Mapping Futuristic Skills among Higher Education Students in Tamil Nadu: Aligning Competencies with Traditional and Emerging Industry Needs

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ABSTRACT

The present research examines the congruence between the skills possessed by the higher education students in Tamil Nadu and the changing human capital needs of not only traditional industries (Automobile, Textile, Agriculture) but also new age industries (Artificial Intelligence, Renewable Energy, Robotics). With funding from the Chief Minister's Research Grant (CMRG), this research assesses the effectiveness of state intervention schemes such as the "Naan Mudhalvan Scheme," while identifying the socioeconomic and geographic constraints in the form of skill constraints. By employing a sequential explanatory design with mixed methods approach, the researchers have collected quantitative data through survey from 1200 higher education students from different parts of Tamil Nadu and received qualitative information from focus groups and industry practitioners. The findings of the research have shown a serious case of "competency paradox," wherein although the level of digital skills has improved due to region-based intervention, there is still a gap in automation-related core competencies, complex problem-solving skills and technical reasoning skills. Higher education students from rural areas and first-generation colleges face a structural constraint in terms of certification costs and infrastructure deficit.

Keywords: Skills, Higher Education, Traditional, Emerging Industry, Mapping, Mapping**.**

INTRODUCTION

Tamil Nadu forms one of India's leading economic powers, defined by its distinctive double industrial setup. On the one side, it has developed vibrant and world-class traditional industries like automobile industry in Chennai, textiles in Coimbatore and Tiruppur, leather industries in Vellore. On the other side, Tamil Nadu is making a swift shift towards new-age technologies that require Expertise in Electric Vehicles (EVs), Green Hydrogen, Generation AI, and Industry 4.0 automated systems. For sustaining such growth, the higher education system of Tamil Nadu requires to create a flexible pool of graduates. In recognition of this challenge, the Government of Tamil Nadu undertook capacity building initiatives like Naan Mudhalvan program. Yet, the mismatch between the inflexible curriculum in academic institutions and dynamic needs of the industries continue to hamper the employability of graduates. The current research study attempts at providing an empirical baseline study for identifying futuristic skills amongst students pursuing higher education in Tamil Nadu.

LITERATURE REVIEW

The Evolution of Skill Requirements: Industry 4.0 vs. Traditional Core

Industry 4.0 has changed the nature of engineering and the arts science discipline. According to research conducted by the World Economic Forum, complex problem-solving skills, critical thinking skills, and data literacy have replaced procedural domain expertise skills as key factors of success at work. With respect to Tamil Nadu industry environment, there is need to recognize that traditional industries cannot survive without

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technological innovations. This means that engineers must have knowledge on battery management system and embedded software in the case of automotive belt industry.

Institutional Ecosystems and Policy Interventions in Tamil Nadu

Interventions by the government can be extremely important in rebalancing regional capabilities. The idea behind the Naan Mudhalvan model was the creation of an accessible pathway to acquiring highly demanded skills through the inclusion of technical components in college curricula. Previous research on regional skill development programs has found that whereas centralized programs help increase technological literacy, their effectiveness greatly depends on local circumstances.

Systemic Inequities and the Digital Divide

Sociological studies of education bring to attention the fact that such socio-economic placements as geographic placement (urban vs. rural) and educational heritage (first-generation status) have a huge impact on the manner in which learners get access to advanced learning materials. It is hard for rural higher educational institutions to possess laboratory equipment, to maintain stable digital connections, and to attract companies' presence at their campus.

RESEARCH METHODOLOGY

Research Design

The study uses a sequential mixed method research design. The quantitative survey mapping forms the first stage of data collection while the second phase involves qualitative focus group discussion (FGD).

Sampling Frame and Participants

Stratified random sampling technique was adopted to choose (N= 1200) students studying in the final year of higher education in Tamil Nadu. These students were distributed equally in the following categories based on institutions and demographics:

- **Geographic Stratification:** 40% Urban Hubs (Chennai, Coimbatore, Madurai); 35% Semi-Urban/Tier-2 Towns (Karaikudi, Salem, Vellore); 25% Rural Regions.
- **Disciplinary Streams:** 45% Engineering & Technology; 35% Arts & Science; 20% Commerce & Management.
- **Socio-Economic Variables:** 38% identified as First-Generation College Students.

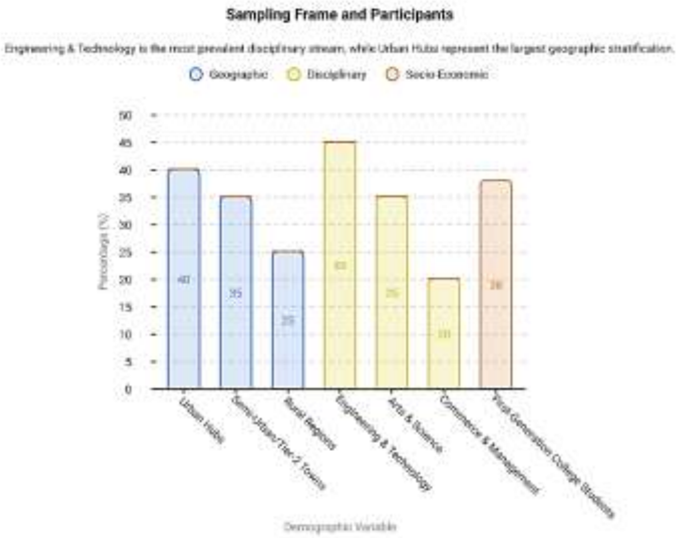

Figure 1. Sampling Frame and Participants

Instrumentation

Data collection was executed using a 50-question master instrument structured into five key dimensions:

- ❖ Demographic Profile & Baseline Socio-Economic Data
- ❖ Competency Mapping in Traditional Sectors
- ❖ Competency Mapping in Emerging Industry Needs
- ❖ Effectiveness of Institutional Frameworks & State Schemes
- ❖ Socio-Economic Barriers & Future Career Readiness

Likert scales (1 to 3) were used to measure self-rated proficiencies, faculty readiness, and institutional alignment. The tool's reliability was validated with a Cronbach's Alpha value of (alpha = 0.86).

Data Analysis Plan

Analysis was conducted using SPSS. Hypothesis testing was used to establish the correlation between the students' attributes and competence in the class by testing four key hypotheses using the Chi-Square test, Independent Samples t-test, and ANOVA.

STATISTICAL HYPOTHESES & FINDINGS

Hypothesis Testing 1: Chi-Square Test of Independence

- **(H0) (Null Hypothesis):** Primary access to learning futuristic skills is independent of the institution's geographical location.
- **(H1) (Alternative Hypothesis):** Primary access to learning futuristic skills is significantly dependent on the institution's geographical location.

Table 1: Chi-Square Test Results Matrix

Variable Connection	**Value (χ^2)**	**df**	**Asymp. Sig. (p-value)**
Higher Education Institution Location vs. Source of Futuristic Skills	84.321	6	< 0.001

Result: Reject H_0. Access channels are highly dependent on geography.

Interpretation: As per cross-tabulation statistics, whereas 68 percent of urban students are helped by both workshop participation and high-quality online classes, over 55 percent of rural students rely exclusively on college lectures or free video lectures. This indicates that location is a significant factor for accessing advanced skill ecosystems.

Hypothesis Testing 2: Independent Samples t-Test (Digital Divide)

- **(H0) (Null Hypothesis):** There is no significant difference in digital literacy self-rating scores between students who have personal laptops and those who depend entirely on mobile phones and college laboratories.

- **(H1) (Alternative Hypothesis):** Personal laptop users have significantly higher average digital literacy self-rating scores.

Table 2: Independent Samples t-Test

Group Variable	N	Mean Score (1-5)	t-value	Sig. (2-tailed)
Laptop Owners	742	4.12	7.84	< 0.001
Non-Owners	458	3.26		

Result: Reject H_0. Personal hardware access significantly affects digital scores.

Interpretation: The huge difference between the mean score (4.12) and (3.26), ($p < 0.001$), proves in no uncertain terms that smart phones cannot replace computers when developing technical knowledge and skills through software programming.

Hypothesis Testing 3: Independent Samples t-Test (Socio-Economic Capital)

- **(H0) (Null Hypothesis):** No significant difference exists in terms of technical interview confidence among first and non-first-generation college students.
- **(H1) (Alternative Hypothesis):** Non-first-generation students display greater levels of confidence.

Table 3: Independent Samples t-Test

Group Variable	N	Mean Score (1-5)	t-value	Sig. (2-tailed)
First-Gen	456	2.89	-6.12	< 0.001
Non-First-Gen	744	3.64		

Result: Reject H_0. Generational academic background correlates with interview confidence.

Interpretation: First Generation Students Felt Less Prepared for Technical Interviews. It seems that this may be because of the reduced access to professional family connections, absence of business mentoring, and less exposure to formal business presentations in English.

Hypothesis Testing 4: One-Way ANOVA (Disciplinary Variations)

- **(H0) (Null Hypothesis):** Perceived readiness to institutional infrastructure is similar among all academic disciplines.
- **(H1) (Alternative Hypothesis):** Perceived readiness to institutional infrastructure differs significantly by academic discipline.

Table 4: One-Way ANOVA Table

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.18	2	21.09	14.35	<0.001
Within Groups	1759.62	1197	1.47		
Total	1801.80	1199			

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Interpretation: According to Post Hoc Tukey tests results, E&T departments experience a higher level of satisfaction regarding laboratory setup and software access compared to Arts and Sciences departments. The results indicate that there is an infrastructure shortage in art and science institutions that are supposed to offer technology-based courses.

Structured Baseline Data Summary

Following is an empirical profile of student feedback from various regions and institutional levels within Tamil Nadu:

Efficacy of the Naan Mudhalvan Scheme

- **Integration Rate:** 88% of those from institutions associated with states reveal that skill courses of Naan Mudhalvan are integrated into their schedules.
- **Skill Relevance Impact:** 42% rate the course modules as "Highly Relevant" to their career goals, 36% rate the modules as "Moderately Relevant," and 22% feel that general platform modules need to be more specific to their regional industries.

Traditional Sector Career Alignment

- **Core Sectors Employment Willingness:** 58 percent of engineering/science students prefer core sectors jobs such as those in automobile or textiles if these sectors apply new technologies.
- **Curriculum Connection Gap:** 24 percent think that their college's department curriculum is somehow related to traditional industries around them.

Core Operational Roadblocks

- **Financial Constraints:** 46% indicate the expensive cost of commercial cloud/data certifications globally as the biggest obstacle to upskilling.
- **Academic Workload:** 31% have mentioned the rigidity of academic schedules and examination procedures, as well as attendance policies, which make it difficult for students to spend time on future-oriented education.

RECOMMENDATIONS & POLICY FRAMEWORK

Based on these findings, we propose a multi-tiered framework to align student capabilities with Tamil Nadu's industrial roadmap:

Contextual Curriculum Customization

Training programs must be modified to suit regional economic strengths. Those HEIs situated within proximity to manufacturing areas (Chennai, Coimbatore) need to offer elective courses in EV architecture and industrial robots, whereas those situated within proximity to agriculture or textiles (Trichy, Tiruppur, Southern regions) must have priority for smart agric business systems, green energy generation, and e-supply chain management.

Institutionalizing Hybrid Infrastructure Hubs

In order to mitigate the digital divide witnessed in the independent t-test results, institutions need to increase the availability of computing facilities. The state can facilitate the conversion of university libraries into digital learning centers that have new software programs and diagnostic tools. Such an arrangement will ensure equal participation of students without laptops in data literacy and programming courses.

Faculty Development and Industry Co-Teaching

Bridging academic and industrial processes necessitates continuous updating of faculty members. Academic bodies need to formulate proper developmental courses where faculty members are linked with industrial processes. Also, institutions can jointly design elective modules with professionals by bringing in industry experts to teach technical subjects.

Focused Mentorship for First-Generation and Rural Students

In order to prepare for interviews and develop professionalism, colleges will have to create relevant support networks. This can be achieved through creating corporate mentorship programs, organizing professional communication clinics at the placement department, and providing globally certified industry certifications to socially/economically challenged students at no cost.

CONCLUSION

The objective of this research paper is to identify the level of convergence between the competencies acquired by the students through higher education and the changing framework of industries in Tamil Nadu state. According to the data, although regional initiatives such as the Naan Mudhalvan scheme have done a decent job in raising the basic technical knowledge of the people in the region, differences in various systems based on geography, access to laptops and funding for subjects are still hampering the performance of the students. These problems can be solved only if the system shifts from the existing theoretical method of teaching to the regional experiential learning model.

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