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Ict-Integrated Blended Teaching and Pedagogical Effectiveness at The Senior Secondary Level: Evidence from Geography Classrooms

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Abstract

Blended teaching brings together face-to-face classroom interaction and technology-supported learning activities. Its empirical chapter, however, reports observations and test results for senior-secondary Geography Post Graduate Teachers (PGTs) rather than a controlled student-achievement experiment. This paper therefore examines the technology-supported and blended dimensions that are actually documented and relates them to observed classroom pedagogy.

The reported study covered 40 senior-secondary schools in Delhi-NCR, including 20 government and 20 private schools, and a teacher sample of 60 Geography PGTs, with 30 from each sector. Two principal instruments were used: The Test on Understanding of the Nature of Geography (TOUNG) and the Observation Schedule Adopted for Classroom Teaching Strategies (OSACTS). The reported findings show that ICT integration was present but uneven. LCD projectors were the most frequently reported ICT resource, while multimedia/mobile phones, laptops, computer-aided instruction and OHPs were used by smaller proportions of teachers. Classroom observations also indicated generally effective pedagogy, but weaker performance in ICT integration and in the use of geography-specific teaching-learning resources.

The paper argues that blended teaching should not be understood as technology display alone. Its educational value depends on purposeful alignment among content, pedagogy, learner needs and appropriate digital or physical resources. The evidence supports a gradual movement from predominantly textbook-led instruction toward more varied, interactive and resource-supported teaching, while also showing the need for teacher preparation and institutional support.

Keywords: Blended teaching, ICT integration, Geography education, pedagogical effectiveness, senior secondary teachers, teaching-learning materials, teacher education

1. Introduction

Educational practice is changing as communication technologies, digital resources and networked learning environments become increasingly available. This describes this change as a movement away from a predominantly teacher-directed classroom toward more flexible, interactive and learner-centred learning. Traditional instruction retains important strengths, especially direct teacher presence and social interaction, while online and technology-enhanced learning provides flexibility, varied resources and opportunities for independent learning. Blended teaching is presented as a way of combining these strengths rather than

treating the two approaches as mutually exclusive.

In the, blended learning is described as an integration of face-to-face instruction and online or technology-enhanced learning. The approach can include discussion, demonstration, projects, case studies, web resources, learning platforms and digital communication. Its value is linked to the way technology is connected with subject content and instructional purpose. This explicitly cautions against using technology merely to demonstrate technical competence; the technology should contribute to understanding the lesson.

For teacher education, this distinction is important. Teachers

need subject knowledge, pedagogical knowledge and the ability to select and use suitable technological resources. This repeatedly connects technology integration with changes in the teacher's role, from information provider toward facilitator, guide and learning designer. Learners similarly receive greater scope for self-direction, interaction and independent study when blended environments are appropriately designed.

This paper focuses on the documented classroom evidence in the reports. It does not reinterpret the reported data as a randomized test of blended learning or as a direct measure of student academic achievement. Instead, it examines the extent to which the observed teaching practices reflect the blended-learning principles described in the reports.

Geography provides a useful context for examining technology-supported pedagogy because the subject depends on spatial representation, maps, visual information, field observation, real-life examples and interpretation of relationships between people and environments. The reports note that geography teaching can benefit from maps, globes, atlases, charts and digital tools. When these resources are connected to geographical phenomena and learners' experiences, they can support conceptual understanding rather than simple memorisation.

The empirical findings reveal a mixed pattern. The reported classroom observations indicate that 58.33% of teachers introduced lessons effectively and 25.00% did so most efficiently. Yet the specific modes used to begin lessons show that 36.66% started by reading the textbook, while 30.00% connected concepts with real-life events and 16.66% explained content through geographical phenomena. Only 16.66% of teachers began through direct map use or display of a topic-relevant map. These figures suggest that technology and visual resources had not replaced conventional entry points into lessons.

The ICT findings reinforces this interpretation. LCD projectors were reported by 36.66% of teachers, multimedia/mobile phones by 26.66%, laptops by 16.66%, computer-aided instruction by 13.33%, and OHPs by 6.66%. These data demonstrate availability and use, but they do not by themselves establish that technology improved student achievement. The more defensible interpretation is that teachers were adopting selected technologies within an otherwise varied pedagogical environment.

Accordingly, the central issue is not whether technology is present, but whether it is pedagogically integrated. A blended classroom becomes meaningful when technology, face-to-face explanation, subject-specific resources, interaction, assessment and learner activity work together.

2. Review of Literature

This review blended learning as an approach that combines conventional teaching with online or technology-enhanced learning. It cites work describing blended learning as an integrated use of different delivery media, learning activities and instructional strategies. The literature discussed in the generally treats blended learning as a flexible design rather than a single teaching method. Different models may include face-to-face driver, rotation, flex, online lab, self-blend and online driver arrangements.

Research cited in the also addresses learner outcomes and perceptions. Nazarenko's 2015 ^[1] case study is presented as

a comparison of blended and traditional learning. Eryilmaz's 2015 ^[7] work examined the effectiveness of blended learning environments. Kintu, Zhu and Kagambe (2017) ^[10] considered relationships among student characteristics, design features and outcomes. Other studies in the examiner teachers' perceptions, attitudes, professional development and the application of blended learning in language and teacher-education contexts.

A consistent theme is that blended learning is most effective when instructional design is intentional. This refers to the need to select technologies according to the content and requirements of a learning task. This shifts attention from the novelty of a device to the quality of the learning activity. Discussion, brainstorming, project work, demonstrations and collaborative tasks can be combined with online resources to encourage active participation.

The literature therefore supports a broad understanding of blended teaching: it is a pedagogical arrangement in which physical and digital modes are coordinated. The approach can support learner autonomy and engagement, but its success depends on teacher competence, access to resources, course design, feedback and the fit between technology and subject matter.

This also connects blended teaching with learning theories. Behaviorism emphasizes observable changes in behaviour, cognitivism focuses on mental processes and changes in knowledge, and constructivism treats learning as the active construction of meaning through experience and interaction. Blended learning can draw from more than one of these perspectives because it is a delivery and design approach rather than a single learning theory.

From a constructivist perspective, discussion boards, collaborative activities, problem-solving tasks and project work can provide opportunities for learners to connect new information with previous knowledge. From a cognitivist perspective, multimedia explanations, structured resources and feedback may support information processing. From a behaviourist perspective, practice activities and immediate feedback can reinforce learning. This uses these theoretical positions to explain why a combination of methods can be more adaptable than reliance on a single instructional mode. The literature on technology-assisted teaching also stresses the role of teachers. These cites work by Beetham and Sharpe, Garrison and Vaughan, Graham, Sharma and others to describe digital pedagogy as a redesign of teaching practice rather than a simple substitution of devices for textbooks. Teacher educators therefore need opportunities to develop technological confidence together with pedagogical judgment.

In Geography, this means that digital maps, projectors, mobile resources or computer-based activities should be connected to geographical concepts, spatial reasoning and real-world interpretation. Technology can extend the range of representations available to learners, but the teacher remains responsible for selecting appropriate examples, asking meaningful questions and supporting interpretation.

The literature in the also identifies challenges. Unequal access to devices and connectivity can limit participation. Teachers may use technology superficially when they have not received sufficient professional development. Overemphasis on technology may also reduce attention to subject content or face-to-face social interaction. These

issues are particularly relevant in school contexts where resources vary across institutions.

The empirical material of the adds an important classroom perspective to the literature. While blended learning literature often reports perceptions, satisfaction or learning outcomes, the present also records observable pedagogical practices. The OSACTS covers lesson introduction, pedagogy, geography-specific teaching-learning materials, skills and strategies, teacher-student relationship and interaction, classroom diversity, assessment and classroom management. This makes the study useful for understanding the practical conditions under which technology-supported and blended teaching can operate.

The literature review therefore leads to three broad propositions for this paper. First, blended teaching should integrate, rather than merely juxtapose, face-to-face and technology-supported activities. Second, subject-specific pedagogy remains central even when digital resources are used. Third, institutional support and teacher professional development are necessary for sustained implementation. These propositions guide the interpretation of the findings without converting them into unsupported causal claims. The empirical data can show patterns of teacher practice and ICT use; they cannot, on their own, establish that blended teaching caused changes in student academic achievement.

3. Objectives

The paper uses three objectives derived from the themes and empirical material. They are deliberately limited to three, as requested, and are framed so that each can be examined from the available source data.

1. To examine the extent and pattern of ICT integration and resource-supported teaching practices among senior-secondary Geography teachers.
2. To analyse the reported effectiveness of classroom pedagogy, including lesson introduction, geography-specific methods, teaching-learning materials, interaction, assessment and classroom management.
3. To interpret the relationship between teachers' understanding of the nature of Geography and their observed pedagogical practices within the blended and technology-supported teaching context.

4. Research Methodology

The source describes a descriptive and inferential research design. The study area was Delhi-NCR. The population consisted of Post Graduate Teachers teaching Geography in government and private schools in the region. The reported school sample comprised 40 senior-secondary schools, divided equally between 20 government and 20 private schools. The reported teacher sample comprised 60 Geography PGTs, with 30 teachers from government schools and 30 from private schools.

The sampling and data-collection process involved obtaining consent from school principals, visiting selected schools, administering the test and conducting classroom observations. The reports that two observers assessed classroom teaching using a three-point rating scale. One observer was the researcher and the other was an experienced, qualified observer who had been oriented to the schedule before data collection.

Two principal instruments were used. The first was the Test

on Understanding of the Nature of Geography (TOUNG), a 55-item multiple-choice test. Each correct answer received one mark, producing a maximum possible score of 55. This reports a split-half reliability coefficient of 0.83 for the test. The second instrument was the Observation Schedule Adopted for Classroom Teaching Strategies (OSACTS), designed to capture classroom practices across eight dimensions. Its reported inter-observer reliability coefficient was 0.81.

The TOUNG instrument covered several dimensions of understanding the nature of Geography, including its dual nature as science and arts, geographical facts/laws/theories, the variety of approaches to studying Geography, characteristics of geographers, location-based attitudes, geographical approaches, and geographical societies and geo-literacy. The source reports a mean score of 25.22, a standard deviation of 3.88 and a mean percentage of 49.71% for the 55-item test.

OSACTS examined eight broad areas: lesson introduction; pedagogy employed; geography-specific teaching-learning materials; Geography skills and strategies; teacher-student relationship and interaction; management of classroom diversity; assessment; and classroom management. Each area was observed and rated using the schedule described in the methodology chapter.

Data were entered and analysed using SPSS as reported. The statistical methods included frequencies, percentages, mean, standard deviation and chi-square. The reports states that mean and standard deviation were used to determine the level of understanding of the nature of Geography, percentages were used to describe teaching strategies, and chi-square was used to examine the association between understanding and pedagogical practices.

The methodology is appropriate for describing patterns in teacher knowledge and classroom behaviour. However, the design is not sufficient to establish a causal effect of blended teaching on student achievement. The present paper therefore treats the findings as descriptive evidence of technology-supported and pedagogical practice.

5. Limitation of Research work (Research Gap)

The first limitation concerns the mismatch between the broad title and the empirical evidence in the reports. The title refers to the effectiveness of blended teaching on academic achievement and technological pedagogical dimensions, whereas the detailed empirical chapter reports Geography PGTs' understanding of the nature of Geography and their classroom practices. Student academic achievement is discussed conceptually, but a direct controlled comparison of student achievement under blended and conventional teaching is not reported in the empirical tables used here.

Second, the geographical scope is restricted to Delhi-NCR. Broader studies across different states and socio-cultural settings. Consequently, the reported percentages should be interpreted as findings for the selected sample rather than as estimates for all Geography teachers in India.

Third, the sample size is relatively limited, and the reported tables primarily describe 60 teachers. Some narrative passages in refer to 80 teachers, creating an internal inconsistency. This paper uses the 60-teacher figures presented consistently across the principal descriptive tables

and states that choice explicitly rather than silently reconciling the discrepancy.

Fourth, classroom observations capture teaching practice at particular points in time. They cannot fully represent every lesson a teacher conduct. Fifth, ICT-use percentages indicate reported use of particular technologies, but they do not measure quality, duration, frequency, connectivity or learning impact. These limitations identify a research gap for future experimental or longitudinal studies that directly compare blended and conventional instruction using student-level achievement, engagement and retention measures.

6. Results and Discussion

The first major result concerns teachers' understanding of the nature of Geography. The 55-item TOUNG produced a mean of 25.22, a standard deviation of 3.88 and a mean percentage of 49.71%. The source table classifies 63% of teachers in the average category, 17% in the exceptional category and 20% in the low category. The findings indicate that a substantial majority had an intermediate level of conceptual understanding, while a smaller group showed stronger understanding and one-fifth showed weaker understanding.

The dimension-level results show variation. The highest mean percentage was reported for the dimension concerning the variety of ways in which Geography can be studied (53.18%), followed by geographical facts, laws and theories (52.45%), characteristics and personalities of geographers (51.44%), Geography's dual nature (50.36%), and location-based attitudes (50.33%). The lowest reported percentages were for geographical approaches (43.07%) and geographical societies and geo-literacy (45.00%).

These findings matter for blended teaching because technology cannot compensate automatically for gaps in subject understanding. A digital map, presentation or video becomes educationally useful only when the teacher can connect it with geographical concepts and guide learners in interpreting it. Stronger subject understanding can therefore provide a foundation for more purposeful technology integration.

Table 1: Show the TOUNG indicator Reported value

TOUNG indicator	Reported value
Number of items	55
Mean	25.22
Standard deviation	3.88
Mean percentage	49.71%
Average category	63%
Exceptional category	17%
Low category	20%

The classroom data show that teachers used a range of instructional approaches, but conventional practices remained visible. For lesson introduction, 36.66% began by reading the book, 30.00% connected concepts with real-life events, 16.66% explained the content in relation to geographical phenomena, 10.00% displayed a relevant map and 6.66% used a map directly. This pattern suggests that contextual and visual approaches were present but were not yet the dominant starting point.

For general teaching methods, discussion was used by

33.33% of teachers and discussion-cum-demonstration by 28.33%. Lecture-cum-demonstration accounted for 16.66%, project work 13.33% and lecture alone 8.33%. Geography-specific methods included map use at 36.66%, direction/scale/symbols at 21.66%, regional methods at 16.66%, field visit and surveying at 10.00%, observational methods at 8.33% and excursions at 6.66%. No teacher in the reported table used laboratory methods.

The findings are consistent with the blended-learning principle that multiple instructional modes can be combined. Discussion, demonstration, projects and map-based activities can be supported by digital resources without eliminating direct teacher guidance. The issue is therefore one of purposeful combination: technology can extend a lesson, but the teacher must retain responsibility for structuring learning.

Table 2: General method, Teachers and Percentage

General method	Teachers	Percentage
Lecture	5	8.33%
Lecture-cum-demonstration	10	16.66%
Discussion	20	33.33%
Discussion-cum-demonstration	17	28.33%
Project	8	13.33%

The ICT results provide the clearest empirical picture of technology integration. LCD projectors were the most frequently reported ICT resource, used by 36.66% of teachers. Multimedia/mobile phones were reported by 26.66%, laptops by 16.66%, computer-aided instruction by 13.33% and OHPs by 6.66%. Thus, ICT integration was present, but it was distributed across a relatively small number of tools and was not uniform across teachers.

Teaching-learning materials showed a similar pattern. Globe/map use was reported by 48.33% of teachers, atlases by 23.33%, cut-outs by 15.00%, charts by 8.33% and self-made thematic maps by 5.00%. No teachers reported using toposheets/imageries or aerial photographs in the table. This is significant because Geography is strongly visual and spatial; the limited use of some subject-specific resources may constrain opportunities for richer geographical inquiry.

Observation ratings were somewhat more positive. For overall pedagogy, 46.66% were rated effective and 28.33% most efficient, while 25.00% were rated inefficiently. For ICT integration specifically, 40.00% were rated inefficiently, 36.66% effectively and 23.33% most efficiently. This difference suggests that teachers may be pedagogically competent in general while still requiring support in using ICT in a consistently purposeful manner.

Teacher preparation should therefore emphasize integration rather than device operation. Professional development can focus on designing a sequence in which a digital representation, face-to-face explanation, collaborative discussion and assessment task reinforce one another.

Table 3: Show the ICT resource and Percentage of teachers

ICT resource	Percentage of teachers
LCD projector	36.66%
Multimedia/mobile phones	26.66%
Laptop	16.66%
Computer-aided instruction	13.33%
OHP	6.66%

Other OSACTS dimensions provide evidence about the broader pedagogical environment in which blended teaching occurs. Teacher-student relationship and interaction were rated effective for 55.00% of teachers and most efficient for 26.66%, while 18.33% were rated inefficiently. Assessment was rated effective for 70.00%, most efficient for 18.33% and inefficient for 11.66%. Classroom management was rated effective for 50.00%, most efficient for 16.66% and inefficient for 33.33%. Management of classroom diversity was rated effective for 46.66%, most efficient for 25.00% and inefficient for 28.33%.

These findings show that technology-supported teaching operates within a larger pedagogical system. A projector or mobile phone cannot substitute for classroom relationships, assessment, communication and management. Blended teaching therefore requires balanced professional competence: content knowledge, pedagogical strategy, resource selection, digital literacy, interaction and assessment.

This reports a chi-square value of 8.90 at the stated significance level, exceeding the cited critical value. The interpretation provided in the source is that teachers' understanding of the nature of Geography and their pedagogical practices are associated. The practical implication is that subject understanding and classroom method should be developed together.

The evidence should still be interpreted cautiously. Association does not establish that stronger subject understanding causes better pedagogy, nor does it establish that blended teaching causes higher student achievement. What the findings support is a relationship between teacher knowledge and observed pedagogical practice, alongside evidence of uneven ICT integration.

7. Conclusions

The evidence indicates that senior-secondary Geography teachers used a combination of conventional, interactive, subject-specific and ICT-supported methods. The pattern was neither wholly traditional nor fully digital. Discussion, demonstration, projects and map-based teaching coexisted with textbook use, while ICT tools such as LCD projectors, multimedia/mobile phones and laptops were used by portions of the sample.

A central conclusion is that the presence of technology should not be treated as equivalent to effective blended teaching. The strongest evidence of effective practice came from the broader OSACTS dimensions, while ICT integration itself received a more mixed assessment. This distinction is important for teacher education: professional development should move beyond technical training toward instructional design, content-specific technology use and reflective practice.

The reported association between understanding of the nature of Geography and pedagogical practice further supports integrated teacher preparation. Teachers need conceptual clarity about the subject as well as practical strategies for presenting it through maps, real-world examples, discussion, demonstration and digital resources.

Finally, the paper does not claim that establishes a causal effect of blended teaching on student academic achievement. A future empirical study should directly measure student achievement and compare instructional

conditions. The present findings instead provide a grounded picture of the pedagogical and ICT conditions that may support more effective blended teaching.

8. References

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