for public-school students and 74.88% for private-school students. These patterns identify substantial sectoral disparities and positive associations, not causal effects of ICT. Improving equitable access and the purposeful use of ICT may therefore be relevant priorities, subject to further evaluation.

Keywords: and communication technology, academic performance, secondary education, digital divide, public and private schools, Quetta

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1. INTRODUCTION

Education supports individual development and participation in social and economic life. Beyond transmitting knowledge, contemporary schooling seeks to develop critical thinking, problem-solving and digital competence. Information and Communication Technology (ICT) can extend how learning materials are accessed, communicated and assessed (Basri et al., 2018).

ICT refers to digital tools and communication resources used to collect, store, process, share and present information. In schools, these may include computers, internet access, projectors, interactive boards, educational videos, digital libraries, learning management systems and mobile applications (Jan, 2018). Such resources may make classroom activities more interactive and give students additional opportunities for independent inquiry, although their educational value depends on how they are integrated into instruction (Valverde-Berrocoso et al., 2022; Li et al., 2025).

ICT is particularly relevant to Grades 9 and 10, when students prepare for examinations that shape subsequent academic pathways. Pakistani studies report associations between digitally supported learning and achievement (Samiullah et al., 2021), while research on smart-classroom quizzes reports positive performance outcomes (Awan et al., 2024). Access to devices alone, however, does not ensure effective instructional use (Timotheou et al., 2022).

ICT integration is uneven across schools in Pakistan, including in Balochistan. Differences in infrastructure, connectivity and teacher preparation intersect with resource disparities between public and private institutions (Jamil, 2023; Mehmood, 2025). Quetta provides a setting in which these sectoral differences can be examined within one city; the selected schools should not, however, be treated as representative of the entire province.

Although educational technology receives increasing policy attention in Pakistan, evidence focused specifically on secondary schools in Quetta remains limited. Much of the cited national research concerns higher education or schools in Punjab and Sindh (Ishaq et al., 2020; Rind et al., 2022; Abbasi & Hussain, 2024). The present study adds descriptive, sector-disaggregated evidence on ICT availability, reported use and academic performance in selected Quetta schools.

1.1 Objectives of the Study

The study pursued three objectives:

1. To determine the availability and usage of ICT in secondary schools of Quetta.
2. To examine the relationship between ICT and students' academic performance at the secondary level in Quetta.
3. To compare public and private secondary schools of Quetta with respect to ICT application and its association with students' academic performance.

1.2 Research Questions

1. What is the availability and usage of ICT in secondary schools of Quetta?
2. What is the relationship between ICT and students' academic performance at the secondary level in Quetta?
3. What differences exist between public and private secondary schools of Quetta with respect to ICT application and its association with academic performance?

The study provides locally relevant evidence for considering ICT access, teacher support and equity in educational planning. Because schools were selected purposively, its estimates describe the participating schools rather than the full population of schools in Balochistan.

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2. LITERATURE REVIEW

2.1 Theoretical Foundations

Two perspectives help distinguish access to technology from meaningful educational use. The Technology Acceptance Model (TAM) emphasizes perceived usefulness and ease of use as influences on technology acceptance; these factors are relevant to teachers' willingness to use ICT (Scherer et al., 2019). Connectivism emphasizes learning through access to, evaluation of and synthesis across networked sources (Goldie, 2016). Together, these frameworks suggest that educational opportunities depend on both users' engagement with technology and students' ability to construct knowledge through it. The present survey did not directly test either framework.

2.2 Availability Versus Usage of ICT

Availability and instructional use are related but distinct. Saleem et al. (2018) identify availability, accessibility, sufficiency and usability as important conditions for educational benefits. Fernández-Gutiérrez et al. (2020) indicate that learning outcomes depend on the context and purpose of technology use, while Consoli et al. (2025) emphasize the quality of integration in relation to engagement and digital competencies. A computer laboratory or projector may therefore expand opportunities without showing whether instruction changes in a pedagogically meaningful way. Related Pakistani research on curriculum alignment also illustrates the importance of matching instructional activities to learning objectives (Bhatti & Bashir, 2025); it does not itself establish an ICT effect.

2.3 ICT and Academic Performance

Evidence on ICT and achievement is mixed and context-dependent. Cross-national analysis links the relationship between ICT and literacy to the purpose and setting of its use (Hu et al., 2018). A meta-analysis of mathematics and science education suggests that digital tools can support learning when combined with appropriate pedagogy (Hillmayr et al., 2020). Positive associations between digital literacy and achievement have also been reported (Li et al., 2025; Zakir et al., 2025). Nevertheless, technology should be evaluated against specific learning objectives rather than assumed to improve attainment (Escueta et al., 2020). Differences in access and skills may further shape the relationship (Ben Youssef et al., 2022).

2.4 The Public–Private Divide and Equity in Pakistan

Public and private schools in Pakistan operate under different funding and administrative arrangements, which may influence ICT access (Ali, 2020). Research from Punjab and Sindh describes sectoral inequalities in learning resources and outcomes (Saleem et al., 2018; Rind et al., 2022; Abbasi & Hussain, 2024), while pandemic-era experiences exposed barriers to digital learning (Jamil, 2023). Evidence from Quetta remains limited. This study examines whether similar differences are observable in its selected public and private secondary schools; it does not determine which institutional features explain any observed gap.

3. METHOD

3.1 Research Design

A quantitative, non-experimental, cross-sectional survey design was adopted. ICT availability and use were measured at one point in time, and outcomes were compared between public- and private-school respondents. Because no intervention or random assignment occurred, statistical relationships are interpreted as associations rather than effects.

3.2 Population and Sample

The accessible population comprised Grade 9 and 10 students attending secondary schools in Quetta that had at least some ICT provision. Schools without any reported ICT provision were excluded. School selection was purposive rather than probability-based. Nine schools participated:

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five private schools (Horizon School, Saryab; Convent Saint Joseph; Grammar Cambridge School, Jinnah Town; Origin School System; and Civitas School) and four public schools (F.G. Public School; Government Girls High School, Jinnah Town; Government Girls High School, Almo; and Government Boys High School, Jinnah Road). Students in Grades 9 and 10 were subsequently recruited within these schools. The manuscript does not specify a probability-based procedure for student selection; the results should therefore not be described as a representative random sample.

Cochran's large-population formula ($n_0 = Z^2pq/e^2$, with $Z = 1.96$, $p = q = .50$ and $e = .05$) yields an indicative target of approximately 385 observations under its sampling assumptions. The final analyzed sample was 285 because of permissions, respondent availability and returned questionnaires. Because school selection was purposive and observations were clustered within nine schools, the formula should not be interpreted as establishing a 5% margin of error for this sample.

3.3 Instrument

A researcher-developed questionnaire was informed by the study objectives and reviewed literature. Part A recorded school sector, grade, gender, age and academic group. Part B contained eight yes/no items relating to ICT facilities and educational practices. Part C comprised 15 statements rated from 1 (strongly disagree) to 5 (strongly agree), organized into three five-item subscales: ICT use in teaching and learning, perceived relationships between ICT and academic performance, and comparative perceptions of ICT. These subscales assess students' reports and perceptions, not direct observations of classroom instruction.

3.4 Validity and Reliability

The questionnaire content was reviewed with input from the supervisor and subject experts. A pilot involving 20 respondents yielded Cronbach's $\alpha = .773$ for the 15-item scale. In the main sample, the overall α was .842 and the three five-item subscales exceeded .70 (Table 2). The Kaiser–Meyer–Olkin value was .783; Bartlett's test was significant, $\chi^2(105) = 1376.42$, $p < .001$. These statistics describe reliability and factorability but do not, by themselves, establish the questionnaire's full construct validity.

3.5 Data Collection

After obtaining permission from school administrations, the researcher explained the study to school personnel and students. Grade 9 and 10 students completed the questionnaires, which were collected and screened; incomplete questionnaires were excluded. Where access was granted, cumulative academic records were consulted. The manuscript does not specify the record period, grading comparability across schools or the exact number of records accessed; these matters require verification from the original study documentation.

3.6 Data Analysis and Ethical Considerations

The data were coded and analyzed in SPSS. Frequencies and percentages summarized categorical responses; means and standard deviations described scale scores. Independent-samples t-tests compared sectors, and Pearson correlations examined associations among ICT availability, use, perceived performance and academic record scores. The record-based results were summarized descriptively. The reported t-tests treat student observations as independent despite students being nested within nine schools; without school-level information, cluster-adjusted inference cannot be reconstructed. Participation was reported as voluntary, questionnaire responses as confidential, and information as restricted to academic use. Because records were accessed, the procedures for linking records to questionnaire responses and obtaining any required consent should be clarified in the study documentation.

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3.7 Limitations

These findings have several limitations. First, the nine purposively selected schools were all located in Quetta and schools without ICT provision were excluded; neither the sample nor its ICT estimates represent all secondary schools in Quetta or Balochistan. Second, the sample of 285 fell below the indicative Cochran target. Third, some measures reflect self-reported perceptions and may be affected by reporting bias. Fourth, schools differ in socioeconomic composition, teaching quality, school environment and other unmeasured factors; the comparisons do not isolate ICT as an explanation for academic differences. Fifth, clustering of students within schools may affect conventional significance tests. Finally, the cross-sectional design prevents causal conclusions.

4. RESULTS

The results describe the sample, instrument reliability, sector differences in ICT-related measures, correlations with academic performance, and distributions of cumulative academic record scores.

Table 1

Demographic Profile of Respondents (N = 285)

Variable	Category	*f*	%
Gender	Male	136	47.7
	Female	149	52.3
Class	Grade 9	142	49.8
	Grade 10	143	50.2
School type	Public	145	50.9
	Private	140	49.1
Age (years)	13–14	52	18.2
	15–16	182	63.9
	17 and above	51	17.9
Academic group	Science	222	77.9
	Arts	63	22.1

Note. Percentages are computed within the full sample.

The sample included 149 female students (52.3%) and 136 male students (47.7%). Grade 9 and Grade 10 respondents were nearly equally represented, as were public (n = 145) and private (n = 140) school students. Most respondents were aged 15–16 years (63.9%), and 77.9% were in the science group. Similar sector sample sizes do not remove potential differences in student or school characteristics.

Table 2

Reliability of the Questionnaire and Sub-Scales

Scale	No. of items	Cronbach's α
ICT usage in teaching–learning process	5	.806
ICT and academic performance	5	.812
Comparative perception of ICT	5	.789
Overall questionnaire	**15**	**.842**

Note. All coefficients exceed the conventional .70 criterion, indicating good internal consistency.

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4.1 Availability and Usage of ICT Facilities

Table 3

Availability of ICT Facilities by School Sector (% reporting "Yes")

ICT facility	Public	Private	Total
Computer laboratory	52.4	92.9	72.3
Computers for students	37.9	88.6	62.8
Internet facility	33.1	89.3	60.7
Multimedia / projector	35.2	90.7	62.5
Smart / interactive board	19.3	70.7	44.6
Educational videos in class	39.3	85.7	62.1
Teachers use ICT in lessons	31.7	84.3	57.5
ICT used for assignments	42.1	86.4	63.9

Note. Public n = 145; private n = 140.

Table 3 indicates that private-school respondents reported higher availability or use for every listed ICT item. For example, computer laboratories were reported by 92.9% of private-school respondents and 52.4% of public-school respondents; corresponding figures for internet facilities were 89.3% and 33.1%. These are descriptive percentages. No item-specific significance tests are presented, so statistical significance should not be inferred for each individual facility.

The reported eight-item ICT index ranged from 0 to 8. Its mean was 2.89 (SD = 1.62) for public-school students, 6.88 (SD = 1.21) for private-school students and 4.85 (SD = 2.42) overall. The pooled mean masks a pronounced difference between sectors. The eight-item index combines both facilities and classroom-use practices, so its label as a pure availability index should be interpreted cautiously.

Table 4

Descriptive Statistics for ICT Usage and Perceived Academic Performance (Overall Sub-Scale Means)

Sub-scale	Public M	Private M	Total M
ICT usage in teaching–learning	3.22	4.24	3.72
ICT and academic performance	3.38	4.17	3.77
Comparative perception of ICT	2.70	4.05	3.36

Note. Responses on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

On the ICT-use subscale, the largest reported item difference concerned teachers' use of ICT tools (public M = 2.06; private M = 4.16). Despite lower reported access, public-school respondents rated the statement "ICT makes classroom learning more interesting" at M = 3.64. Across the performance-perception subscale, "ICT makes me more motivated to study" had the highest reported overall item mean (M = 3.88). These responses describe students' perceptions rather than measured changes in motivation or achievement.

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4.2 Sectoral Comparison: Independent-Samples t-Tests

Table 5

Independent-Samples t-Tests Comparing Public and Private Schools

Construct	Public M (SD)	Private M (SD)	t (283)	*p*
ICT availability index	2.89 (1.62)	6.88 (1.21)	−23.53	< .001
ICT usage	3.22 (0.78)	4.24 (0.57)	−12.62	< .001
Academic performance (perception)	3.38 (0.71)	4.17 (0.56)	−10.41	< .001
Academic record score (%)	64.32 (9.86)	74.88 (8.42)	−9.72	< .001

Note. Negative t-values reflect the coding of public schools as the first group; all differences favour private schools.

All four reported sector comparisons were statistically significant ($p < .001$), with higher mean scores among private-school respondents for ICT availability, ICT use, perceived academic performance and cumulative academic record scores. The near four-point gap in the eight-item index is descriptively substantial. Because the sample contains students nested in nine purposively selected schools, the reported student-level t-test p-values should be interpreted with caution.

4.3 Correlation Analysis

Table 6

Pearson Correlations Among Study Variables

Variable	1	2	3	4
1. ICT availability	—			
2. ICT usage	.681**	—		
3. Academic performance (perception)	.584**	.642**	—	
4. Academic record score	.512**	.563**	.608**	—

Note. N = 285. ** $p < .01$ (two-tailed).

All reported correlations were positive and statistically significant at the .01 level. ICT availability correlated with ICT use ($r = .681$), while ICT use correlated with perceived academic performance ($r = .642$) and academic record scores ($r = .563$). These relationships do not establish whether ICT use improves performance or whether school- and student-level characteristics account for some of the associations.

4.4 Document Analysis of Academic Records

Table 7

Distribution of Students Across Academic Performance Categories (%)

Performance category	Public	Private	Total
Low (below 50%)	12.4	2.1	7.4
Average (50–59%)	26.2	8.6	17.5
Good (60–69%)	33.1	25.0	29.1
Very good (70–79%)	20.7	36.4	28.4
Excellent (80% and above)	7.6	27.9	17.5

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Note. Public n = 145; private n = 140. Categories based on cumulative school records.

The academic-record categories also differed by sector. Only 7.6% of public-school respondents were classified as excellent compared with 27.9% of private-school respondents, while 36.4% of private-school students fell in the very good category. Mean record scores were 64.32% in public schools and 74.88% in private schools. The record-based evidence provides a distinct outcome indicator, but it does not independently validate perceptions or establish that ICT accounts for the sectoral achievement gap.

5. DISCUSSION

Across the reported measures, private-school respondents had higher average ICT availability, ICT use, perceived performance and academic record scores. ICT indicators were also positively correlated with performance measures. Three implications emerge from these descriptive and associational findings.

5.1 A Pronounced Public–Private Digital Divide

The reported sector difference on the eight-item ICT index (2.89 versus 6.88) is consistent with unequal access and use in the participating schools. Similar resource disparities have been discussed in Pakistani schooling (Ali, 2020), while digital inequality may constrain educational opportunities (Ben Youssef et al., 2022). Saleem et al. (2018) similarly distinguish the availability, sufficiency and usability of ICT resources. Funding and administrative differences may contribute to the observed contrast, but the present data do not measure school budgets or management practices and cannot identify their effects.

5.2 From Availability to Meaningful Classroom Use

Provision and use should not be conflated. Respondents in private schools reported more frequent teacher use of ICT, alongside greater access to equipment. This pattern is compatible with research emphasizing purposeful technology integration (Fernández-Gutiérrez et al., 2020; Consoli et al., 2025). Teacher preparation and institutional support are plausible considerations in the literature (Scherer et al., 2019; Atabek, 2019), but this study did not directly assess teacher competence or training. Pakistani curriculum research likewise highlights the importance of aligning instructional tasks with learning goals (Bhatti & Bashir, 2025).

5.3 ICT, Motivation, and Academic Performance

Students generally expressed positive perceptions of ICT for engagement and motivation, and ICT use correlated with both perceived performance (r = .642) and cumulative record scores (r = .563). These observations are compatible with research on technology-supported engagement and learning when pedagogy is appropriate (Timotheou et al., 2022; Hillmayr et al., 2020). They do not demonstrate that ICT caused the difference in record scores. As Escueta et al. (2020) note, technology outcomes depend on implementation; unmeasured factors such as household resources, instruction and school climate may also matter. ICT should therefore be considered one possible correlate of achievement rather than its demonstrated cause.

6. CONCLUSION AND RECOMMENDATIONS

This study examined reported ICT availability and use and their associations with performance in nine selected public and private secondary schools in Quetta. Private-school respondents reported greater ICT access and use and had higher average perceived and record-based performance measures. ICT measures were positively correlated with academic outcomes, but the cross-sectional, non-random design does not establish that ICT improved achievement. The findings support closer attention to inequalities in access and to the educational purposes for which ICT resources are used.

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The following recommendations follow from the observed inequalities and the broader literature; their effectiveness would need to be evaluated:

Improve public-school ICT provision. Education authorities could prioritize functional computer laboratories, student access to devices, connectivity and projectors, together with maintenance arrangements.

Support teacher development. Practical professional learning could help teachers connect available ICT tools to curriculum requirements and specific lesson objectives.

Integrate ICT across subjects. Planned, supervised use of available facilities in science, mathematics, English and social studies could be considered rather than limiting ICT to computer studies.

Address unequal student access. Schools could consider supervised access to educational resources for students with limited devices or internet connectivity outside school.

Monitor operation and use. Designated school personnel could maintain equipment and periodically review whether facilities are accessible and used for planned learning activities.

Strengthen digital academic practices. Students could receive guidance on information reliability, responsible use of educational platforms and appropriate screen-time habits, with relevant family engagement.

Future studies should include a wider and probability-based sample of schools, explicitly document academic-record comparability and student recruitment, and account for school-level clustering. Longitudinal or quasi-experimental designs, alongside teacher and administrator perspectives, could help evaluate whether and how ICT contributes to outcomes.

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