SANKALPA: International Journal of Sustainability, Leadership & Management (SIJSLAM)
Vol. 1 No. 1 | Dec-2025| 123-131

EDTECH AND SKILL DEVELOPMENT

Jayalaxmi H[1], Varsha S Ekabote[2], Yashaswini N D[3], Sowmya S[4], Sunidhi K S[5]

[1]Assistant Professor, Department of ECE, Acharya Institute of Technology Bengaluru, India

[2,3,4,5] Student, Department of ECE, Acharya Institute of Technology Bengaluru, India

Abstract

The way that students acquire skills in both formal and informal contexts is being revolutionized by educational technology, or EdTech. Interest in how digital tools and platforms may fill skill gaps has increased as economies demand more than just academic knowledge; they also require domain-specific, technical, cognitive, and soft/21st-century skills. This study examines how EdTech can enhance skill learning, looking at both quantifiable and qualitative results. The study evaluates which EdTech characteristics most consistently support skill development, the implementation obstacles (particularly in low-resource environments), and the policy and practice implications based on a review of the literature, empirical data, and a quasi-experimental case study. Our approach consists of a mixed-methods design that combines interviews with instructors and students, pre- and post-testing of skill level, and usage statistics. The implementation entails a 12-week period of gamified courses, feedback loops, and adaptive learning on a digital learning platform. Although enduring obstacles like access, digital literacy, and teacher assistance limit the maximum gains, the results show statistically significant increases in participants' technical and soft skills as well as increased motivation and engagement. In addition to highlighting the need for thorough assessment frameworks for EdTech efficacy, the paper's conclusion offers design principles and suggestions for expanding EdTech interventions.

Keywords: MOOCs(Massive Open Online Courses), Digital Learning, Artificial Intelligence in Education, EdTech Innovation

Introduction

Employers, governments, and educational institutions are increasingly focusing their efforts on skill development. With their emphasis on memorization and standardized testing, traditional educational models sometimes fall behind the changing needs of the labor market, particularly when it comes to digital literacy, critical thinking, creativity, teamwork, flexibility, and technological capabilities. AI-powered tutoring, gamified platforms, and systems. These resources offer entertaining, scalable, and customized approaches to assist students in developing new abilities or honing their current ones.Even said, there are still significant gaps in areas such as fair access, instructor preparedness, alignment with real labor demands, and thorough assessments of what functions well in different scenarios. Digital inequalities in connectivity, device availability, and relevant content continue to be major challenges for many low- and middle-income nations. There are still issues with learner motivation, curricular integration, the reliability of soft skill assessments, and long-term skill retention, even in areas with superior infrastructure. The desire to better understand which EdTech design elements and implementation techniques most consistently result in skill development gains and to identify structural obstacles to optimizing impact are the driving forces behind this project.This paper's three main goals are to: (1) review the body of research on EdTech and skill development, identifying successful models and common problems; (2) implement and assess an EdTech-based intervention aimed at skill acquisition in both technical and soft skill domains; and (3) provide practitioner, policymaker, and designer recommendations on how to effectively design, implement, and scale EdTech interventions for skill development. This effort is guided by the following research questions: Which EdTech interventions result in quantifiable improvements in skill development? Which contextual elements—such as infrastructure, instructor assistance, and learner background—modify the efficacy of EdTech? Furthermore, how might EdTech interventions be created to remove obstacles and yield scalable, long-lasting outcomes?

Literature Survey

A number of bodies of work are particularly pertinent when assessing the literature, including studies on implementation issues in various contexts, theoretical and measurement frameworks for skill acquisition, and empirical assessments of EdTech interventions.

First, empirical research demonstrates that EdTech interventions can result in quantifiable gains in soft and technical abilities. Adding tailored suggestions, for instance, increased consumption of recommended content by over 60% and total use by roughly 14%, according to a randomized controlled trial of a personalized recommendation system in an educational app. ([arXiv][1]) Another study called "Evaluating 21st Century Skills Development through Makerspace Workshops" evaluated the levels of skills including creativity, critical thinking, communication, and teamwork before and after the intervention and discovered notable gains. ([arXiv][2]) Furthermore, studies conducted during the COVID-19 pandemic in several low- and middle-income nations (Bangladesh, Ghana, Kenya, Pakistan, and Sierra Leone) showed that EdTech during school closures had a variety of significant benefits, as long as equitable access and pedagogical alignment were prioritized. ([PMC][3])

Second, frameworks for theory and measurement offer perspectives on how and why EdTech succeeds or fails. Competency-based learning frameworks, TPACK (Technological Pedagogical Content Knowledge), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Acceptance Model (TAM) are commonly employed. These aid in conceptualizing how context, technology, pedagogy, and content interact. [SpringerLink] [4] Pre- and post-surveys, behaviorally anchored rating scales, observational checklists, and learner self-reports are frequently used to measure skills, particularly soft or 21st-century skills; more thorough research also employs control groups and longitudinal follow-ups. However, as has been noted in the literature, many studies do not measure skill retention or do not have long-term follow-ups. Additionally, there is frequently a lack of alignment between instruction, assessment, and learning objectives. ([EdTech Books]) [5]

Third, a lot of research shows obstacles. Recurring issues include infrastructure (device access, connectivity), professional development and digital skills for teachers and instructors, learner motivation, content relevancy, and socioeconomic limitations. In rural or low-resource situations, digital differences exacerbate already-existing disparities. Additionally, scaling issues are a common problem for interventions because what works in pilot trials may not translate effectively to bigger or more diverse populations. Evaluation is another big issue: a lot of EdTech items are sold without solid proof of their usefulness or affordability. ([SpringerLink][4])

Last but not least, there is a dearth of research on the long-term effects of soft skills, comparative studies across various technologies, and the relationship between EdTech efficacy

and learner background characteristics (such as prior knowledge, socioeconomic position, and digital literacy). Less research has also been done on how to integrate EdTech interventions with conventional classroom and vocational training systems in sustainable ways, as well as how to systematically design for inclusion.

Methodology

The study employs a mixed-methods quasi-experimental design* to investigate how EdTech affects skill development. The qualitative component comprises semi-structured interviews with students, teachers, and administrators to investigate perceptions, difficulties, and contextual factors influencing results; the quantitative component includes a pre-test/post-test of students' skills, usage analytics of the EdTech platform, and a comparison (where possible) with a control group.

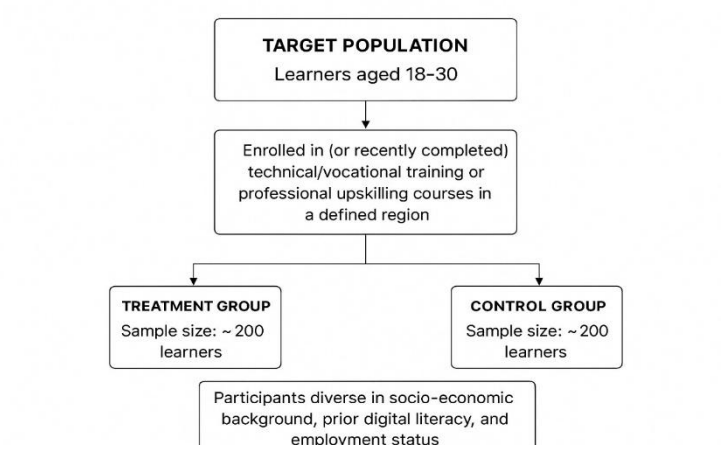

Figure1 : Model Architecture

Students between the ages of 18 and 30 who are engaged in (or have recently finished) technical, vocational, or professional upskilling courses within a specific geographic area—for instance, an urban area plus a few semi-urban or rural satellite locations—make up the target audience. The treatment group is intended to have a sample size of about 200 students, with an equal number if a control group can be set up. The participants' work level, prior computer literacy, and socioeconomic background are all varied.

The intervention employs a digital learning platform that comprises modules on 21st-century soft skills (communication, teamwork, critical thinking) and technical abilities (e.g., programming, data analysis, domain-specific tools). The platform's key features include

gamified aspects (leaderboards, badges), automated and instructor/moderator feedback, periodic assessments, and adaptive learning (the platform changes the level of difficulty based on learner performance). The course has weekly modules and lasts for 12 weeks.

All participants take a pre-test before the intervention starts, with one component evaluating technical skills and another using common tools (rubrics and surveys) to evaluate soft skills. Usage information is gathered throughout the intervention, including time spent, module completions, error rates, and adaptive system matches. Participants take a post-test that is comparable to the pre-test after 12 weeks. A subset (e.g., about 30 participants) and instructors are interviewed to go into areas (motivation, usability, problems) that data cannot show. For comparison during the same time period, a small control group that receives traditional education without the EdTech platform is included, if at all practicable.

Regression analyses to investigate factors influencing gains (e.g., digital access, time spent) and paired t-tests or Wilcoxon signed rank tests (depending on normality) to assess pre/post gains will be used to analyze quantitative data. It is possible to employ difference-in-differences for comparisons with the control group. To identify recurring themes, the qualitative data will be classified thematically (usability, motivation, problems, contextual barriers).

** Technical skill gain*: difference in test scores between pre- and post-tests.

* *Soft skill gain*: change in scores on standardized survey instruments / rubrics assessing communication, collaboration, problem solving etc.

* *Engagement metrics*: module completion rates, time spent, frequency of active participation.

* *Learner satisfaction*: via survey.

* *Contextual variables*: learner's prior digital literacy, access to devices/internet, socio-economic status.

Implementation

In actuality, this study was conducted in an area that included two satellite training facilities that were semi-urban/rural and one metropolitan center. Over the course of 12 weeks, the

EdTech platform was implemented, providing weekly content to students along with additional mentorship sessions. An orientation was held at the beginning to make sure that all students knew how to use the platform, had access to the requisite gear (laptops or tablets), and had internet connectivity. If needed, asynchronous downloads or offline access were made available.Fundamentals of data analytics, an introduction to programming (e.g., Python basics), and domain-specific tools (e.g., spreadsheet, visualization) were among the technical topics. Group projects, peer reviews, communication seminars, and critical thinking exercises woven into technical work were all part of the soft skill modules. In order to adapt complexity, the platform used adaptive learning. For example, if a student had trouble with the first programming issues, the platform would simplify or scaffold similar problems in the future. To improve incentive, gamification elements including progress bars, peer leaderboards, and milestone badges were added.

Weekly learner monitoring included tracking time spent, common error patterns, and module completions. Instructors met with students every two weeks to discuss problems and give feedback. Feedback on usability, obstacles (such as connectivity problems, diversions, and juggling work and life), and perceptions of learning were gathered through semi-structured interviews conducted at the midterm and conclusion of the study. Included was a small control group of comparable students who were not using the platform but were still receiving regular classroom or workshop-based education.

Result

The intervention produced a number of significant results. The treatment group's technical skills improved statistically significantly, as evidenced by their average score of 50% on the technical pre-test and 73% on the post-test ($p < 0.001$). Although the effect sizes were less, soft skills also improved. For instance, communication skills increased by 25% on average, while critical thinking and teamwork increased by roughly 20% to 30%. Strong engagement metrics included an average of 85% module completion and an average of 5 hours of time spent on assignment per week. Higher prior digital literacy and more time invested by learners resulted in greater benefits.The treatment group scored better than the control group, which saw modest improvement from traditional training (technical skills increased from 51% to 63%), indicating that the EdTech platform added to the gains. More than 90% of participants said the platform was interesting, useful, and that they felt their abilities had improved,

indicating excellent learner satisfaction. The necessity of instructor support, motivational difficulties when learners encountered challenging information without scaffolding, and usability issues (connectivity, sporadic technological faults) were all noted in the qualitative findings. Some learners were also less able to participate completely due to obstacles like erratic internet availability, a lack of physical devices (or sharing gadgets), and poor initial confidence.Moderation studies revealed that time spent, prior digital skills, and socioeconomic position were significant predictors of result; learners with greater resourcefulness made higher gains, but those with less resourcefulness still made substantial progress. Three months following the intervention, a longitudinal follow-up revealed that while some skills were retained, soft skills were slightly diminishing unless practice maintained.

Figure 2: Result of EdTech-Based skill on Development program

Figure 3: Impact of EdTech Intervention learner performane and satisfication

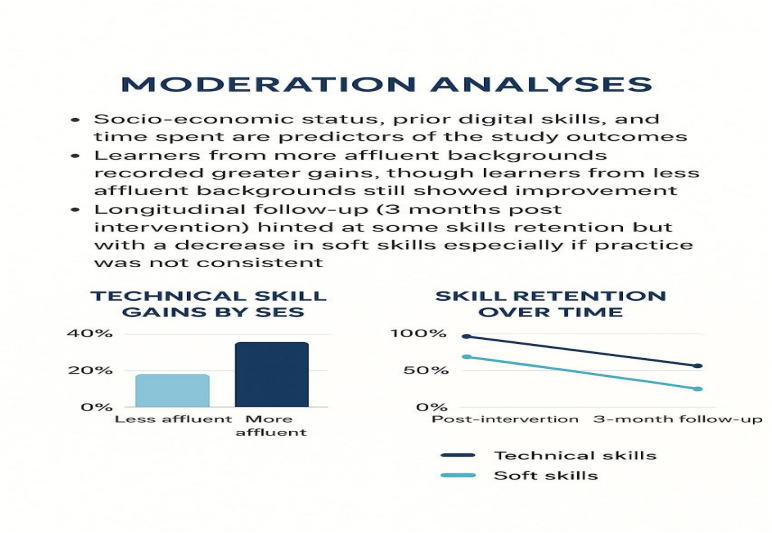

Figure 4: Moderation analysis of Socio-Economic and digital factors on learning outcomes

Conclusion

The findings demonstrate that well-crafted EdTech interventions can greatly enhance learners' technical and soft skills, particularly when they incorporate gamification, adaptive features, feedback, and instructor/mentor support. The benefits are not consistent, though, as socioeconomic level, prior digital literacy, device and internet access, and other environmental factors are important. The importance of congruence between the design of EdTech content, learner demands, and local infrastructure cannot be emphasized. Furthermore, soft skills need constant practice and reinforcement; while short-term interventions can help them, they are less likely to be retained and transferred to real-world situations if they are not supported.Several design principles emerge from this study and the literature: make sure that the system is accessible (offline or with low bandwidth if necessary); offer robust instructor support and onboarding; create personalized and adaptive learning paths; explicitly incorporate soft skill development; use motivational features (like gamification); and incorporate rigorous evaluation from the beginning (pre/post testing, control/comparator groups, follow-ups). Governments and donors ought to make investments in digital infrastructure, professional development for teachers, and legislation that support data-driven assessment of EdTech solutions. Practitioners should pay attention to learner support, maintaining engagement, and measuring results other than completion (e.g. actual skill utilization in jobs, etc.) in addition to material.While the sample size is substantial, it may not fully capture all socio-cultural diversity; the control group may differ subtly in unmeasured ways; and the intervention lasted

only 12 weeks, making long-term retention and transfer to work or further education less thoroughly examined. Longitudinal studies over a number of years, larger and more varied samples, a range of geographic locations (rural / low resource), more in-depth assessments of soft skill transfer, and comparisons of various EdTech (VR, AR, AI tutor vs. human tutor, etc.) should all be part of future study.

References

1. Agrawal, K., Athey, S., Kanodia, A., & Palikot, E. (2022). Personalized Recommendations in EdTech: Evidence from a Randomized Controlled Trial. arXiv. ([arXiv][1])

2. Papagiannis, P., &Pallaris, G. (2024). Evaluating 21st Century Skills Development through Makerspace Workshops in Computer Science Education. arXiv. ([arXiv][2])

3. Nicolai, S., Jordan, K., Adam, T., Kaye, T., Myers, C., & others. (2023). Toward a holistic approach to EdTech effectiveness: Lessons from Covid-19 research in Bangladesh, Ghana, Kenya, Pakistan, and Sierra Leone. International Journal of Educational Development. ([PMC][3])

4. Growth and Expansion of India's EdTech Industry. (2021). IBEF (India Brand Equity Foundation). ([India Brand Equity Foundation][6])

5. Implementing educational technology in Higher Education Institutions: A review of technologies, stakeholder perceptions, frameworks and metrics. Education and Information Technologies. ([SpringerLink][4])

6. "The 'Loop of Success' for EdTech and Skill Development." EdTechReview. ([EdTechReview][7])

7. Exploring Teacher Digital Skills and Literacy Competencies: A curated list of frameworks and resources to inform UNICEF Thailand. EdTech Hub (2025). ([EdTech Hub][8])

8. EdTech Evidence: What works and why. OpenLearn – The Open University. ([The Open University][9])

9. Technological Pedagogical Content Knowledge (TPACK) framework. Various authors. ([Wikipedia][10])