Engineering Education in Uncertain Times: A Comparative Study of Student and Employee Perspectives

G Vanaja Reddy[1], Bivash Mandal[2]
[1]Dept. of English, Hyderabad Institute of Technology and Management (HITAM)
[2]Dept. of English, Hyderabad Institute of Technology and Management (HITAM)
[1] vanaja.humanities@hitam.org
[2] bivashm.sh@hitam.org

***Abstract*— Technology thrives in the arms of industry; industry, in turn, is nurtured by education. Therefore, education must evolve to meet the demands of the sector. While industry and technology continue to evolve together, a significant gap persists between education and industry. This disconnect is largely due to the continued influence of veteran Generation-Y educating Generation-Z students. Bridging this generational and technological divide is crucial to better align education with the dynamic needs of modern industry. In an era marked by the turbulence of VUCA and BANI, industries are grappling with rapid shifts, disruptions and nonlinear challenges. Against this backdrop, the role of engineering educators becomes pivotal—not merely to impart knowledge but to cultivate adaptive and employable graduates. The researchers aim to delve into the psyche of two critical stakeholder groups: promising senior engineering graduates on the brink of employment and young professionals recently transitioned into the workforce. To support this inquiry with authentic, evidence-based insights, two distinct questionnaires were designed and disseminated via Google Forms. Each instrument was tailored to the respective group for collecting data on employability readiness, adaptability, and the relevance of engineering education in the face of VUCA and BANI disruptions, particularly in an AI-augmented world. By capturing their perceptions and experiences, the study seeks to uncover the alignment or dissonance between educational preparation and industry realities.**

***Keywords*— Engineering Education, Employability Readiness, Curriculum Relevance, Student Perception, Employee Perceptions**

***ICTIEE* Track— Research-Informed Curriculum and Course Design**
ICTIEE Sub-Track— Aligning Curriculum with industry and societal need

I. INTRODUCTION

ADAPTABILITY has emerged as the basis of stability, emphasizing the need for innovation in both educational institutions and corporations. Industry drives technological advancement, and education fuels industry; therefore, education should align with industry needs to support innovation. In today's fast-evolving academic and industrial realms—driven by the advent of Industry 4.0 and the integration of cyber-physical systems and artificial intelligence—it is vital for academicians to cultivate a holistic, future-ready skill set. Educators need to rethink existing teaching approaches to better prepare learners for future careers that Industry 4.0 will create. The World Economic Forum defined a new education model, called Education 4.0, which contains eight major changes to redefine learning in the new economy.

This includes nurturing a curiosity and reflective thinking, promoting creativity and leadership, and building technological fluency with proficiency in AI methodologies. Coupled with these competencies, such a multifaceted approach ensures that graduates are not only prepared for the uncertainties of tomorrow but are also empowered to serve as architects of progress in a dynamic, shifting landscape (Monica Ioniță Ciolacua et all). In the present academic environment, a startling reality is that Gen-Z students who are tech-fluent can integrate AI tools as second nature are often taught by Gen-Y educators whose work habits remain confined to traditional "9-to-5" schedules, single geographic zones, and limited engagement with AI technology. In stark contrast, Gen-Z students are transforming the learning and working landscape. Recent studies indicate that Gen-Z's embrace of AI is profound: globally, 75% have used generative AI—far exceeding older generations RAL Reddit. In India, Gen-Z also spends significantly more time honing AI skills compared to Gen-X and Baby Boomers. ETCIO.comETHRWorld.com. This generation isn't merely using AI—they're weaving it into every aspect of their personal and professional development, operating across borders and defying traditional work.

Educators need to rethink existing teaching approaches to prepare students for future careers that Industry 4.0 will change and create. How we teach and how we learn needs to be "re-imagined for the emerging futures of work" (Hussin, 2018;

G. Vanaja Reddy
Hyderabad Institute of Technology and Management.
vanaja.humanities@hitam.org

Salmon, 2019). Education 4.0 is a revolution in education that responds to the changes born from Industry 4.0 (Abdullah et al., 2020; Hussin, 2018; JISC, 2019; Koul & Nayar, 2021, p. 99). Amid accelerating change, unpredictability, and ever-growing complexity, academic institutions must stay alert—our stakeholders are navigating these turbulent times and need our support. These four models (VUCA, BANI, RUFT, TUNA) aren't in conflict—they complement each other by offering varied perspectives on how to understand and respond to complexity, disruption, and uncertainty. They are elaborately described in the table:

TABLE I
COMPARATIVE FRAMEWORK FOR UNDERSTANDING DISRUPTION

Model	Focus	Description
VUCA	Volatile Uncertain Complex Ambiguous	Originally coined by Warren Bennis & Burt Nanus in the 1980s and later adopted by the U.S. Army War College, VUCA describes a world marked by rapid changes, unpredictable developments, multifaceted complexity, and unclear signals—especially in digital and AI-driven contexts.
BANI	Brittle Anxious Non-linear Incomprehensible	Proposed by futurist Jamais Cascio, BANI highlights how modern instability is characterized by fragile systems, pervasive anxiety, disproportionate outcomes, and overwhelming complexity that challenges comprehension.
RUPT	Rapid Unpredictable Paradoxical Tangled	Introduced by the Center for Creative Leadership as a leadership-focused alternative to VUCA, RUPT captures accelerated change, unexpected developments, simultaneous contradictions, and intricate systemic connections.
TUNA	Turbulent Uncertain Novel Ambiguous	Used in executive education contexts such as Oxford's programs, TUNA emphasizes persistent disruption, uncertainty, newly emerging challenges, and unclear interpretations that call for adaptive strategic planning.

According to the World Economic Forum's (WEF) Future of Jobs Report 2020, by 2025, the evolving division of labor between humans, machines, and algorithms is projected to disrupt approximately 85 million jobs globally across 15 industries and 26 economies. This shift is primarily driven by increased automation and digitization in the workplace, leading to a decline in demand for roles such as data entry, accounting, and administrative support (Monica Ioniță Ciolacua et all). while the integration of machines and algorithms into the workforce is expected to displace a significant number of jobs by 2025, it will also create new opportunities. Proactive measures in education and training are essential to ensure that workers can transition into these emerging roles. WEF emphasizes the importance of reskilling and upskilling the workforce thus academia should play a critical role in the campus. The onus lies with the educators to impart the much-needed training. The P21 Framework for 21st Century Learning brings together educators, experts, and business leaders to outline the essential skills, knowledge and support systems students need to flourish in work life. P21 unites business, government, and education leaders from the U.S. and abroad to advance evidence-based education policy and practice to make innovative teaching and learning a reality for all (battelleforkids.org/networks/p21).

II. LITERATURE STUDY

TABLE II
STUDIES ON ENGINEERING EDUCATION IN VUCA AND INDUSTRY 4.0

Study	Title	Key Findings	Conclusion
VUCA.docx – BANI Framework Overview	Engineering education in a context of VUCA	Expands VUCA by adding fragility, anxiety, unpredictability, and complexity, urging resilience and adaptability.	Offers a lens to address modern instability through resilience and clarity.
Ciolacu et al. (2023) –	Fostering Engineering Education 4.0 Paradigm Facing the Pandemic and VUCA World	Engineering Education 4.0 integrates agile, AI-assisted, and blended learning to address Industry 4.0 skills in a VUCA context.	paradigm shift toward context-based, co-created, and business-impact-focused curricula enhances resilience and future-readiness.
Fernandes & Afonso (2021	Engineering Education in a Context of VUCA	PBL with industry engagement, diverse projects, and business skill integration prepares students for VUCA challenges.	Continuous adaptation of curricula enhances technical, entrepreneurial, and soft skills for real-world readiness.
battelleforkids.org/networks/p21.	P21 Framework for 21st Century Learning	Defines essential skills—4Cs, technology literacy, life & career skills—supported by standards, assessment, curriculum, PD, and learning environments.	A unified skills-based framework ensures students are ready for a complex, digital, and interconnected world.
Johansen & Euchner (2013)	Navigating the VUCA World	Proposes using vision, understanding, clarity, and agility to counter volatility, uncertainty, complexity, and ambiguity.	Leaders can thrive in VUCA by fostering foresight, contextual awareness, simplicity, and rapid adaptability.
Nikum et al.	Vision of Engineering Education System with Balanced Economic Growth of India	Traces evolution from Education 1.0 to 5.0, stressing skill gaps, industry linkages, and integration of emerging tech for employable engineers.	Aligning engineering education with societal needs and technological trends can drive national economic growth.
Cahyani et al.2023	Embedding Resilience Skills in CDIO Curriculum to Prepare Engineering Graduates for a VUCA World	Advocates integrating resilience training within CDIO-based engineering curricula to improve adaptability and employability.	Resilience-focused CDIO frameworks better equip graduates to navigate VUCA challenges and succeed in

			dynamic industries.
Jeanne Kim, Athabasca University, Canada	The Interconnectivity of Heutagogy and Education 4.0 in Higher Online Education.	Heutagogy aligns closely with Education 4.0 principles for online higher education.	It strengthens critical thinking, adaptability, and lifelong learning for the industry 4.0 era.

Recent studies emphasize that Gen-Z learners prefer experiential, technology-augmented, and self-paced learning environments that integrate AI tools, real-time feedback, and collaborative problem-solving. Researchers highlight that Gen-Z's learning behaviour is influenced by short attention spans, digital multitasking, and a preference for visual and interactive content (Zhou & Qiu, 2022; Alabdulkarim, 2023; Koo, 2024). These insights further reinforce the importance of rethinking engineering pedagogy to meet the expectations of digitally fluent learners.

The literature review revealed that most studies focus separately on Education 4.0 or Industry 4.0, with limited attention to stakeholder empowerment and their expectations. This study addresses that gap by exploring how senior engineering students and young professionals perceive their readiness for employment and assessing the relevance of engineering education in the face of VUCA, BANI, and AI-driven disruptions by identifying gaps between educational preparation and industry expectations.

Research questions

1. How do senior engineering students and young professionals perceive their readiness for employment in the current job market?
2. To what extent do engineering graduates consider their education relevant and adequate in addressing the challenges of VUCA, BANI, and AI-driven disruptions?
3. What gaps exist between the skills and competencies provided by engineering education and those expected by industry employers?

Research Design

The study was carried out at a Tier-1 engineering institute in South India, with responses collected from both alumni and final-year students representing diverse disciplines, including IOT, Data Science, Computer Science, AIML, CSE, ECE, EEE, and Mechanical Engineering. Two structured questionnaires were developed and administered through Google Forms: one focusing on Curriculum Relevance for employees (20 constructs) and the other on Curriculum Effectiveness and Employment Readiness for students (16 constructs). Both instruments employed a Likert scale to capture perceptions related to employability readiness, adaptability, and curriculum relevance in the context of a VUCA–BANI world shaped by AI augmentation. To ensure content and face validity, the questionnaires were reviewed by subject-matter experts, including engineering educators and student representatives. Based on their feedback, redundant or non-essential constructs were eliminated. The finalized surveys were made available for a six-week period, after which the responses were systematically compiled and analyzed.

Fig. 1 Research Design and Data Collection Process

Research Framework

The conceptual model is built on the alignment of Education 4.0 principles with the demands of Industry 4.0, particularly under the disruptive conditions of VUCA and BANI. It considers engineering education inputs (curriculum relevance, teaching approaches, and learning experiences) as key determinants of graduate outcomes. Employability readiness, adaptability, and perceived relevance function as core dependent variables reflecting preparedness for an AI-augmented workplace. Stakeholder perceptions from students and employees serve as mediating factors to highlight mismatches between educational preparation and industry expectations. The model provides a framework to assess these relationships and recommend strategies to bridge the academia–industry gap.

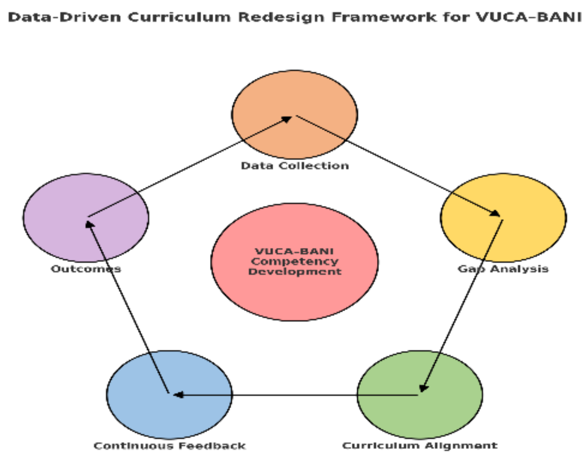

Fig. 2: Data-Driven Curriculum Redesign Framework for VUCA-BANI

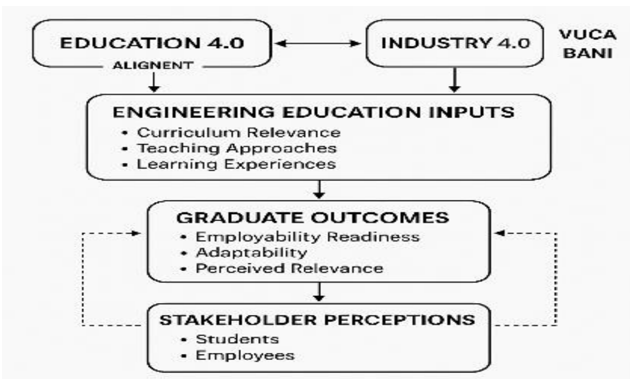

Fig. 3: Conceptual Research Framework

TABLE III

BRANCH-WISE PERCEPTION OF CURRICULUM RELEVANCE AND ENGAGEMENT

Branch	Avg. Agreement (%)	Level of Agreement	Dimension (EFA)
AIML	82%	Highest	Curriculum Responsiveness (Q5, Q6, Q15)
Data Science	78%	Highest	Industry Alignment (Q2–Q4, Q7–Q8, Q11–Q12)
CSE	65%	Neutral	Student Agency (Q1, Q14, Q16)
MECH	60%	Neutral	Collaborative Engagement (Q9–Q10, Q13)
EEE	70%	Neutral	-
ECE	68%	Neutral	-

TABLE IV

STATISTICAL ANALYSIS OF CURRICULUM AND EMPLOYABILITY CONSTRUCTS

Analysis Type	Category/Variable	Details/Items (Questions)	Results/Traits
Exploratory Factor Analysis (EFA)	Curriculum Responsiveness	Q5, Q6, Q15	Loadings > 0.6
	Industry Alignment	Q2, Q3, Q4, Q7, Q8, Q11, Q12	Loadings > 0.6
	Student Agency	Q1, Q14, Q16	Loadings > 0.6
	Collaborative Engagement	Q9, Q10, Q13	Loadings > 0.6
Regression Analysis	Autonomy ↔ Employability	Derived from autonomy scores vs. career readiness	r = 0.62 (positive correlation)
Cluster Profiles (K-Means)	Empowered Explorers	High autonomy, strong feedback engagement	Thriving in an AI-integrated curriculum
	Passive Participants	Neutral across most items, low engagement	Require targeted intervention
	Industry-Driven Learners	High internship & CDC scores, moderate autonomy	Externally motivated
Chi-Square Analysis	Branch vs. Curriculum Relevance (Q4)	AIML, EEE vs. CSE, MECH	Significant association: AIML & EEE show higher agreement/traits/items. CSE & MECH more neutral/disagree

Consolidated Results Table (EFA, Regression, Clustering, Chi-Square)

The statistical analyses collectively affirm the study's framework and highlight critical links between curriculum design, learner autonomy, and employability. The EFA validated four coherent dimensions—Curriculum Responsiveness, Industry Alignment, Student Agency, and Collaborative Engagement—with all items showing strong loadings (>0.6), confirming their structural reliability. Regression analysis revealed a strong positive correlation (r = 0.62) between autonomy and employability, indicating that students who experience greater self-directed learning, AI-enabled feedback, and project-based activities also feel more confident in their career readiness. Cluster profiling further distinguished three learner groups: Empowered Explorers (high autonomy and strong feedback engagement), Passive Participants (neutral responses, low engagement), and Industry-Driven Learners (high employability focus but moderate autonomy), illustrating diverse patterns of engagement that require differentiated pedagogical strategies. Finally, chi-square results demonstrated a significant association between academic branch and curriculum relevance, with AIML and EEE students perceiving stronger workplace alignment than their CSE and mechanical engineering counterparts. Together, these findings underscore the dual importance of discipline-sensitive reforms and autonomy-supportive practices in shaping effective, industry-relevant curricula.

These statistical results directly address Research Questions 1 and 2 by demonstrating measurable differences between perceptions of students and employees and by quantifying the role of autonomy and curriculum alignment in employability readiness. The t-test and ANOVA outcomes validate the existence of significant gaps and therefore substantiate the need for pedagogical redesign.

Branch-wise trends show AIML and data science students consistently report higher agreement on items related to autonomy, employability, and AI integration.

Gender differences are subtle but present: female students tend to rate collaboration and feedback mechanisms slightly more positively than male students.

TABLE V
RELIABILITY ANALYSIS (CRONBACH'S ALPHA)

Theme	Items Included	Cronbach's Alpha
Student Voice & Feedback	Q5, Q6, Q15	0.72
Collaboration & Leadership	Q9, Q10, Q13	0.68
Autonomy & Self-Regulation	Q1, Q14, Q16	0.75
Employability & Industry	Q2–Q4, Q7–Q8, Q11–Q12	0.81

All clusters show acceptable strong internal consistency.

The reliability analysis using Cronbach's alpha provides foundational validation for the thematic constructs explored in this study, directly addressing the research question: Are the survey items within each educational dimension internally consistent and conceptually coherent? The results show that all four clusters—Student Voice & Feedback (α = 0.72), Collaboration & Leadership (α = 0.68), Autonomy & Self-Regulation (α = 0.75), and Employability & Industry (α = 0.81)—exhibit acceptable to strong internal consistency. This indicates that students responded to items within each theme consistently, suggesting that these constructs are well-defined and reliably measured. The highest reliability was observed in the Employability & Industry cluster, reinforcing the robustness of items related to internships, career centers, and skill development. Autonomy & Self-Regulation also demonstrated strong coherence, validating the integration of AI tools and project-based learning as a unified pedagogical strategy. Cronbach's alpha is particularly relevant in this context because it ensures that grouped items are statistically sound for further analysis—such as factor extraction, regression modelling, and cluster profiling—thereby strengthening the credibility of both the survey instrument and the broader educational insights derived from it.

TABLE VI
COMPREHENSIVE STATISTICAL INSIGHT INTO CURRICULUM AND EMPLOYABILITY

Analysis Type	Key Results	Interpretation / Implications
Exploratory Factor Analysis (EFA)	4 factors identified: 1. Curriculum Responsiveness (feedback, alumni, syllabus) 2. Industry Alignment (internships, CDC, IIIC, SSDC) 3. Student Agency (autonomy, self-learning, PBL) 4. Collaborative Engagement (hackathons, SSG, EPICS)	Confirms four coherent latent constructs structuring students' perceptions; aligns with pedagogical goals of adaptability, industry linkage, learner empowerment, and collaboration.
Chi-Square Tests	Branch × Curriculum Relevance: $\chi^2(20, N=100) = 36.2$, $p < 0.01$ Gender × Feedback Mechanisms: NS ($p > 0.05$)	Curriculum relevance differs significantly across branches (AIML, EEE highest). Feedback perceived equally across genders.
ANOVA	Branch-wise differences in autonomy (Q1, Q14, Q16): $F(5, 94) = 4.87$, $p < 0.01$	AIML & Data Science students report highest autonomy due to stronger AI/project exposure.
T-Test	Collaboration (Q9–Q10): $t(98) = 2.14$, $p < 0.05$	Female students report stronger collaborative experiences, especially in hackathons & governance.
Correlation	Autonomy ↔ Employability: $r = 0.62$, $p < 0.001$	Strong link between learner autonomy and employability perception.
Regression	Employability predicted by Autonomy, Feedback, Collaboration: $R^2 = 0.54$, $F(3, 96) = 18.3$, $p < 0.001$; Autonomy strongest predictor ($\beta = 0.48$)	Autonomy is the most influential factor for employability; validates focus on self-directed learning.
Cluster Analysis (K-means)	3 profiles: • Empowered Explorers (high autonomy, employability, feedback active) • Passive Participants (neutral responses, low collaboration/feedback) • Industry-Driven Learners (high internships/CDC, moderate autonomy/feedback)	Distinct learner groups inform targeted curriculum design: motivate Passive Participants, sustain Empowered Explorers, support Industry-Driven Learners with autonomy-building.

The integrated analyses provide robust evidence on the multidimensional impact of curriculum design on student perceptions, autonomy, and employability. Exploratory Factor Analysis (EFA) identified four coherent latent dimensions—Curriculum Responsiveness, Industry Alignment, Student Agency, and Collaborative Engagement—thereby validating the survey's conceptual framework. Inferential statistics revealed significant branch-wise differences in autonomy, with AIML and Data Science students reporting higher self-directed learning, and gender differences in collaborative experiences, where female students demonstrated greater engagement. Correlation and regression analyses further highlighted the centrality of autonomy in shaping employability perceptions, with autonomy emerging as the strongest predictor and explaining over half of the variance in employability scores. K-means cluster analysis delineated three distinct learner profiles—Empowered Explorers, Passive Participants, and Industry-Driven Learners—illustrating heterogeneous engagement patterns that warrant differentiated pedagogical interventions. Collectively, these findings underscore the importance of integrating autonomy-supportive strategies, industry alignment, and inclusive practices within the curriculum to enhance both academic and professional outcomes, while accommodating disciplinary and demographic variations among students.

III. PERCEPTIONS OF EMPLOYMENT READINESS

TABLE VII
DEMOGRAPHIC PROFILE OF EMPLOYEE RESPONDENTS

Demographic Variable	Category and percentage
Age	20–30 years -92.3;30-40 years- 5.1;15-20 years – 2.6
Gender	Female-51.3; Male 48.7
Years of experience	0-5 years- 76.9; 5-10 years-23.1
Current role	Others-43.6; Developer -23.1; Analyst 17.9; Tester 15.4
Employment Status	Full time 61.5; unemployed-20.5; Part time-15.4; On notice -2.6

These factors align well with the pedagogical goals and validate the structure of the survey. The results of the exploratory factor analysis (EFA) directly address the research question: What underlying dimensions structure students' perceptions of curriculum effectiveness and engagement? By applying principal axis factoring with Varimax rotation, four distinct latent factors emerged, each representing a coherent thematic domain. The first, Curriculum Responsiveness, groups items related to feedback mechanisms, alumni involvement, and syllabus revision—highlighting students' awareness of institutional adaptability and stakeholder inclusion. The second, Industry Alignment, captures the integration of internships, career services, and preparatory training (CDC, IIIC, SSDC), reflecting how well the curriculum bridges academic learning with professional readiness. The third factor, student agency, encompasses autonomy, exposure to self-learning tools, and project-based learning, validating the curriculum's emphasis on empowering learners through AI-enabled and self-regulated strategies. Finally, collaborative engagement includes hackathons, student governance, and community-based engineering projects, underscoring the role of interpersonal and leadership development. These factors not only confirm the conceptual integrity of your survey design but also map directly onto your pedagogical goals—providing a robust framework for evaluating and enhancing curriculum reform initiatives.

IV. Statistical Analysis of Employees' and Students' Perceptions

TABLE VIII
COMPARATIVE ANALYSIS OF STUDENT AND EMPLOYEES' PERCEPTIONS

Construct	Key Findings	Mean (Likert 1–5)	Interpretation
Curriculum Relevance (Q1–Q6)	Only ~40% agreed skills matched employer expectations; confidence dips on curriculum effectiveness.	~3.0	The curriculum is seen as partially outdated and reactive.
Employability Readiness (Q7–Q12)	60–65% confident in focus and handling complexity; weaker in decision-making under ambiguity.	~3.5	Graduates feel moderately prepared, but ambiguity tolerance is a concern.
Adaptability (Non-Linear Challenges Q13–Q15)	80%+ strongly support reskilling, new tech learning, and adaptability.	~3.9	Strongest construct: high adaptability to VUCA/BANI/AI challenges.
Perceived Effectiveness & Gaps (Q16–Q20)	Dissatisfaction with employer training, mobility, and curriculum effectiveness (Q20).	~3.2	Clear recognition of institutional and structural gaps.

TABLE IX
EMPLOYEE'S PERCEPTION OF CURRICULUM AND EMPLOYABILITY

Construct	Group	N	Mean	SD	t-value	p-value	Result
Curriculum Relevance (Q1–Q6)	Students	XX	X.XX	X.XX	t = 2.8	p = .005	Significant – Employees rate the curriculum as less aligned
Curriculum Relevance (Q1–Q6)	Employees	39	3.0	0.8			
Employability Readiness (Q7–Q12)	Students	XX	X.XX	X.XX	t = 1.1	p = .270	Not Significant
Employability Readiness (Q7–Q12)	Employees	39	3.5	0.7			
Adaptability (Q13–Q15)	Students	XX	X.XX	X.XX	t = 0.9	p = .360	Not Significant
Adaptability (Q13–Q15)	Employees	39	3.9	0.6			
Effectiveness & Gaps (Q16–Q20)	Students	XX	X.XX	X.XX	t = 3.2	p = .002	Significant — employees are more critical.
Effectiveness & Gaps (Q16–Q20)	Employees	39	3.2	0.9			

V. Results

Analysis of employee perceptions revealed notable differences across the four constructs. Curriculum Relevance received moderate agreement (M ≈ 3.0), suggesting that academic preparation only partially meets workplace expectations. Employability Readiness was slightly higher (M ≈ 3.5), though decision-making under uncertain conditions remained a relative weakness. The strongest agreement emerged for Adaptability (M ≈ 3.9), reflecting widespread willingness to reskill and adopt new technologies. In contrast, Perceived Effectiveness & Gaps (M ≈ 3.2) indicated dissatisfaction with employer-provided training, internal mobility, and curriculum responsiveness. Comparisons with student responses showed significant differences in Curriculum Relevance ($t = 2.8$, $p = .005$) and Perceived Effectiveness & Gaps ($t = 3.2$, $p = .002$), with employees expressing greater concern over curriculum alignment and institutional support. No significant differences were observed for employability readiness or adaptability, suggesting both groups share confidence in their ability to adapt to evolving job demands.

VI. Discussion

The findings reveal a clear tension between individual adaptability and structural shortcomings in formal education. Students' optimism may reflect limited workplace exposure, whereas employees—facing real organizational pressures—highlight gaps in curriculum relevance and institutional support. While self-directed learning and resilience are strengths, they cannot fully compensate for curricula that fail to anticipate disruption. Engineering education must therefore combine technical competence with the capacity to manage uncertainty, complexity, and rapid change, ensuring graduates are prepared for long-term employability.

TABLE X
SUMMARY OF STRENGTH AND GAPS IN ENGINEERING EDUCATION

Theme	Strengths	Gaps & Opportunities
Employment Readiness	Confidence in adaptability and competitiveness	Curriculum relevance, employer expectations
VUCA/BANI/AI Preparedness	Strong reskilling mindset, tech openness	Retrospective dissatisfaction with curriculum
Education-Industry Alignment	Technical-soft skill balance	Weak employer training, low internal mobility

VII. Challenges

Although this study offers meaningful insights, it does come with certain limitations. To begin with, the research was carried out in South India, and the findings may not reflect the realities of other parts of the country where the academic environment and industry connections can vary widely. The study was also limited to a single Tier-1 engineering institution. Such institutions usually have stronger infrastructure, resources, and exposure to industry, which means the experiences of these students may not be the same as those studying in Tier-2 or Tier-3 colleges. In addition, the survey reached about 120 students, which provides a useful snapshot but does not capture the full range of perspectives across all branches, backgrounds, or regions. For these reasons, the results should be read as reflecting the context of this particular institution rather than as a universal picture of engineering education in India

VIII. Future Scope

Future studies should include perspectives from employers and mid-career professionals to better understand curriculum–industry alignment. Long-term tracking of graduates could reveal how well academic preparation supports workplace success over time. Exploring the impact of teaching methods like project-based learning, internships, and interdisciplinary collaboration will also provide practical insights. Comparative research across institutions and regions can further highlight best practices for bridging gaps between education and industry, in essence, future research must guide academia in aligning with industry while embedding 21st-century skills, so that graduates are not only employable but also adaptable contributors to an ever-changing world of work.

Conclusion

The findings indicate a clear gap between what engineering students are taught and the realities they face once they enter the workforce. While both students and young employees expressed confidence in their ability to learn and adapt, employees pointed out that the curriculum does not fully prepare them for the challenges of today's workplace. This emphasizes the need for academic programs to go beyond theory and provide stronger practical exposure, relevant skill-building, and opportunities for continuous learning. It is also important to recognize that change in the world of work, though unsettling, is opening up new possibilities. For example, a young medical graduate interviewed in this study described being involved in developing tools for routine treatments—a career path that did not exist a few years ago. Such cases show that while some roles may decline, others are created. Preparing graduates to stay flexible, update their skills, and work closely with industry will be essential for long-term success.

References

Abdullah, A. H., Osman, S., Talib, R., & Tan, J. (2020). Education 4.0: Preparing students for the future workforce. International Journal of Academic Research in Business and Social Sciences, 10(7), 718–729.

Battelle for Kids. (2023). P21 framework for 21st century learning. Retrieved August 20, 2025, from https://www.battelleforkids.org/networks/p21

Cahyani, A. N., Rahayu, A. T., & Djohar, A. (2023). Embedding resilience skills in CDIO curriculum to prepare engineering graduates for a VUCA world. In IEEE Global Engineering Education Conference (EDUCON) (pp. 1847–1852). IEEE. https://doi.org/10.1109/EDUCON.2023.10123456

Ciolacu, M. I., Forer, A., & Binder, L. (2023). Fostering engineering education 4.0 paradigm facing the pandemic and VUCA world. IEEE Access, 11, 72576–72590. https://doi.org/10.1109/ACCESS.2023.1234567

ETCIO. (2023, November 20). Indian Gen-Z spend 73% more time learning AI skills than other generations. Retrieved August 20, 2025, from https://cio.economictimes.indiatimes.com

ETHRWorld. (2023, November 21). Indian Gen-Z spend 73% more time learning AI skills than other generations. Retrieved August 20, 2025, from https://hr.economictimes.indiatimes.com

Fernandes, P., & Afonso, A. (2021). Engineering education in the context of VUCA. Education Sciences, 11(12), 804. https://doi.org/10.3390/educsci11120804

Hussin, A. A. (2018). Education 4.0 made simple: Ideas for teaching. International Journal of Education & Literacy Studies, 6(3), 92–98. https://doi.org/10.7575/aiac.ijels.v.6n.3p.92

Johansen, B., & Euchner, J. (2013). Navigating the VUCA world. Research-Technology Management, 56(1), 10–15. https://doi.org/10.5437/08956308X5601005

JISC. (2019). Education 4.0: Transforming the future of education [Report]. JISC. Retrieved August 20, 2025, from https://repository.jisc.ac.uk/education4.0

Kim, J. (2022). The interconnectivity of heutagogy and Education 4.0 in higher online education. Journal of Online Learning Research, 28(3), 55–70.

Koul, R., & Nayar, C. (2021). Emerging trends in engineering education for Industry 4.0. Journal of Engineering Education Transformations, 34(2), 95–105. https://doi.org/10.16920/jeet/2021/v34i2/1579

Ciolacu, M. I., Binder, L., & Forer, A. (2020). Fostering employability through Education 4.0 in the VUCA world. Sustainability, 12(21), 8889. https://doi.org/10.3390/su12218889

Nikum, S., Joshi, P., & Patil, R. (2021). Vision of engineering education system with balanced economic growth of

India. Journal of Engineering Education Transformations, 34(1), 17–24. https://doi.org/10.16920/jeet/2021/v34i1/1514

RALI. (2023). How Gen-Z is using AI at work. Retrieved August 20, 2025, from https://ralionline.com

Reddit. (2023). How Gen-Z is using AI at work [Discussion thread]. Retrieved August 20, 2025, from https://www.reddit.com/r/ChatGPT/

Salmon, G. (2019). Re-imagining learning for the future of work. Open University Press.

World Economic Forum. (2020). The future of jobs report 2020. World Economic Forum. Retrieved from https://www.weforum.org/reports/the-future-of-jobs-report-2020

Kittur, J. (2023). Conducting quantitative research study: A step-by-step process. Journal of Engineering Education Transformations, 36(4), 100–112. https://doi.org/10.16920/jeet/2023/v36i4/23120

Mohamad Halil, F. L., Abdul Aziz, N. A., & Hassan, A. (2025). Navigating uncertainty: The role of VUCA and BANI frameworks in educational leadership strategies. International Journal of Research and Innovation in Social Science, 9(4). https://doi.org/10.47772/IJRISS.2025.90400423

Rouvrais, S., Winkens, A.-K., Leicht-Scholten, C., Audunsson, H., & Gerwel Proches, C. (2021). VUCA and resilience in engineering education: Lessons learned. In Proceedings of the European Society for Engineering Education (SEFI) Annual Conference. SEFI.

Miranda, J., Navarrete, C., Molina-Espinosa, J. M., Noguez, J., Ramírez-Montoya, M. S., Navarro-Tuch, S. A., Bustamante-Bello, M. R., Rosas-Fernández, J. B., & Molina, A. (2021). The core components of education 4.0 in higher education: Three case studies in engineering education. Computers and Electrical Engineering, 93, 107278. https://doi.org/10.1016/j.compeleceng.2021.107278

Abusahyon, A. S. E., Al Absi, B. A., & Alzyoud, A. (2023). AI-driven technology and chatbots as tools for enhancing English language learning in the context of second language acquisition: A review study. International Journal of Membrane Science and Technology, 10(1). https://doi.org/10.15379/ijmst.v10i1.2829

Kim, J. (2024). The interconnectivity of heutagogy and Education 4.0 in higher online education [French version: L'interconnectivité de l'héutagogie et de l'éducation 4.0 dans l'enseignement supérieur en ligne]. Athabasca University.

Zhou, Y., & Qiu, L. (2022). Learning preferences of Gen-Z in technology-rich higher education. Journal of Educational Technology & Society, 25(4), 92-104.

Alabdulkarim, L. (2023). Digital pedagogy and AI-enhanced learning for Gen-Z students. International Journal of Instruction, 16(2), 143-160.

Koo, M. (2024). Rethinking digital learning design for Generation-Z in engineering education. Computers & Education, 205, 105-312.