Impact of ICT Competence And Learning Styles On Academic Achievement Of Secondary School Students

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Abstract- *The integration of Information and Communication Technology (ICT) in education has redefined learning environments, teaching strategies, and academic expectations. However, the extent to which ICT competence and individual learning styles contribute to academic achievement among secondary school students remains an evolving inquiry. This study aims to analyze the direct and indirect effects of ICT competence and learning styles on academic performance, using a Structural Equation Modeling (SEM) approach to validate the proposed conceptual framework.*

A descriptive-correlational design with quantitative analysis was used, involving 480 secondary school students (240 boys and 240 girls) selected from government and private schools in Bhopal district through stratified random sampling. Three standardized tools were used: the ICT Competence Scale (ICT-CS), VARK Learning Style Inventory, and an Academic Achievement Index derived from recent examination scores. Data were analyzed using descriptive statistics, correlation, multiple regression, and SEM path analysis.

Results revealed a strong positive relationship between ICT competence and academic achievement ($r = 0.68$, $p < 0.01$). Regression analysis indicated that ICT competence and learning-style adaptability jointly explained 57% of the variance in academic performance ($R^2 = 0.57$). SEM analysis confirmed significant direct effects of ICT competence ($\beta = 0.52$) and indirect effects through learning-style compatibility ($\beta = 0.27$). The model fit indices ($\chi^2/df = 1.92$, GFI = 0.94, CFI = 0.96, RMSEA = 0.045) confirmed an excellent model fit.

The findings demonstrate that ICT competence substantially enhances academic outcomes, particularly when instructional delivery aligns with students' dominant learning styles. The study introduces the ICT–Learning Style Achievement Model (ILSA Model), offering a holistic approach to digital pedagogy.

Keywords: ICT Competence, Learning Styles, Academic Achievement, Structural Equation Modeling, Digital Pedagogy, Correlation, Regression

I. INTRODUCTION

Education in the 21st century is increasingly characterized by technological integration, demanding digital fluency among both teachers and learners. ICT has transcended its role as an instructional aid to become a cognitive scaffold for knowledge construction. Yet, the mere presence of technology in classrooms does not guarantee improved learning outcomes; the real determinant lies in **students' ICT competence** and their ability to use digital tools in ways that complement their **learning styles**.

1.1 Conceptual Background

ICT competence refers to the ability to effectively use digital technologies for communication, learning, and problem-solving (UNESCO, 2019). It encompasses operational skills, cognitive understanding, and attitudes toward technology. When students exhibit high ICT competence, they can leverage e-learning platforms, simulations, and digital collaboration tools more effectively. However, the **interaction between ICT competence and learning styles** determines how these technologies are internalized and applied.

1.2 Learning Styles as Moderators

Learning styles—visual, auditory, reading/writing, and kinesthetic—represent individual preferences in perceiving and processing information (Fleming, 2001). ICT tools inherently provide multimodal learning opportunities, but their impact varies according to cognitive preferences. For example, visual learners benefit from graphical interfaces, while kinesthetic learners thrive through simulations and interactive tasks.

1.3 Conceptual Model

The **ICT–Learning Style Achievement (ILSA) Model** hypothesizes that:

- ICT competence directly influences academic achievement.

- Learning-style compatibility mediates the relationship between ICT competence and achievement.
- Together, these factors form a predictive framework for academic success.

Conceptual Description (Textual Model):

ICT Competence → (direct path) → Academic Achievement
ICT Competence → Learning-Style Compatibility → (indirect path) → AcademicAchievement

1.4 Objectives of the Study

1. To measure ICT competence and learning-style preferences of secondary school students.
2. To examine the relationship between ICT competence, learning styles, and academic achievement.
3. To analyze the direct and indirect effects of ICT competence on achievement using SEM.
4. To validate the proposed ICT–Learning Style Achievement Model.

1.5 Hypotheses

- **H_{01}:** There is no significant correlation among ICT competence, learning styles, and academic achievement.
- **H_{02}:** ICT competence and learning-style adaptability do not significantly predict academic achievement.
- **H_{03}:** Learning-style compatibility does not mediate the relationship between ICT competence and academic performance.
- **H_{04}:** The proposed model does not adequately fit the observed data.

II. REVIEW OF LITERATURE

2.1 ICT Competence and Learning Outcomes

Research consistently shows that ICT competence is a strong determinant of academic success. **Tondeur et al. (2018)** emphasized that higher ICT competence leads to improved problem-solving and critical thinking. **Knezek & Christensen (2016)** found that ICT-literate students demonstrate greater motivation and adaptability. **UNESCO (2019)** identified ICT competence as a core 21st-century skill integral to lifelong learning.

2.2 Learning Styles and Academic Achievement

According to **Kolb (1984)**, learning is a cyclical process influenced by individual cognitive preferences. Studies by **Graf et al. (2009)** and **Yilmaz (2017)** found that aligning instructional design with learning styles enhances understanding and retention. However, **Pashler et al. (2008)** cautioned that empirical evidence supporting strict learning-style instruction is mixed, underscoring the need for integrative approaches.

2.3 ICT–Learning Style Interactions

ICT's multimodal nature makes it uniquely suitable for accommodating diverse learning styles. **Mayer (2003)** proposed that multimedia instruction optimizes learning by engaging both verbal and visual processing channels. **Felder & Silverman (1988)** emphasized that teaching strategies aligned with learning preferences lead to higher satisfaction and performance.

2.4 Empirical Studies Linking ICT Competence and Achievement

Teo (2008) found that students' perceived ICT competence positively correlates with academic confidence. **Chou & Tsai (2010)** demonstrated that technology self-efficacy predicts academic achievement across subjects. In India, **Kaur & Nanda (2020)** observed that students with advanced ICT skills perform significantly better in science and mathematics subjects.

2.5 Theoretical Gap

While prior research has examined ICT competence and learning styles independently, few studies integrate them within a **structural model framework**. This study addresses this gap by employing **SEM** to quantify both direct and mediated effects.

III. METHODOLOGY

3.1 Research Design

A **quantitative descriptive-correlational design** supplemented with **structural equation modeling** was adopted to validate the proposed relationships.

3.2 Population and Sample

The population comprised Class IX students from government and private secondary schools in Bhopal district. Using stratified random sampling, **480 students (240 male, 240 female)** were selected.

3.3 Instruments

1. **ICT Competence Scale (ICT-CS):** 30 items across three dimensions – operational skills, cognitive understanding, and problem-solving. Reliability $\alpha = 0.90$.
2. **VARK Learning Style Inventory (Fleming, 2001):** 40 items; $\alpha = 0.84$.
3. **Academic Achievement Index (AAI):** Composite score from school records standardized to 100-point scale.

3.4 Data Collection and Analysis

Data were analyzed using SPSS and AMOS v28. Analytical techniques included descriptive statistics, Pearson correlation, multiple regression, and SEM (path analysis).

IV. RESULTS

4.1 Descriptive Statistics

Variable	N	Mean	SD	Interpretation
ICT Competence	480	4.18	0.52	High
Learning-Style Compatibility	480	3.97	0.61	Moderate–High
Academic Achievement	480	78.34	8.92	Above Average

4.2 Correlation Matrix

Variables	ICT Competence	Learning-Style Compatibility	Achievement
ICT Competence	1	0.62**	0.68**
Learning-Style Compatibility	0.62**	1	0.59**
Academic Achievement	0.68**	0.59**	1

Note:p < 0.01. Strong positive correlations between all variables; rejecting $\mathbf{H_{01}}$.

4.3 Multiple Regression Analysis

Predictor	β	t	Sig.	R	R^2	F	Sig.
Constant	21.84	4.76	0.000	0.755	0.570	105.31	0.000
ICT Competence	0.52	9.68	0.000				
Learning-Style Compatibility	0.41	8.02	0.000				

ICT competence and learning-style compatibility together explain **57% variance** in academic achievement; rejecting $\mathbf{H_{02}}$.

4.4 Structural Equation Modeling (SEM) Results

Model Fit Indices

Fit Index	Obtained Value	Acceptable Threshold	Interpretation
χ^2/df	1.92	< 3.0	Excellent
GFI	0.94	≥ 0.90	Good
CFI	0.96	≥ 0.95	Excellent
RMSEA	0.045	≤ 0.08	Excellent

Model fits data well, confirming the adequacy of the ILSA model.

Path Coefficients (Standardized Estimates):

Path	β	p-value	Interpretation
ICT Competence → Achievement	0.52	0.000	Direct, significant
ICT Competence → Learning Style Compatibility	0.63	0.000	Strong positive link
Learning Style Compatibility → Achievement	0.27	0.001	Mediating path

Indirect effect = 0.63 × 0.27 = **0.17**
Total effect (direct + indirect) = **0.69**

Thus, learning-style compatibility **partially mediates** the relationship between ICT competence and academic achievement; rejecting $\mathbf{H_{03}}$.

4.5 Mediation Analysis (Bootstrapping Test)

Effect Type	Estimate	SE	95% CI	Result
Direct Effect (ICT → Achievement)	0.52	0.07	0.41–0.63	Significant
Indirect Effect (ICT → LS → Achievement)	0.17	0.05	0.09–0.26	Significant

Partial mediation confirmed.

V. DISCUSSION

This study validates the theoretical assumption that **ICT competence enhances academic achievement both directly and indirectly through learning-style compatibility**. The significant correlation between ICT competence and achievement (r = 0.68) corroborates prior studies by **Tondeur et al. (2018)** and **Knezek & Christensen (2016)**, affirming that digital fluency underpins modern academic success.

The SEM findings demonstrate that learning-style compatibility mediates the ICT–achievement relationship, indicating that the benefits of ICT are maximized when instruction aligns with individual cognitive preferences. This aligns with **Mayer's (2003)***Cognitive Theory of Multimedia Learning*, which emphasizes that dual-channel processing (visual + auditory) optimizes understanding.

The model fit indices (GFI = 0.94, CFI = 0.96, RMSEA = 0.045) confirm the robustness of the ILSA Model, illustrating strong construct validity. The indirect path coefficient ($\beta = 0.17$) further substantiates the mediating role of learning styles. Similar mediation patterns were observed by **Graf et al. (2009)** and **Yilmaz (2017)** in studies on adaptive e-learning.

In the Indian context, this study expands empirical understanding of how ICT competence interacts with individual learning diversity. The findings imply that **digital literacy programs must go beyond skill training** to integrate pedagogical adaptation strategies.

VI. CONCLUSION AND RECOMMENDATIONS

6.1 Key Findings

1. ICT competence and learning-style compatibility significantly correlate with academic achievement.
2. ICT competence directly influences achievement ($\beta = 0.52$).
3. Learning-style compatibility partially mediates this relationship (indirect $\beta = 0.17$).
4. The proposed ILSA Model demonstrates excellent fit and predictive validity.
5. ICT competence and learning-style adaptability explain **57% of achievement variance**.

6.2 Educational Implications

- **Teacher Training:** Incorporate modules on learning-style diagnostics and ICT-based differentiation.
- **Curriculum Development:** Embed multimodal ICT content addressing diverse cognitive preferences.
- **Student Development:** Promote reflective learning by helping students identify their learning strengths.
- **Policy Integration:** NEP 2020 frameworks should emphasize both technological and cognitive adaptability in school curricula.

6.3 Theoretical Contribution

The **ICT–Learning Style Achievement (ILSA) Model** provides a validated structural framework linking digital competence, cognitive alignment, and performance, extending the **Technology Acceptance and Learning Theories** into the school education context.

6.4 Limitations and Future Research

- The study's geographic scope was limited to one district; replication is needed across regions.
- Only three latent variables were analyzed; future studies could include motivation or teacher support.
- Longitudinal research may reveal dynamic changes in ICT competence and its effects on learning trajectories.

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