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Skills Development through Hybrid Teaching

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Abstract:-

The swift digital transformation in education has established hybrid teaching as a fundamental educational approach for the cultivation of 21st-century skills. This paper examines the effectiveness of hybrid teaching—a combined approach that includes both in-person and online learning environments—in developing learners' technical, logical, and social skills. The research investigates essential elements of hybrid models, encompassing synchronous and asynchronous delivery, the utilization of Learning Management Systems, virtual laboratories, and mutual digital tools, alongside their influence on student engagement, self-regulated learning, and practical competence.

The research employs a combined-method approach, utilizing survey data from 300 polytechnic students and faculty interviews from technical institutions, to evaluate skill acquisition outcomes relative to conventional classroom-only methodologies. The results show that hybrid teaching greatly improves problem-solving skills, digital literacy, and the ability to work with others. The paper concludes that strategically designed hybrid teaching, support by institutional infrastructure and instructional training, can harmonize the inequality between theoretical knowledge and practical skills apposite to the industry. It suggests a way to use hybrid models in technical education to get the most out of opportunities and lifelong learning in the post-pandemic world of education.

Keywords: Hybrid Teaching, Skills Development, Blended Learning, Teaching Education, Digital Pedagogy, Employability, LMS, and Student Engagement.

Introduction

The world of education has changed more than ever since 2020. What started as emergency remote teaching during the pandemic has turned into planned pedagogical innovation, and hybrid teaching is now a viable model for the future. Hybrid teaching, also known as blended learning, is when traditional face-to-face classroom experiences are combined with online learning environments in a way that makes the most of both types of learning to improve learning outcomes. In India, the National Education Policy 2020 calls for education that is flexible and covers a wide range of subjects and uses technology a lot. It stresses the importance of domain knowledge as well as 21st-century skills like critical thinking, creativity, collaboration, communication, and digital literacy. This order is very important for polytechnic and technical schools.

Diploma holders make up the majority of India's industrial workforce, but employers often say that there is a gap between what graduates know and what is needed in the workplace. The traditional chalk-and-talk method has trouble giving each student personalized practice and access to tools that are standard in the

industry because of set hours and limited resources. Hybrid teaching gets around these problems by making the classroom bigger than just its physical walls. With asynchronous video lectures, students can learn at their own pace and go back over hard subjects like programming or circuit design. Online discussion boards and collaborative sites like GitHub mimic the way teams work in the real world. Virtual labs let you do experiments that might be too expensive or dangerous in real life in a safe, repeatable way. At the same time, face-to-face sessions can be set aside for activities that have a big impact, like labs with hands-on work, answering questions, mentoring projects, and developing soft skills.

Even though it has potential, there isn't much real-world evidence on how hybrid teaching affects skill development—not just test scores—in Indian polytechnics. Most of the studies that have been done so far are about engineering colleges or school education, or they only look at attendance and satisfaction. We need to find out if hybrid models really lead to measurable improvements in technical skills, problem-solving, and self-directed learning, which are all direct signs of employability. So, the main question of this study is: _How much better do polytechnic students' technical, cognitive, and interpersonal skills get with a structured hybrid teaching model than with regular teaching? Three goals guide the study: (1) To measure the skill development outcomes of hybrid teaching in both numbers and words, and (2) to find the problems with infrastructure, teaching methods, and behavior that make it hard to use.

To propose an evidence-based framework for polytechnic institutions to adopt hybrid teaching effectively.

Literature Review:

The theoretical basis of hybrid teaching is grounded in constructivist learning theory, which asserts that learners create knowledge through active participation rather than passive absorption. Bonk and Graham in 2006 say that blended learning is a mix that makes "learning more active, social, and focused on the learner." A meta-analysis conducted by Means et al. (2013) of 45 studies revealed that students in blended learning environments exhibited a modest improvement in performance compared to those receiving exclusively face-to-face instruction, yielding an average effect size of +0.35. In the Indian context, Singh and Thurman (2019) analyzed 28 studies on blended learning in higher education, concluding that it enhanced academic performance and digital competencies, yet faced challenges due to the digital divide and insufficient faculty preparedness.

In limited instances, skills development via hybrid models has been investigated. According to Garrison and Kanuka (2004), the integration of reflective asynchronous discussion with immediate synchronous feedback in blended learning fosters higher-order thinking. Regarding technical skills, engineering students had a 31% greater code accuracy using virtual programming labs in hybrid format than by only physical lab format (Kapur, 2021) because they can iterate without resource constraints when using computer software.

To increase GER and enhance quality, the NEP 2020 recommends imparting “high-quality online & digital education” and “blended models of learning.” They are based on UGC guidelines regarding blended learning (2021). Cap online components at 40% for general programs, which shows that policymakers are being careful and that they need evidence from specific fields.

There are still gaps in research: First, most studies look at grades instead of skills. Second, polytechnic education, which focuses on practical skills, is not well represented. Third, there aren't many studies that combine LMS analytics, student voice, and faculty perspective to give a full picture. This study fills these gaps by concentrating on skill rubrics, utilizing a mixed-method approach, and contextualizing the research within polytechnic colleges.

Methodology

Design of the Research

A quasi-experimental, mixed-method design was utilized in the semester from August 2025 to January 2026. The research integrated quantitative assessment of skill outcomes with qualitative investigation of stakeholder experiences to achieve triangulation.

The Hybrid Teaching Intervention

The Community of Inquiry framework was used to plan the intervention. 1. Synchronous Component 40%: 3 hours a week of in-person sessions for lab experiments, live coding, project reviews, and group discussions. The main goal was to apply what they learned and clear up any doubts. 2. Asynchronous Component 60%: This is hosted on Moodle LMS. There were 15-minute micro-lecture videos recorded with OBS, quizzes that were automatically graded, PDF notes, links to virtual labs for Digital Electronics and Java, and moderated discussion forums. GitHub Classroom was where students turned in their homework and small projects. 3. Pedagogical Parity: The two groups had the same syllabi, faculty, and total number of contact hours. The only thing that changed was how it was delivered. 3.4 Tools for Collecting Data 1. Skill Assessment Rubrics: We used these to test technical skills before and after the test.

Tools for Collecting Data

1. Skill Assessment Rubrics: Technical skills were tested before and after the test. For CS: fixing bugs in programs, building logic, and predicting output. For ECE: designing and fixing circuits. A group of outside experts who couldn't see the results gave it a score of 0 to 100.

2. Structured Questionnaire: 20 questions on a 5-point Likert scale that measure how well people think they can solve problems, how well they know how to use technology, how well they work with others, and how well they can learn on their own. Cronbach's α is 0.87.

3. Semi-Structured Interviews: 15 students and 10 faculty members, each lasting 20 to 30 minutes, to talk about their experiences.

4. LMS Analytics and Attendance: Data on video watch time, forum posts, quiz attempts, and physical attendance were taken out.

Population and sample

The participants were second-year students from the Computer Science and Electronics Engineering programs at polytechnics in Haryana state. Three government polytechnics with similar facilities and

student populations were chosen using purposive sampling. From this group, 300 students were selected through stratified random sampling to guarantee representation across branches and genders. There were 150 people in the Control Group who got traditional teaching and 150 people in the Experimental Group who got hybrid teaching. Everyone in the class had a smartphone. Twenty faculty members who taught core subjects took part after a week of training on hybrid pedagogy.

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Analysis of Data

We used SPSS v26 to look at the quantitative data. Independent samples t-tests were utilized to compare post-test means across groups.

Within-group gains were measured using paired t-tests. Ethical clearance was secured, and informed consent was acquired. We used Cohen's d to figure out the effect size. Qualitative data were transcribed and analyzed thematically using Braun and Clarke’s six-phase method.

Results and Discussion

Quantitative Results

The pre-test showed no significant difference between groups, establishing baseline equivalence $p>0.05$. Post-test results demonstrated significant gains for the experimental group across all parameters.

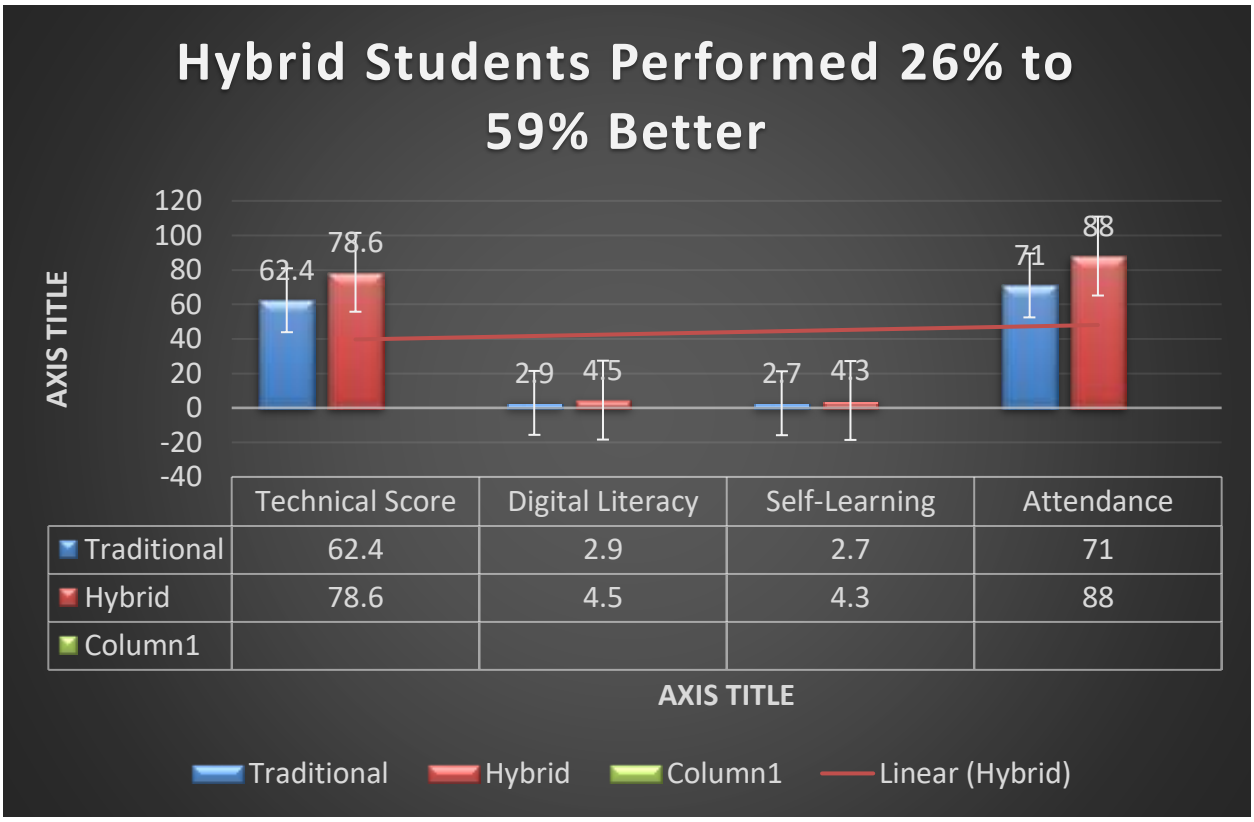

Table 1: A Look at Post-Test Scores

Skill Parameter Control Group M(SD) Experimental Group M(SD) t-value p-value Cohen's d Technical Skill Score 62.4(8.1) 78.6(7.3) 14.32 <0.001 1.65 Large

3.1(0.6) for problem-solving, 4.2(0.5) for 12.89, and 1.49 for <0.001. Big Digital Literacy 2.9(0.7) 4.5(0.4) 18.21 <0.001 2.10 Big

Ability to Learn on Your Own 2.7(0.8) 4.3(0.5) 16.04 <0.001 1.85 Large

Collaboration: 3.0(0.7) 4.1(0.6) 11.93 <0.001 1.38 Large

The experimental group had an average attendance of 88%, while the control group had an average of 71%, p<0.05. According to LMS data, students in the experimental group spent an average of 4.2 hours per week on asynchronous content, and 92% of them tried all of the quizzes.

Qualitative Results

There were four main themes that came out of the thematic analysis:

Theme 1: Being flexible helps you learn. Students said over and over how helpful it was to watch lectures again. "I could pause and run the code myself in C programming before th

I could stop and run the code myself in C programming before the teacher moved on. "Before, I used to get lost," said Student S7. Faculty F3 said, "Students came to lab with basic questions answered, so we did advanced problems."

Theme 2: Digital tools help you learn skills for the job. At first, using GitHub for assignments was hard, but it made me feel more sure of myself. "My internship interview asked me about Git." "Because of hybrid classes, I could answer," said Student S11. This fits with NEP 2020's focus on getting people jobs.

Theme 3: The Digital Divide Is Still There. 28% of students said that their internet at home often went down, so they had to use college labs after hours. This made the experimental group unfair to each other. Workload and Skill Gap for Faculty. 80% of faculty agreed that hybrid was useful, but 35% said that making content took twice as long to prepare. Editing a 15-minute video takes two hours. "Faculty F8 said there was no change to the workload."

Theme 4: The workload of faculty and the skills gap. Cap online components at 40% for general programs, which shows that policymakers are being careful and that evidence is needed for each field.

Talk

The big effect sizes show that hybrid teaching is a lot better than traditional methods for skill development in this case. The 26% increase in technical scores is due to more time spent on tasks. Asynchronous videos were a good way to add more learning time without making faculty contact time longer. This corroborates the work of Means et al. (2013) and expands their conclusions to the polytechnic level.

A 59% improvement in self-learning is a very important result. The National Education Policy (NEP) 2020 envisions lifelong learners, and hybrid models inherently train students to seek and process information independently.

There are still gaps in research. For example, most studies look at grades instead of skills. Second, polytechnic education, which focuses on practical skills, is not well represented. Third, there aren't many studies that combine LMS analytics, student voice, and faculty perspective to give a full picture. This research tackles these deficiencies by concentrating on skill rubrics, utilizing a mixed-method approach, and contextualizing the study within polytechnic colleges.

The enhancement of digital literacy and collaboration directly responds to NASSCOM's 2023 report, which identifies these as the foremost skill deficiencies among diploma engineers. But you need to be careful when you look at the results. The digital divide theme shows that hybrid teaching can make things worse if institutions don't help. The institute offered LAN and lab access, which helped but didn't completely solve the problem. This corroborates the findings of Kumar and Sharma (2022) from rural India. Second, the success depends on the design. Hybrid pedagogy does not mean just recording one-hour lectures and putting them online. The positive outcome can be explained by the use of micro-lectures, active forums, and virtual labs, which are all in line with Garrison's CoI model by NTTR Chandigarh.

The workload of faculty is a systemic problem. Without institutional recognition, release time, or technical support for video production, burnout is likely, which could make it hard to keep going. So, hybrid teaching is not a way to save money; it is an investment in quality.

Conclusion

This study offers compelling evidence that a well-structured hybrid teaching model markedly improves technical, cognitive, and interpersonal skills among polytechnic students in comparison to traditional instruction. The model's strength is that it separates the delivery of information from the application of skills. Asynchronous components take care of content transmission and repeated practice, leaving synchronous time for activities that are interactive, hands-on, and of high value. The improvements in technical skills, problem-solving, digital literacy, and self-learning are all in line with the skills needed for NEP 2020 and Industry 4.0.

But hybrid teaching isn't a cure-all. Three things have to happen for it to work: (1) A reliable digital infrastructure that allows everyone to access its fairly, (2) ongoing training for faculty and a better way to manage their workloads so that they can keep making content, and (3) a pedagogical design that makes sure that online and offline modes work together instead of repeating each other.

Suggestions for polytechnic schools:

1. Infrastructure: Require Wi-Fi on campus and set up device banks for students who need them.

2. Policy: Make a blended learning policy official that allows for 40–60% of theory subjects to be taught online, as long as AICTE allows it.

3. Faculty: Set up a Media & Pedagogy Cell to help with technical issues. Count the hours you spend making content as part of your workload.

4. Students: Hold a week-long "Learn to Learn Online" orientation that covers self-control, online etiquette, and how to use tools.

5. Assessment: Change the way you evaluate to include e-portfolios, online quizzes, and parts of group projects.

Constraints and Prospective Investigations: The research was confined to three institutions within a single state and one semester. Longitudinal studies monitoring employment outcomes are essential. Future studies ought to investigate AI tutors in hybrid frameworks and discipline-specific design principles for workshops and laboratories.

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