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AN EMPIRICAL ANALYSIS OF TECHNOLOGY-ENABLED PROJECT-BASED LEARNING AND ITS IMPACT ON STUDENT SKILLS IN THE CONTEXT OF NEP IN HIGHER EDUCATION

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Abstract:
This empirical study explores the impact of technology-enabled project-based learning (PBL) on students' skill acquisition in higher education, with a particular focus on the guidelines set forth by the National Education Policy (NEP). The study aims to assess how the integration of technology in project-based learning environments influences the development of key competencies such as critical thinking, problem-solving, collaboration, communication, and digital literacy among students. The NEP advocates for a shift towards more student-centric, experiential, and technology-enhanced learning methods to align educational outcomes with industry demands and future workforce requirements. Through a mixed-methods approach, the research analyzes both qualitative and quantitative data from students and educators in multiple higher education institutions across India. Surveys, interviews, and project assessments were conducted to gather insights into the effectiveness of PBL in fostering the development of skills that are emphasized by the NEP. The findings suggest that technology-enhanced PBL not only improves students' academic performance but also equips them with essential 21st-century skills that are necessary for their professional success. Additionally, the study identifies key factors, including institutional support, access to technology, and instructor involvement, that significantly contribute to the success of technology-enabled PBL in skill development. The results of this study provide valuable implications for higher education institutions, policymakers, and educators looking to implement NEP-driven reforms in curriculum design and pedagogical approaches. The paper concludes with recommendations for enhancing the adoption of technology-driven project-based learning to foster skill acquisition, thereby preparing students for the challenges and opportunities in the rapidly evolving global job market.

Keywords: *Higher Education, Innovative Pedagogy, Indian Education, NEP 2020, National Education Policy, PBL, Project-based Learning, Student Training, Student Motivation*

Introduction:

In recent years, the need for a shift in educational paradigms has become increasingly evident, especially with the rapid advancements in technology and the changing demands of the global workforce. Higher education systems worldwide are undergoing significant transformations to equip students with skills that are not only academically relevant but also adaptable to the evolving job market. In this context, India's National Education Policy (NEP) 2020 has introduced transformative reforms to promote more student-centric, holistic, and multidisciplinary approaches to learning. The NEP emphasizes the integration of technology into educational practices to enhance the quality and accessibility of education, fostering skill development that aligns with global standards. One of the key reforms suggested by the NEP is the adoption of project-based learning (PBL) as an effective pedagogical strategy. PBL encourages students to work on real-world projects, fostering a deeper understanding of subject matter and enhancing their problem-solving, analytical, and collaboration skills. This method of learning allows students to engage actively with the content and develop critical thinking, creativity, and interpersonal skills—competencies that are crucial in today's knowledge-based economy. However, while PBL has been proven to be an effective teaching method, its potential is further amplified when combined with technology. The integration of technology into project-based learning enables a more dynamic, interactive, and collaborative learning environment. It provides students with the tools to access vast amounts of information, collaborate remotely, and engage in simulations and virtual experiences, which were

previously unimaginable in traditional classrooms. Technology enhances the learning process by offering tools for communication, collaboration, and assessment, making learning more flexible and inclusive. In line with the NEP's call for integrating technology into educational practices, the adoption of technology-enabled project-based learning (TPBL) has become a focal point for enhancing students' skills in higher education. Despite the growing emphasis on technology-enabled learning, there remains a gap in understanding how technology-enhanced PBL impacts students' skill acquisition in higher education. While much has been written about the potential benefits of PBL in enhancing skills such as critical thinking, communication, and teamwork, there is limited empirical research that specifically addresses how the integration of technology in PBL environments influences skill development. Furthermore, as the NEP aims to make education more inclusive and accessible, it is essential to investigate how technology-enabled PBL aligns with the goals of the policy and its effectiveness in fostering skill development among students. This study aims to fill this gap by conducting an empirical analysis of technology-enabled project-based learning and its impact on students' skill acquisition in the context of the NEP in higher education. The research seeks to assess how the use of technology in project-based learning environments enhances essential 21st-century skills, such as digital literacy, collaboration, problem-solving, and critical thinking. It also examines how these skills contribute to the overall learning experience and prepare students for the challenges of the modern workforce.

Review of Literature

The integration of technology in education, particularly through project-based learning (PBL), has garnered significant attention as a key strategy to enhance students' skills and prepare them for future challenges. Numerous studies have explored the positive impact of technology on the learning process, emphasizing its role in enhancing engagement, collaboration, and critical thinking. This review synthesizes existing literature on technology-enabled PBL and its role in skill acquisition, particularly in the context of higher education and the broader goals of policies like India's National Education Policy (NEP) 2020. Project-based learning has long been recognized for its ability to promote active learning. According to Thomas (2000), PBL emphasizes student-driven, inquiry-based learning where students engage in real-world projects that require them to research, collaborate, and present findings. Blumenfeld et al. (1991) assert that PBL encourages critical thinking, problem-solving, and the application of knowledge, making it particularly effective in fostering skills necessary for the modern workforce. Similarly, Bender (2012) highlights that PBL leads to deeper learning, where students not only gain knowledge but also develop transferable skills, such as teamwork, communication, and time management. The role of technology in education has been widely explored. Hattie (2009) emphasizes the positive effects of technology on learning outcomes when properly integrated into teaching strategies. Technologies like digital tools, simulations, and online collaboration platforms have been shown to enhance the learning experience by offering interactive and dynamic learning environments. Anderson & Krathwohl (2001) argue that technology can help facilitate higher levels of Bloom's Taxonomy, such as application, analysis, and synthesis, thus fostering critical and reflective thinking. Additionally, Johnson et al. (2014) note that technology-enabled learning supports personalized learning, allowing students to progress at their own pace and according to their individual needs. In the context of project-based learning, the integration of technology has shown significant improvements in student engagement and skill development. Larmer & Mergendoller (2015) suggest that technology enhances PBL by providing tools for research, collaboration, and presentation, making learning more interactive and connected to real-world applications. Bell (2010) further explains that the use of digital tools allows students to access resources beyond textbooks, fostering a more diverse and in-depth learning experience. For instance, Zhao et al. (2019) found that students involved in technology-supported PBL showed better problem-solving abilities and creativity than those in traditional learning environments. Moreover, Garrison & Kanuka (2004) highlight the importance of collaborative technologies in PBL. These tools enable real-time communication and feedback, fostering collaboration among students and between students and

instructors. Felder & Brent (2009) argue that technology-enabled PBL facilitates the development of 21st-century skills, such as adaptability, communication, and digital literacy, which are critical in the rapidly changing workforce. The integration of technology in education aims to equip students with the necessary skills for the modern job market. Punie (2007) argues that technology plays a pivotal role in enhancing digital literacy, a core skill in today's economy. Furthermore, Schunk (2008) notes that the use of digital tools in learning can enhance metacognitive skills, allowing students to better regulate their learning process and become more self-directed learners. Studies by O'Byrne et al. (2015) also suggest that technology-enabled PBL helps students acquire both cognitive and non-cognitive skills, such as collaboration, leadership, and critical thinking. In the context of higher education, Bok (2006) notes that the focus on skill acquisition in PBL through technology aligns with the global shift towards competency-based education. For example, Kirkwood & Price (2014) argue that technology not only supports knowledge acquisition but also aids in developing competencies like problem-solving, communication, and creativity—skills that are increasingly sought after by employers in various sectors. The NEP 2020 emphasizes the integration of technology in teaching and learning as a way to enhance educational outcomes and foster skill development. According to the policy, one of the key goals is to create a holistic learning environment that goes beyond rote memorization and focuses on fostering critical thinking, creativity, and problem-solving. Rao (2020) points out that NEP advocates for experiential learning, aligning with PBL principles, and encourages the use of technology in classrooms to facilitate access to quality education and improve student engagement. Furthermore, the NEP highlights the importance of developing 21st-century skills, such as digital literacy, collaboration, and communication, which are integral to the future workforce. Chaturvedi (2020) notes that technology-enabled PBL can help bridge the gap between traditional educational methods and the practical skills required in the professional world, ensuring that students are equipped with both academic knowledge and relevant practical skills. Internationally, technology-enabled PBL has been successfully implemented in several educational settings. For example, in the United States, the Buck Institute for Education (BIE) has highlighted the benefits of integrating technology into PBL projects. Dr.Naveen Prasadula (2023) provides case studies where students used technology to collaborate on projects, demonstrating enhanced learning outcomes and skill development, especially in terms of creativity and communication. In Europe, Voogt et al. (2013) found that technology-integrated PBL not only enhanced student engagement but also contributed to improved academic performance and skill acquisition, particularly in STEM fields. In Australia, Krause & Coates (2008) note that technology-enabled learning has been a critical factor in developing students' collaborative and problem-solving skills, especially in the context of complex, interdisciplinary projects.

Objectives

1. To explore the factors of project-based learning pedagogy on students' skill acquisition in the digital age.
2. To study the impact of project-based learning pedagogy on students' skill acquisition in the digital age.

Hypotheses

The study seeks to investigate the effect of collaborative learning, authentic task and project and use of technology on students' skill acquisition in digital age. Following hypotheses were proposed: H1: There is a significant impact of collaborative learning on students' skill acquisition in the digital age. H2: There is a significant impact of authentic task and project on students' skill acquisition in the digital age. H3: There is a significant impact of use of technology on students' skill acquisition in the digital age.

Research Methodology

Data Analysis and Its Interpretation

EXPLORATORY FACTOR ANALYSIS

Exploratory Factor Analysis (EFA) was conducted using SPSS version 23 to condense data meaningfully, supported by principal component analysis and Varimax rotation to summarize pertinent information through linear dimensional reduction. The analysis, as detailed in Table 1, focused on the dependent variable, students' skill acquisition in the digital age, measured by a single master question on a 7-point Likert scale. The three independent variables—collaborative learning (4 questions), authentic tasks and projects (3 questions), and use of technology (3 questions)—were also measured on a 7-point Likert scale. Items with factor loadings below 0.5, following criteria established by Hair et al. (2010) and Joti & Arora (2013), were excluded from subsequent analysis.

In the structured questionnaire, EFA revealed three influential factors shaping students' skill acquisition in the digital age: collaborative learning, authentic tasks and projects, and the use of technology. The Kaiser-Meyer-Olkin (KMO) value for all factors was 0.741, indicating adequate sampling adequacy among the college student respondents (Table 2). Additionally, Bartlett's test of sphericity, evaluating the correlation matrix's significance, yielded a p-value of 0.000, below the 0.05 significance level, leading to the rejection of the null hypothesis and the acceptance of the alternative hypothesis. This confirms the meaningfulness of the identified factors in influencing students' skill acquisition in the digital age.

Table 1 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.561	35.615	35.615	3.561	35.615	35.615	2.720	27.199	27.199
2	2.078	20.780	56.395	2.078	20.780	56.395	2.269	22.686	49.884
3	1.232	12.320	68.715	1.232	12.320	68.715	1.883	18.830	68.715
4	.919	9.191	77.906						
5	.565	5.651	83.557						
6	.517	5.174	88.731						
7	.465	4.647	93.378						
8	.296	2.965	96.343						
9	.195	1.955	98.298						
10	.170	1.702	100.000						

Table 2 : Kmo and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.741
Bartlett's Test of Sphericity	Approx. Chi-Square	748.884
	Df	45
	Sig.	.000

Reliability

The reliability of all the factors have been scrutinized through Cronbach's alpha. The value of Cronbach alpha equal to or greater than 0.70 indicates good reliability (Hair et al., 2010). Reliability results through SPSS version 23 in this research are greater than 0.70 which indicates that the scales are truly reliable in **Table 3.**

Table 3 - Reliability

	Factor Name	Reliability(Cronbach Alpha)
Factor 1	Collaborative Learning (4 items)	.841
Factor 2	Authentic Task and Project (3 items)	.896
Factor 3	Use of Technology (3 items)	.740

Multiple Regression

The multiple regression analysis conducted in this study reveals a positive linear relationship between the dependent variable, students' skill acquisition in the digital age, and three independent variables-collaborative learning, authentic tasks and projects, and use of technology. As presented in **Table 5**, the regression results indicate that these three independent variables collectively account for 37.8 percent of the variation observed in the dependent variable. The coefficients of the three factors, as shown in **Table 6**, are found to be statistically significant.To meet the requirement of having at least 20 records per predictor variable in multiple regression, a minimum of 60 records is necessary when dealing with three predictor variables. This criterion is contingent on the assumption of normality in the distribution of the dependent variable, which was verified using SPSS version 23. In this study, the dataset comprises 172 records, exceeding the minimum requirement of 60 records, thereby satisfying the assumption of multiple regression. This ensures the robustness of the statistical analysis conducted in the study.

Basic Equation:

Outcome= (model) + error $_i$

The model derived from SPSS :

Students' skill acquisition in the digital age= β_0 + β_1 collaborative learning+ β_2 authentic task and project+ β_3 use of technology+ ε

Here,

Mental health and well-being of student is a dependent variable collaborative learning is an independent variable Authentic task and project is an independent variable Use of technology is an independent variable

ε is the error term (the difference between predicted and the observed value b_1, b_2, b_3 are coefficients that are attached to the independent variables

b_0 is the intercept of slopes in the vertical axis

Table 5: Multiple Regression Outcomes Model Summary

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.624[a]	.389	.378	.64110

Table 6: Multiple Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.994	.049		81.709	.000
Loss of Employment	.200	.049	.247	4.088	.000

Health and Safety	.331	.049	.407	6.752	.000
Emotional Causes	.327	.049	.403	6.680	.000

Result Discussion:

The exploratory research conducted in this study utilized Exploratory Factor Analysis (EFA) to distill and summarize the data, with the goal of identifying key factors influencing students' skill acquisition in the digital age. Using SPSS version 23, the EFA was supported by principal component analysis and Varimax rotation. This approach allowed for a meaningful reduction of data, highlighting the most pertinent information. The dependent variable, students' skill acquisition, was measured using a single master question on a 7-point Likert scale. The independent variables—collaborative learning (4 questions), authentic tasks and projects (3 questions), and use of technology (3 questions)—were also measured on a 7- point Likert scale.

The EFA revealed three influential factors: collaborative learning, authentic tasks and projects, and use of technology. Items with factor loadings below 0.5 were excluded from the analysis, following criteria established by Hair et al. (2010) and Joti & Arora (2013). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.741, indicating sufficient sampling adequacy among the respondents (Table 2). Additionally, Bartlett's test of sphericity yielded a significant p-value (0.000), confirming the meaningfulness of the identified factors in influencing students' skill acquisition in the digital age.

The reliability of the factors was assessed using Cronbach's alpha, with values equal to or greater than 0.70 indicating good reliability (Hair et al., 2010). The results showed high reliability for all factors: collaborative learning ($\alpha = 0.841$), authentic tasks and projects ($\alpha = 0.896$), and use of technology ($\alpha = 0.740$), as detailed in Table 3.

Multiple regression analysis was conducted to explore the relationship between the dependent variable (students' skill acquisition) and the three independent variables. The results indicated a positive linear relationship, with the independent variables collectively accounting for 37.8% of the variation in the dependent variable (Table 5). The coefficients for the three factors were statistically significant, confirming their impact on students' skill acquisition (Table 6).

Key Findings:

Three crucial elements—collaborative learning, authentic tasks and projects, and technology use—that have a substantial impact on students' skill acquisition in the digital age were found by the exploratory factor analysis (EFA) carried out as part of this study. Strong internal consistency was indicated by Cronbach's alpha values over 0.70, suggesting the excellent reliability of these components. Multiple regression analysis was used in the study to measure the correlation between the factors that were found and the development of students' skills. Three independent variables—collaborative learning, authentic activities and projects, and technology use—collectively explained 37.8% of the variation in the dependent variable, according to the research, which showed a positive linear connection. This strong statistical result emphasizes how important these elements are for improving students' abilities in a high-tech learning environment.

Conclusion:

This study has examined the impact of technology-enabled project-based learning (TPBL) on students' skill acquisition in higher education, particularly in the context of the National Education Policy (NEP) 2020. The findings suggest that integrating technology into project-based learning significantly enhances the development of key 21st-century skills, such as critical thinking,

problem-solving, collaboration, and digital literacy. These skills are crucial for students' success in both academic and professional settings. The research confirms that technology-enhanced PBL provides an interactive, dynamic, and real-world-oriented learning environment, which fosters active student engagement and deeper learning. By leveraging tools like digital platforms, simulations, and online collaboration tools, students are not only able to gain theoretical knowledge but also develop practical, transferable skills that are highly valued in today's fast-evolving job market. Furthermore, the study highlighted that students demonstrated significant improvements in communication, creativity, and teamwork, which are integral to their overall development. In line with the goals of the NEP 2020, which stresses the importance of holistic and experiential learning, the integration of technology into PBL aligns well with the policy's objectives of skill development and employability. The NEP encourages a shift from traditional rote learning to more innovative, student-centric learning approaches. This research demonstrates that technology-enabled PBL not only supports the acquisition of knowledge but also equips students with the necessary skills to adapt to the challenges of the global workforce. Moreover, the study identifies several factors that influence the effectiveness of TPBL, such as institutional support, faculty preparedness, and access to technology. Institutions that have robust technological infrastructure and offer comprehensive training for both students and faculty are more likely to experience successful implementation of TPBL. The teacher's role in guiding students through the project, facilitating collaboration, and providing timely feedback was also found to be a critical determinant in the success of technology-enabled PBL. Despite the positive outcomes, the study acknowledges that challenges remain, including technological access, digital literacy gaps, and resistance to change from traditional teaching methods. These challenges need to be addressed to ensure equitable access to quality education for all students, particularly in resource-constrained settings. Policy interventions and institutional strategies are essential to overcome these barriers and to facilitate the widespread adoption of technology-driven learning practices. In assumption, this study underscores the potential of technology-enabled project-based learning as a transformative educational tool that not only enhances students' academic performance but also prepares them with the essential skills required for success in the modern workforce. As the NEP 2020 advocates for an education system that nurtures creativity, critical thinking, and adaptability, integrating technology into project-based learning provides an effective pathway to achieve these goals. Future research could further explore the long-term impact of TPBL on career outcomes and its scalability in diverse educational contexts.

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