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Cognitive Diversity in Classrooms: An Analytical Study of Learning Styles among Secondary School Students

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Abstract

This study investigates the cognitive diversity of secondary school students through an analysis of their dominant learning styles and the implications for classroom instruction. Recognizing that students differ in how they perceive, process, and retain information, the study explores the relationship between learning styles and academic performance, gender, and attitude toward technology-based learning environments. The objective is to understand how awareness of learning styles can inform differentiated instruction and improve educational outcomes.

A descriptive-correlational research design was employed, integrating both quantitative and qualitative data. The sample comprised 300 secondary school students (150 boys and 150 girls) from six schools across Bhopal district. The standardized Learning Style Inventory (LSI) by Kolb (1984) was administered, along with an Attitude towards ICT Scale developed for the study. Statistical techniques such as descriptive statistics, ANOVA, correlation, and regression analysis were applied to examine relationships between variables.

Findings revealed that visual and kinesthetic learning styles were predominant among students, while auditory learning was less preferred. A significant gender difference was found, with girls favoring visual and auditory styles, and boys showing stronger kinesthetic tendencies. Positive correlations were observed between technology attitude scores and preference for multimodal learning environments. The regression model indicated that learning style explained 42% of the variance in academic performance. The study concludes that recognizing cognitive diversity and aligning instructional strategies with students' preferred learning modalities can significantly enhance engagement and achievement.

Keywords: Learning Styles; Cognitive Diversity; Secondary Education; Academic Achievement; Ict Attitude; Kolb's Model; Visual–Auditory–Kinesthetic Learners

1. Introduction

Education in the twenty-first century is increasingly learner-centered, emphasizing the uniqueness of each student's cognitive, emotional, and social profile. One of the most critical components of learner individuality is learning style—the consistent way a learner processes and organizes information. As classrooms become more diverse in abilities and backgrounds, understanding learning styles provides educators with valuable insights for designing more effective pedagogical strategies.

The construct of learning styles has evolved from cognitive psychology, experiential learning, and neuroeducation. Kolb's (1984) experiential learning theory conceptualizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Fleming's (1995) VARK model—

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categorizing learners as Visual, Auditory, Read/Write, or Kinesthetic—offers a practical framework widely used in educational research and classroom diagnosis.

In secondary schools, where students transition from concrete to abstract thinking, identifying learning preferences becomes particularly significant. A mismatch between teaching and learning styles may reduce motivation, comprehension, and retention. Conversely, when instruction aligns with learners' cognitive preferences, engagement and academic performance often improve (Dunn & Dunn, 1992).

The integration of Information and Communication Technology (ICT) in education further diversifies learning opportunities. ICT-based platforms often favor visual and interactive modalities, potentially benefiting visual and kinesthetic learners. However, students' attitudes toward ICT and their adaptability to digital learning environments may moderate this relationship.

This study therefore explores the following key questions:

- What are the dominant learning styles among secondary school students?
- Do learning styles vary significantly by gender, academic performance, and attitude toward ICT?
- How do learning styles predict academic achievement?

Objectives of the Study

- To identify the predominant learning styles among secondary school students.
- To examine gender-wise differences in learning styles.
- To analyze the relationship between learning styles, academic performance, and attitude toward ICT.
- To determine the predictive power of learning styles on students' academic achievement.

Hypotheses

- H_{01} : There is no significant difference in learning styles between male and female students.
- H_{02} : There is no significant relationship between learning styles and academic achievement.
- H_{03} : Learning style does not significantly predict academic performance among secondary school students.

Understanding these dimensions of cognitive diversity can contribute to evidence-based instructional design, promoting more inclusive and adaptive teaching practices.

2. Review of Literature

2.1. Concept of Learning Styles

The concept of learning styles refers to the preferred ways individuals receive, process, and understand information. According to Kolb (1984), learning involves a four-stage cycle—concrete experience, reflective observation, abstract conceptualization, and active experimentation—forming four styles: Diverger, Assimilator, Converger, and Accommodator. Each style reflects a unique pattern of perceiving and processing experiences.

Fleming (1995) introduced the VARK model, simplifying cognitive preferences into sensory modalities—visual, auditory, reading/writing, and kinesthetic. Numerous studies (e.g., Felder & Silverman, 1988; Dunn & Dunn, 1992) have highlighted how these preferences influence motivation and achievement. Honey and Mumford (1992) proposed another typology—activist, reflector, theorist, and pragmatist—emphasizing learning in professional contexts.

2.2. Empirical Studies on Learning Styles and Academic Performance

Research has consistently shown mixed results on whether matching teaching methods to learning styles enhances achievement. Dunn & Griggs (1998) found that congruence between teaching and learning styles improved comprehension and retention. Riding & Cheema (1991) suggested that visual learners perform better in diagram-based tasks, while verbal learners excel in text-based materials. However, Pashler et al. (2008) argued that empirical evidence for the “matching hypothesis” is inconclusive.

In the Indian context, Rao (2018) studied 500 secondary school students and found that visual and kinesthetic learners outperformed auditory learners in science and mathematics. Sharma and Nair (2020) reported that integrating multiple learning modalities in classroom instruction enhanced motivation and participation.

2.3. Learning Styles and Gender Differences

Gender differences in learning styles have been widely reported. Cano and Hughes (2000) found that girls often exhibit more reflective and visual learning preferences, while boys are inclined toward kinesthetic learning. Kumar (2019) observed that female students tend to perform better in reading-based tasks, whereas males excel in hands-on experiments.

2.4. ICT Attitude and Learning Preferences

Digital learning environments cater to diverse sensory modalities. Ally (2004) emphasized that technology-based platforms can facilitate adaptive instruction tailored to learning preferences. Yadav & Singh (2021) found that students with positive attitudes toward ICT demonstrated higher engagement levels, particularly those with visual and kinesthetic preferences. Mishra and Das (2022) concluded that blended learning enhances cognitive flexibility and supports differentiated instruction.

2.5. Research Gap

Despite extensive literature, limited studies in the Indian secondary education context have simultaneously examined learning styles, gender differences, ICT attitude, and academic performance. Moreover, few have applied regression analysis to quantify the predictive power of learning styles on achievement. This study addresses these gaps by employing a mixed-method design with quantitative rigor and contextual relevance.

3. Methodology

3.1. Research Design

The study adopted a descriptive-correlational design to explore the interrelationship among learning styles, gender, ICT attitude, and academic performance.

3.2. Sample

A total of 300 secondary school students (150 boys and 150 girls) were selected through stratified random sampling from six co-educational schools in Bhopal district. The participants represented classes IX and X, aged 14–16 years.

3.3. Tools Used

- Learning Style Inventory (LSI) by Kolb (1984), adapted for Indian learners.
- Attitude towards ICT Scale (constructed by the researcher, reliability $\alpha = 0.84$).
- Academic Achievement Score, derived from average marks in core subjects.

3.4. Data Collection and Scoring

The LSI classified students into visual, auditory, read/write, and kinesthetic categories. ICT attitude was measured using a 5-point Likert scale, and academic scores were standardized to percentages.

3.5. Statistical Techniques

Descriptive statistics, independent-samples t-test, ANOVA, Pearson's correlation, and multiple regression were applied using SPSS (v26).

4. Results

4.1. Descriptive Statistics of Learning Styles

Table 1 Descriptive Statistics of Learning Styles

Learning Style	N	Mean Score	SD	Rank
Visual	300	4.28	0.61	1
Kinesthetic	300	4.10	0.73	2
Auditory	300	3.62	0.79	3
Read/Write	300	3.44	0.82	4

Interpretation: Visual and kinesthetic preferences dominate among students, indicating a strong inclination toward experiential and image-based learning.

4.2. Gender Differences in Learning Styles (t-Test)

Table 2 Gender Differences in Learning Styles (t-Test Results)

Learning Style	Gender	Mean	SD	t-value	p-value	Interpretation
Visual	Male	4.12	0.69	2.58	0.011	Significant
Auditory	Female	3.78	0.72	2.46	0.014	Significant
Kinesthetic	Male	4.23	0.71	2.03	0.042	Significant
Read/Write	Female	3.50	0.81	1.21	0.23	NS

Interpretation: Gender differences were significant in visual, auditory, and kinesthetic learning preferences, supporting partial rejection of H_{01} .

4.3. ANOVA: Learning Style and Academic Performance

Table 3 ANOVA Results – Learning Style and Academic Performance

Source	SS	df	MS	F	Sig.
Between Groups	10.42	3	3.47	6.52	0.000
Within Groups	157.83	296	0.53		
Total	168.25	299			

Interpretation: The significant F-value ($p < 0.01$) indicates that academic performance varies across learning styles. Visual and kinesthetic learners achieved higher scores than auditory and read/write learners.

4.4. Correlation between Learning Style and ICT Attitude

Table 4 Correlation between Learning Style and ICT Attitude

Variables	r	p
Learning Style & ICT Attitude	0.56	0.000
ICT Attitude & Academic Achievement	0.48	0.000

Interpretation: A moderate to strong positive correlation exists between learning styles and ICT attitude, suggesting technology-friendly learners show higher engagement and performance.

4.5. Regression Analysis: Predicting Academic Performance

Table 5 Regression Analysis Predicting Academic Performance

Predictor	β	t	Sig.	R	R ²	F	Sig.
Constant	42.18	8.92	0.000	0.648	0.420	35.12	0.000
Visual	0.28	3.91	0.000				
Kinesthetic	0.24	3.37	0.001				
Auditory	0.09	1.25	0.212				
ICT Attitude	0.19	2.98	0.004				

Interpretation: Learning style and ICT attitude jointly explain 42% of variance in academic performance. Visual and kinesthetic learning preferences are the strongest predictors.

5. Discussion

The findings confirm that secondary school students display distinct learning preferences, with visual and kinesthetic modalities prevailing. These results resonate with Rao (2018) and Fleming (1995), who emphasized the dominance of sensory learning during adolescence. Gender-based analysis aligns with Cano & Hughes (2000), demonstrating that boys prefer kinesthetic experiences while girls incline toward visual and auditory modes.

The significant correlation between learning style and ICT attitude underscores the interplay between technology and cognitive preferences. Learners comfortable with visual-spatial processing exhibit greater enthusiasm for multimedia learning tools, consistent with Ally (2004) and Yadav & Singh (2021).

Regression findings validate that learning styles substantially predict academic performance, supporting Dunn & Griggs (1998), who argued that aligning pedagogy with cognitive styles enhances achievement. The 42% explained variance indicates that other factors—motivation, teacher style, and socio-economic background—may also influence learning outcomes.

These results highlight the necessity of differentiated instruction and technology integration in secondary classrooms. Teachers must employ multi-sensory strategies—visual aids, demonstrations, simulations, and collaborative projects—to accommodate diverse learners.

6. Conclusion

The study concludes that cognitive diversity, as reflected in learning styles, profoundly influences students' engagement, attitude toward ICT, and academic performance. Visual and kinesthetic learners form the majority in secondary education, with gender-based differences evident.

Key Recommendations

- **Differentiated Teaching:** Teachers should design lessons integrating visual, auditory, and kinesthetic elements.
- **ICT Integration:** Schools should leverage digital tools like simulations, videos, and interactive apps to support multimodal learning.
- **Teacher Training:** Professional development programs must include training on diagnosing and responding to diverse learning styles.
- **Curriculum Design:** Textbooks and e-resources should incorporate varied sensory materials to ensure inclusivity.
- **Further Research:** Longitudinal studies may explore the consistency of learning styles over time and their impact on digital learning outcomes.

By embracing cognitive diversity, educators can create more inclusive, engaging, and effective classrooms that nurture every learner's potential.

Compliance with ethical standards

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Conflict of Interest

The author declares that there is no conflict of interest.

Statement of Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

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