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FUTURE CAREERS: MERGING SUSTAINABILITY WITH TECHNOLOGY EXPERTISE

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ABSTRACT

As technological advancements and sustainability imperatives reshape the job market, educational systems must evolve to prepare students for future technical careers. This article explores the readiness of educational institutions to equip students with the skills necessary for sustainable and technological roles. Drawing on findings from a comprehensive study, it examines how integrating sustainability principles and digital literacy into technical education can address emerging career demands. The research highlights the importance of curriculum updates, industry-academia collaborations and supportive policies in fostering a workforce capable of navigating the complexities of a sustainable and technologically advanced future. This article offers practical insights and recommendations to bridge the gap between current educational practices and the evolving job market requirements.

Keywords – Technical Education, Sustainability, Career Readiness, Digital Awareness, Curriculum Development

1. INTRODUCTION

In an era where technological advancements and sustainability are at the forefront of global priorities, educational systems must evolve to prepare students for the careers of tomorrow. This article examines the readiness of educational institutions and industries in equipping students with the skills necessary for emerging careers in technology and sustainability. Based on a comprehensive study, the research highlights the critical role of integrating sustainability principles and digital literacy into curricula. Emphasizing the need for curriculum updates, industry-academia collaborations and supportive policies, this article aims to address the gap between current educational practices and the evolving demands of the job market. By fostering a workforce adept at navigating technological advancements and sustainable development challenges, we can ensure a future-ready and resilient generation of professionals.

1.1 Changing landscape of Technical Careers

Technological innovations such as artificial intelligence, robotics and data analytics are transforming industries, leading to the creation of new technical roles. Careers in renewable energy, environmental technology and sustainable manufacturing are becoming increasingly important. These changes necessitate a workforce that is skilled in both cutting-edge technologies and sustainability practices.

1.2 Educational Readiness for Sustainable Technical Careers

Many educational systems are still based on traditional approaches, which can be inadequate for preparing students for modern technical careers. Updating curricula to include sustainability principles is essential. This involves fostering digital literacy, technical proficiency and an understanding of sustainable practices. Educational institutions must also emphasize critical thinking, problem-solving and adaptability to prepare students for the dynamic nature of technical careers.

2. LITERATURE REVIEW

UNESCO (2024), published the article in International Institute for Educational Planning, under the title "4 Lessons on the Sustainable Use of Digital Technology for Transforming Education". UNESCO outlined the strategies for integrating digital technologies into educational planning and management. Successful initiatives align technology with national digital policies and educational goals, ensuring consistency and community involvement across all government levels. Maintaining organizational autonomy from political and business interests is crucial, achieved through transparent processes and stakeholder dialogue. Scaling education technology can be enhanced through public-private partnerships, improving access and equity by reaching marginalized populations. Finally, incorporating robust monitoring and evaluation systems allows for

continuous learning and evidence-based decision-making, ensuring interventions remain effective and adaptable.

The GEM Report by UNESCO, (2023), titled "Technology in Education: A Tool on Whose Terms?", explored the global use of technology in education through the lenses of relevance, equity, scalability and sustainability. The report emphasizes that education systems must prioritize learners' interests and utilize digital technologies to enhance, not replace, human interaction. It highlights the potential of technology to reach disadvantaged learners and disseminate knowledge in more engaging and affordable ways. The report also addresses improving the quality of teaching and learning basic and digital skills essential for daily life and it acknowledges technology's role in managing education systems, particularly through assessment data and education management information.

Yun Li et al, (2022), in the article, "Using Emerging Technologies to Promote Creativity in Education: A Systematic Review, emphasized the importance of fostering creativity in students to prepare them for an unpredictable world. The study reviewed current research on how digital tools and emerging technologies can enhance creativity in educational settings. Findings show that these technologies positively impact creativity, especially within interactive learning environments. However, the review also identifies significant issues in existing research, such as unclear implementation processes, insufficient study design details and inadequate methods for measuring creativity. Addressing these gaps is crucial for effectively leveraging technology to boost creativity in education.

Anna Sung et al, (2020), in the article "Emerging Technologies in Education for Sustainable Development," highlighted the crucial role of education in achieving sustainability development goals by influencing behavior. The study discusses how technology can enhance Education for Sustainable Development (ESD) by promoting and evaluating behavior changes in learners. Effective application of technology in ESD requires a robust partnership between educators and technologists, which can accelerate educational innovation, inspire new teaching methods, improve learner experiences and expand access to skills and resources.

Nicholas C et al, (2020), in his article, "Five Trends of Education and Technology in a Sustainable Future, highlighted the critical role of education in sustainable development, as emphasized in the United Nations 2030 Agenda. The article discusses how new digital technologies are transforming educational aims, contexts, processes and governance, both in formal and informal settings. While these innovations hold significant promise for educational reform and sustainability, they also present risks that must be managed. Achieving sustainable educational reform requires a willingness to rethink and potentially abandon traditional educational practices. This balance of embracing new possibilities and mitigating dangers is essential for the future quality of human life and global sustainability.

3. RESEARCH METHODOLOGY

The research methodology involved using a structured questionnaire with 82 questions across 9 constructs, focusing on technical education, sustainability, career readiness, digital literacy and curriculum development. Data collection included responses from principals, department heads and placement officers of 36 educational institutions. The study used a descriptive approach with multistage random sampling and a sample size of 220 respondents. This mixed-method approach provided a holistic understanding of perspectives from industry and academia, facilitating a comprehensive analysis of sustainability integration in technical education and its impact on career readiness amid a dynamic job market.

4. FINDINGS AND DISCUSSIONS

Table 4.1 Frequency analysis on Digital Concept Awareness from Institution Respondents

Characteristics	*f*	*%*
Artificial Intelligence and Machine Learning		
Aware	195	88.6
Not Aware	25	11.4
Data Analytics		
Aware	176	80
Not Aware	44	20
Automation and Robotics		
Aware	181	82.3
Not Aware	39	17.7
Digital Forensics		
Aware	109	49.5
Not Aware	111	50.5
Edge Computing		
Aware	97	44.1
Not Aware	123	55.9
Cloud Computing		
Aware	164	74.5
Not Aware	56	25.5
IoT		
Aware	181	82.3
Not Aware	39	17.7
Deep Learning and NLP		
Aware	152	69.1
Not Aware	68	30.9

The data from Table 4.1 highlights a strong understanding and engagement with advanced technologies among respondents. Familiarity rates ranging from 69.1% to 88.6% for components like Artificial Intelligence, Data Analytics, Automation, Cloud Computing, IoT and Deep Learning/NLP indicate a high level of digital literacy and readiness for cutting-edge technologies. However, Digital Forensics and Edge Computing showed more balanced responses, suggesting differing levels of awareness in these areas. Overall, the data portrays a digitally adept population ready to harness technological advancements across various domains.

Table 4.2 Mean and Standard Deviation for Institution Curriculum Contribution

No	*Curriculum Contribution*	*M*	*SD*
1	I have advanced technical concepts in my curriculum to empower students' knowledge and skills	4.36	1
2	I am about to introduce the advanced technical concepts in my curriculum	3.82	1.17
3	I do not have advanced technical concepts in my curriculum	2.49	1.27
4	I feel the industry will not suit all the program of the institution	3.02	1.22
5	The advanced technical concepts curriculum implementation will not support the rural colleges	2.7	1.18
6	Need of one or two Advanced technical concepts courses in the regular curriculum is enough	3.6	1.06
7	Introduction of new program / degree alone will satisfy the advanced technical concepts content	3.47	1.14
8	Government/University can play a significant role in realizing Advanced technical concepts in the curriculum	4.44	0.5
9	Implementation of Advanced technical concepts in curriculum improves institution / university competitiveness at the international stage	4.35	0.59

Table 4.2 reflects nuanced perspectives on advanced technical concepts in curricula. The highest mean score of 4.36 indicates strong agreement on their empowering effect. However, a lower mean score of 2.49 highlights a lack of such content, signaling a need for inclusion. Concerns about suitability (mean score 3.02) and adaptability in rural settings (mean score 2.70) are evident. While there's a preference for limited integration (mean score 3.60), acknowledgment of competitiveness impact (mean score 4.35) and government/university roles (mean score 4.44) is notable. This mix underscores diverse viewpoints, emphasizing the complexity of integrating advanced technical concepts in curricula.

Table 4.3 Mean and Standard Deviation for Graduate Readiness

No	*Graduate Readiness*	*M*	*SD*
1	My students are meritorious and ready for new concepts	4.28	0.69
2	I have maximum of rural students with limited adoptions	3.55	1.13
3	My students do not enable with equipment at home	3.38	1.29
4	My students are able to leverage on digital tools for collaboration and remote connectivity	3.91	0.93
5	My institution facilitating the student's readiness for technical concepts	4.2	0.7
6	We use digital tools for knowledge management and skill enhancement of students	4.28	0.56
7	I have skilled professionals to get ready my students' technical concepts	3.89	0.84
8	My students are provided with affordable online program in technical concepts	4	0.81

Mean scores from Table 4.3 reveal a positive perception on graduate readiness for Advanced technical concepts (mean score 4.20). While challenges like rural students' limited adoptions (mean score 3.55) and lack of home equipment (mean score 3.38) exist, efforts to enhance readiness through skilled professionals (mean score 3.89) and affordable online programs (mean score 4.00) show proactive initiatives. Overall, the data reflects a proactive approach in preparing graduates for the evolving technological landscape, albeit with room for improvement in addressing rural challenges.

Table 4.4 Mean and Standard Deviation for Industry Tie-up

No	*Industry tie-up*	*M*	*SD*
1	My institution is having Industry collaboration to train emerging skills for student and faculty members	4.09	0.76
2	My institution is having Industry collaboration under CSR initiative for intern and skill courses	3.89	0.9
3	My institution is having limited collaboration with industries	3.3	1.12

4	The Government and universities are offering wide range of online programs with the collaboration of industries	3.98	0.8
5	I have industry tie-up with financial commitment to have industry module curriculum	3.4	1.09
6	Industries are not willing to collaborate with institutions	3.07	1.11

Table 4.4 demonstrates a mixed landscape in industry tie-ups. A high mean score of 4.09 reflects strong agreement with industry collaboration for skills training, followed by CSR initiatives (mean score 3.89). However, challenges like limited collaboration (mean score 3.30), financial constraints (mean score 3.40) and industry reluctance (mean score 3.07) are evident. Positive perceptions on online programs (mean score 3.98) show potential. Institutions should address these barriers to foster stronger ties with industries for mutual benefit and skill development.

Table 4.5 Mean and Standard Deviation for Institutional Readiness

No	*Institutional Readiness*	*M*	*SD*
1	My institution is ready to meet out the job demand due to Advanced technical concepts	4	0.71
2	My institution is having streamlined curriculum to meet out the job demand due to Advanced technical concepts	4.09	0.72
3	My institution is equipped with digital ready faculties to meet out the academic demand due to Advanced technical concepts	3.95	0.74
4	My institution is having well equipped infrastructure to meet out the job demand due to Advanced technical concepts	3.89	0.8
5	My institution is developing digital ready graduates to meet out the job demand due to Advanced technical concepts	3.93	0.72
6	I know that advanced technical concepts can produce skilled work force in the labor market	3.94	0.78

Table 4.5 reveals a positive outlook on institutional readiness for Advanced technical concepts, with high mean scores indicating proactive efforts. Institutions show readiness in curriculum alignment (mean score 4.09), job demand readiness (mean score 4.00), faculty digital readiness (mean score 3.95), infrastructure readiness (mean score 3.89) and graduate preparation (mean score 3.93). The understanding of Advanced technical concepts' potential (mean score 3.94) further underscores readiness. These findings collectively indicate institutions' preparedness to navigate the challenges and opportunities of Advanced technical concepts, ensuring graduates are well-equipped for the modern job market.

Table 4.6 Difference of opinion between the constructed variables of institution readiness and the location of institutions

Group Statistics					
Factors	***Institute Location***	***M***	***SD***	***t-value***	***p value***
Curriculum Contribution	Rural	3.47	0.37	-2.392	0.018
	Urban	3.64	0.53		
Industry tie-up	Rural	3.66	0.61	0.679	0.498
	Urban	3.6	0.59		
Graduate Readiness	Rural	3.93	0.37	-0.09	0.928
	Urban	3.94	0.45		
Institutional Readiness	Rural	4	0.51	-0.016	0.987
	Urban	4	0.52		

Table 4.6, show the analysis comparing perceptions between rural and urban institutions reveals a significant difference in curriculum contribution (t-value = -2.392, $p = 0.018$, $p < 0.05$), where rural institutions scored lower on average. However, no significant differences were found in perceptions of industry tie-ups (t-value = 0.679, $p = 0.498$, $p > 0.05$), graduate readiness (t-value = -0.09, $p = 0.928$, $p > 0.05$), or institutional readiness (t-value = -0.016, $p = 0.987$, $p > 0.05$) between rural and urban institutions. These findings suggest a specific need for improvement in curriculum contributions in rural settings compared to urban counterparts, while other aspects such as industry collaborations, graduate preparedness and institutional readiness do not show significant disparities based on location.

5. Findings

The analysis indicates a notable disparity in the perceptions of curriculum contribution between rural and urban institutions, with rural institutions scoring lower on average. This suggests a specific need for improvement in curriculum offerings and contributions in rural settings to align with the demands of technological advancements. However, no significant differences were found in perceptions related to industry tie-ups, graduate readiness, or institutional readiness between rural and urban institutions. This implies that while rural institutions may face challenges in curriculum enhancement, they are on par with urban institutions in terms of industry collaborations, graduate preparedness and institutional readiness for advanced technological skills.

6. Implications

The findings underscore the importance of targeted interventions to enhance curriculum contributions in rural institutions, focusing on digital literacy, advanced technical concepts and industry relevance. Institutions in rural settings may benefit from tailored support, such as capacity building programs, industry partnerships and curriculum development initiatives, to bridge the gap and ensure students' readiness for sustainable and technological careers. Additionally, there is a broader implication for all institutions to prioritize digital literacy and industry collaborations to prepare students effectively for the evolving job market and contribute to sustainable development initiatives. Collaboration between governments, universities and industries is crucial in providing the necessary resources and frameworks to address these challenges and foster a future-ready workforce across all educational settings.

7. Conclusions

The journey towards sustainable and technological careers requires a holistic approach encompassing curriculum enhancement, industry collaboration and digital literacy initiatives. While rural institutions may need targeted support to bridge gaps in curriculum contributions, the collective effort of all institutions, supported by governments and industries, is crucial in preparing a future-ready workforce. Embracing innovation, fostering partnerships and nurturing digital skills will empower students to thrive in the dynamic landscape of demanding technologies and contribute meaningfully to sustainable development goals, paving the way for a brighter, more resilient technological careers in future.

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