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Routing towards Education 5.0 via sustainable technology empowerment : Potential challenges to academicians in Universities

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Abstract

Purpose: To examine the technological empowerment of professionals in education as an instrument to facilitate the sustainable implementation of Education 5.0. This research investigates the prevalent challenges that hinder the advancement of technology Empowerment among academic professionals.

Design, Methodology, and Approach: This paper directed an inclusive evaluation of the existing literature pertaining to the obstacles that impede the ability of educators to harness the full potential of technology. A collection of 58 challenges have been suggested for examination through the FDM. The present investigation evaluated the viewpoints of professionals concerning the degree of significance of obstacles that impede the production of accurate and dependable outcomes.

Findings: The study's results reveal that out of the 58 barriers examined, 11 were deemed significant. The most crucial technology empowerment barriers for educators were identified as inequitable involvement, constraints in the acceptance of technological advances, insufficient accountability, Excessive Workload, and Lack of teacher self-efficacy. The presence of these obstacles poses a significant challenge to the achievement of the education-oriented Sustainable Development Goals (SDGs).

Implications: The suggested results have significant implications for professionals in the field of education, policymakers, developers of educational systems, and researchers. The aforementioned statement facilitates stakeholder accessibility to the primary obstacles hindering the technological empowerment necessary for the sustainable integration of Education 5.0.

Originality: Academicians, the key stakeholders in adopting Education 5.0, play a significant role in its successful implementation. Very few earlier studies report on a specific application for the implementation of Education 5.0 focusing on contributing towards the SDGs.

Subject Classification: *90B50, 03B52.*

Keywords: *Technology empowerment, Education 5.0, Sustainable development goals, MCDM, Fuzzy Delphi Method (FDM).*

1. Introduction

The education sector is currently undergoing significant transformations as a result of the transition to digital technologies. The shifting paradigms have resulted in the digitization of education, which has sparked a newfound interest in the integration of artificial intelligence (AI) and Learning Analytics (LA) within universities. This development has contributed to the expansion of the education system in developing nations such as India, Indonesia, and Iran. The utilization of Information Technology (IT) and Information Technology Enabled Services (ITES) has facilitated the exchange of knowledge in India, thereby serving as a model for other nations to cultivate citizens who are proficient in ICT (Crisolo, 2018). Moreover, the recent pandemic has impacted the higher education institutions in India and proposed to build a comprehensive framework for dealing with any future crisis (Sahoo et al., 2021). Due to this, the integration of Education 5.0 and IR 5.0 is necessary in the technology-driven education industry. This amalgamation is based on the premise that knowledge can be downloaded. Lantada's (2020) research indicates that contemporary changes in engineering education have resulted in the development of more proficient engineers who are better equipped to meet the demands of the future. Conversely, academic institutions are increasingly cognizant that prioritizing financial gains alone is insufficient for ensuring their viability during the current era of Education 5.0, which is characterized by heightened emphasis on adaptability. According to Rahim (2021), Education 5.0 necessitates the acquisition of three essential 21st century competencies, namely learning skills, literacy skills, and life skills. These competencies are crucial in facilitating the attainment of sustainable development goals (SDGs) by enhancing the upskilling and reskilling of education sector stakeholders. The utilization of Information and Communication Technology (ICT) is widely acknowledged as a means to facilitate educational reforms and foster effective communication among various stakeholders within educational institutions. This approach serves as a crucial foundation for achieving Sustainable Development Goal Four (SDG4), as noted by Adarkwah (2021). The fourth Sustainable Development Goal (SDG4) centre's on providing high-quality education, with the ultimate goal of ensuring equitable access to digital literacy, pertinent technical and vocational competencies, and career advancement opportunities through the use of information and communication technology (ICT).

The integration of online programs into the standard curriculum can expand educational opportunities for remote populations, ultimately improving student learning outcomes (El Turk & Cherney, 2016). ICT has the potential to provide limitless opportunities for students to access evolving educational platforms that can improve the quality of teaching content and pedagogy. According to Chirwa (2018) the utilization of technology in knowledge exchange processes has the potential to broaden educational opportunities. The efficacy of any novel initiative or programme introduced in the realm of education is contingent upon the active participation of the faculty, who serve as the primary purveyors of high-quality instruction (Tabata & Johnsrud, 2008). A recent study conducted at the outbreak of the pandemic, highlighted that the existing higher educational institutions are underprepared to handle technology adoption for teaching and storage of data storage thus, leading to a feeling of dissatisfaction among academicians (Khan et al., 2021). The ongoing pandemic has compelled education sector stakeholders to reconsider their methods of knowledge dissemination. Although numerous studies have explored the obstacles to technology empowerment analysis, there is a dearth of prior research on a particular implementation of Education 5.0. The implementation of Education 5.0 in India is reinforced by the acceptance of key stakeholders, particularly academicians, who play a crucial role in ensuring its successful execution within the education system. There exist several obstacles that educators encounter while implementing technology-based pedagogical approaches. The challenges at hand have the potential to impede the pace of progress towards attaining the requisite level of upskilling and reskilling essential for the sustainable assimilation of technology with mindfulness. The present investigation aimed to tackle two primary research inquiries:

1. What are the major obstacles encountered by educators at different stages of technology integration in their efforts to achieve sustainable progress towards Education 5.0?
2. What is the redressal order of the significant obstacles that impede the technology empowerment for Education 5.0 towards the attainment of sustainable development?

The present study puts forth a research framework aimed at identifying and analyzing the barriers that exert a significant influence on technology empowerment in the implementation of Education 5.0. The methodology employed involves the utilization of the fuzzy Delphi method (FDM) to gather expert opinions within a specific domain. **The ultimate objective is to identify and prioritize the most significant obstacles that impact a given phenomenon**. The implementation of FDM has the potential to significantly impact the identification of novel pathways in the realm of education (Ciptono et al., 2019). The subsequent sections of the research are structured in the following manner. Section 2 pertains to a comprehensive account of the methodologies employed. Section 3 presents the outcomes obtained through the Fuzzy Delphi Method (FDM). Section 4 presents a conclusion.

2. Methodology

This section provides an overview of the technological empowerment of academicians with a focus on the sustainable development of Education 5.0. The Fuzzy Delphi Method is explicated in this section.

2.1 *Identification of Challenges*

According to the procedure presented above, we started with stage I and identified a series of barriers to Technology empowerment in the process of building an education 5.0 active environment. 58 barriers to technology empowerment of academician have been identified and listed in Table 2. During Phase 1, the Technology Empowerment barriers are assessed by distributing a questionnaire to experts. These experts are then asked to evaluate the barriers and rate them based on their personal experience and judgment regarding the level of prominence they hold in the Education sector. All these experts have extensive experience of at least 10 years in the Education sector in India.

2.2 *Fuzzy Delphi Method*

Ishikawa et al. (1993) conducted a study that proposed the integration of fuzzy set theory with the Traditional Delphi Methodology. Furthermore, Noorderhaben (1995) utilised Fuzzy Delphi Method (FDM) towards achieving group consensus by addressing the ambiguity of expert opinions in order to improve the efficiency and value of surveys. The categorization facilitated by the FDM confers the benefit of reducing the duration of inquiry and proposing a more definitive expression of the knowledge of experts. Expert *a* has evaluated the significance value of attribute b.

$j = (x_{ab}; y_{ab}; z_{ab})$, a= 1, 2, 3,….n; b = 1, 2, 3….m; then, weight j_b of element b is $j_b = (x_b; y_b; z_b)$ where $x_b = (x_{ab})$, $y_b = (\Pi_1^n y_{ab})^{1n}$, and $z_b = (z_{ab})$

Table 1

Transformation Table of linguistic terms

Linguistic Terms (Performance/ Importance)	Corresponding Triangular Fuzzy numbers
Strong Prominence	(0.75, 1.0, 1.0)
High Prominence	(0.5, 0.75, 1.0)
Neutral	(0.25, 0.5, 0.75)
Low Prominence	(0,0.25,0.5)
No Prominence	(0,0,0.25)

Therefore, the linguistic terms and triangular fuzzy numbers have been reformed into linguistic values, as presented via Table 1.

In order to obtain the convex combination value, D_d, Wu et al. (2016) suggested utilising a $\propto$ cut-based approach, which involves implementing the following equations.

$$u_b = z_b - \alpha(z_b - y_b)\ , l_b = x_b - \alpha(y_b - yx_b), b = 1, 2, 3 \ldots m \tag{1}$$

Typically, the value of 0.5 is utilised to represent a standard or typical scenario. The assigned value is variable within the range of 0 to 1, contingent upon the experts' disposition as either positive or negative perceivers. The precise value of D_d can be computed through the following procedure

$$D_d = \int(u_b, l_b) = \delta[u_b + (1-\delta)l_b] \tag{2}$$

Where, δ is applied to express the positivity level of a decision maker and to establish symmetry around the vital decisions amongst the expert group.

Subsequently, $\gamma = \Sigma_{a=1}^{n}(D_d / n)$ is the threshold utilised to screen and select the fundamental attributes. If If $D^d \geq \gamma,$ attribute b is deemed acceptable. Otherwise, it must be rejected.

3. Results

The outcomes of the initial and subsequent stages of the Fuzzy Delphi Technique have been compiled into Tables 2 & 3, which include the corresponding weight and threshold values for attribute testing purposes.

Table 2

Phase 1- Barriers screening out and renaming accepted factors

S. NO	BARRIERS	SOURCE	u(y)	l(y)	Db	Decision	Renaming of accepted barriers
BA1	Missing Systematics	(Renz & Hilbig, 2020)	0.500	0.000	0.250	Accept	BA1
BA2	Lack of data sovereignty and understanding	(Renz & Hilbig, 2020)	0.838	-0.338	0.334	Accept	BA2

Contd...

BA3	Shortages of leadership	(Tsai & Gasevic, 2017), (Singhavi et al., 2019)	0.854	-0.354	0.338	Reject	
BA4	Limited modes of Identifying Data Tracking	(Avella et al., 2016)	0.500	0.000	0.250	Reject	
BA5	Data Collection barriers	(Avella et al., 2016)	0.500	0.000	0.250	Accept	BA3
BA6	Lack of Contents in regional Languages	(Singhavi et al., 2019)	0.868	-0.368	0.342	Accept	BA4
BA7	Low quality course content	(Singhavi et al., 2019)	0.820	-0.320	0.330	Accept	BA5
BA8	Restrictive Timetable	((Renz & Hilbig, 2020)	0.857	-0.357	0.339	Accept	BA6
BA9	The pressure to prepare students for exams and tests	(Singhavi et al., 2019)	0.911	-0.411	0.353	Accept	BA7
BA10	Insufficient pedagogical support for teachers	(Singhavi et al., 2019)	0.903	-0.403	0.351	Accept	BA8
BA11	Integration of technology into curriculum seems complicated	(Singhavi et al., 2019), (Renz & Hilbig, 2020)	0.814	-0.314	0.328	Accept	BA9
BA12	Insufficient technical support for teachers	(Mercader & Gairín, 2020)	0.826	-0.326	0.332	Reject	
BA13	Most parents not in favor of the use of ICT	(Singhavi et al., 2019)	0.500	0.000	0.250	Reject	
BA14	No or unclear benefits of using ICT for teaching	(Singhavi et al., 2019)	0.500	0.000	0.250	Reject	

Contd...

BA15	Weak learning management System	(Renz & Hilbig, 2020)	0.500	0.000	0.250	Accept	BA10
BA16	Reliability of online measuring instrument	(Mercader & Gairín, 2020)	0.873	0.002	0.437	Accept	BA11
BA17	Concerns and Anxiety	(Renz & Hilbig, 2020)	0.863	-0.363	0.341	Reject	
BA18	Excessive Workload	(Mercader & Gairín, 2020) (Adarkwah, 2021)	0.500	0.000	0.250	Reject	
BA19	Insufficient accountability	(Singhavi et al., 2019) , (Mercader & Gairín, 2020)	0.500	0.000	0.250	Accept	BA12
BA20	Inequitable involvement	(Tsai & Gasevic, 2017)	0.900	-0.025	0.444	Accept	BA13
BA21	Lack of Faculty Development trainings	(Tsai & Gasevic, 2017), (Singhavi et al., 2019)	0.854	-0.354	0.338	Accept	BA14
BA22	Lack of teacher self-efficacy	(Fearnley & Amora, 2020)	0.857	-0.357	0.339	Accept	BA15
BA23	Lack of Motivation to adapt Technology	(Avella et al., 2016)	0.878	-0.003	0.438	Reject	
BA24	Constraints in accepting technological advances	(Singhavi et al., 2019) , (Renz & Hilbig, 2020)	0.500	0.000	0.250	Accept	BA16
BA25	Excessive Workload	(Renz & Hilbig, 2020)	0.885	-0.385	0.346	Accept	BA17

Contd...

BA26	Lack of Ownership	(Duveskog et al., 2014)	0.808	-0.308	0.327	Reject	
BA27	Delayed Feedbacks to students	(Ali et al., 2018)	0.500	0.000	0.250	Reject	
BA28	Lack of confidence regarding the use of ICT	(Singhavi et al., 2019)	0.796	-0.296	0.324	Reject	
BA29	Lack of interest of teachers	(Singhavi et al., 2019)	0.500	0.000	0.250	Reject	
BA30	Faculty's' resistance towards ICT	(Singhavi et al., 2019)	0.500	0.000	0.250	Accept	BA18
BA31	Digital Ill-literacy	(Singhavi et al., 2019)	0.844	-0.344	0.336	Accept	BA19
BA32	Lack of BDA-related skills of employees	(Weibl & Hess, 2018)	0.885	-0.010	0.440	Reject	
BA33	Engaging Students online	(Ăţ et al., 2021),	0.500	0.000	0.250	Reject	
BA34	Virus Attacks at large scale	(Khan et al., 2020)	0.500	0.000	0.250	Accept	BA20
BA35	Insufficient internet bandwidth or speed	(Sinha & Bagarukayo, 2019)	0.832	-0.332	0.333	Reject	
BA36	Insufficient internets connected computers	(Singhavi et al., 2019)	0.797	-0.297	0.324	Reject	
BA37	Lack of upgradations	(Singhavi et al., 2019)	0.500	0.000	0.250	Reject	
BA38	Digital divide	(Singhavi et al., 2019)	0.800	-0.300	0.325	Accept	BA21
BA39	Insufficient interactive educational software	(Singhavi et al., 2019)	0.826	-0.326	0.332	Reject	

Contd...

BA40	Lack of Technology Infrastructure	(Joshi et al., 2020)	0.500	0.000	0.250	Reject	
BA41	In adequate Software and interface design	(Joshi et al., 2020)	0.500	0.000	0.250	Accept	BA22
BA42	Incompatibility with Old Technology	(Zilvinskis & Wills, III, 2019)	0.808	-0.308	0.327	Reject	
BA43	Data quality issues	(Weibl & Hess, 2018)	0.775	-0.275	0.319	Accept	BA23
BA44	Insufficient data governance practices	(Weibl & Hess, 2018)	0.831	-0.331	0.333	Accept	BA24
BA45	Selection of an appropriate BDA technology	(Weibl & Hess, 2018)	0.840	-0.340	0.335	Accept	BA25
BA46	Security Issues related to personal Information	(Tsai et al., 2020)	0.820	-0.320	0.330	Reject	
BA47	Lack of availability of Budget	(Renz & Hilbig, 2020), (Adarkwah, 2021)	0.500	0.000	0.250	Accept	BA26
BA48	Lack of pedagogical models on how to use ICT for learning	(Tsai & Gasevic, 2017), (Singhavi et al., 2019)	0.906	-0.031	0.445	Accept	BA27
BA49	The absence of a prolonged perspective on data as a valuable asset and its prospective business value	(Weibl & Hess, 2018)	0.905	0.345	0.539	Accept	BA28

Contd...

BA50	Lack of clear use cases to motivate big data projects	(Weibl & Hess, 2018)	0.891	-0.016	0.442	Accept	BA29
BA51	Lack of an enterprise-wide data strategy	(Weibl & Hess, 2018)	0.881	-0.381	0.345	Accept	BA30
BA52	lack of Top-level Commitment	(Zilvinskis & Wills, III, 2019)	0.861	-0.361	0.340	Reject	
BA53	Lack of dedication or reluctance to embrace change among non-IT project stakeholders	(Weibl & Hess, 2018)	0.800	-0.300	0.325	Accept	BA31
BA54	The misalignment of objectives and anticipations between information technology (IT) and business units	(Weibl & Hess, 2018) , (Zilvinskis & Wills, III, 2019)	0.844	-0.344	0.336	Accept	BA32
BA55	Risk averse culture	(Weibl & Hess, 2018)	0.840	-0.340	0.335	Accept	BA33
BA56	High setup cost	(Khalid et al., 2018),	0.906	-0.031	0.445	Reject	
BA57	Barriers of abiding with Regulations according to Govt	(Tsai et al., 2020)	0.500	0.000	0.250	Accept	BA34
BA58	Ethical Barriers	(Tsai et al., 2020)	0.863	0.012	0.435	Reject	
					0.350		

Next, the refined set is used as an input for the Phase II. In this phase the barriers accepted in the Ist phase are taken as a base and then again shared with the experts for their inputs regarding the prominence levels of each barrier to technology empowerment. Table 3 represents the degree of approval by the experts for the refined barriers from Table 2 in which 34 barriers were accepted. The final results will be shown in Table 3.

Table 3

FDM list- Phase II- Barriers screening out and ranking the accepted barriers

Barriers	u(y)	l(y)	Db	Accept/Reject	Ranking
BA1	0.894	-0.019	0.442	Accept	19
BA2	0.894	-0.019	0.442	Accept	19
BA3	0.375	0.000	0.188	Reject	
BA4	0.917	-0.042	0.448	Accept	14
BA5	0.917	-0.042	0.448	Accept	14
BA6	0.375	0.000	0.188	Reject	
BA7	0.926	-0.051	0.450	Accept	12
BA8	0.375	0.000	0.188	Reject	
BA9	0.250	0.000	0.125	Reject	
BA10	0.913	0.337	0.541	Accept	10
BA11	0.250	0.000	0.125	Reject	
BA12	0.937	0.313	0.547	Accept	3
BA13	0.963	0.287	0.553	Accept	1
BA14	0.921	0.329	0.543	Accept	7
BA15	0.937	0.313	0.547	Accept	3
BA16	0.946	0.304	0.549	Accept	2
BA17	0.937	0.313	0.547	Accept	3
BA18	0.902	-0.027	0.444	Accept	17
BA19	0.899	-0.024	0.443	Accept	18
BA20	0.375	0.000	0.188	Reject	
BA21	0.926	-0.051	0.450	Accept	12
BA22	0.375	0.000	0.188	Reject	
BA23	0.921	0.329	0.543	Accept	7
BA24	0.375	0.000	0.188	Reject	
BA25	0.910	-0.035	0.446	Accept	16
BA26	0.929	0.321	0.545	Accept	6
BA27	0.375	0.000	0.188	Reject	
BA28	0.913	0.337	0.541	Accept	10

Contd...

BA29	0.375	0.000	0.188	Reject	
BA30	0.375	0.000	0.188	Reject	
BA31	0.888	-0.388	0.347	Reject	
BA32	0.375	0.000	0.188	Reject	
BA33	0.921	0.329	0.543	Accept	7
BA34	0.375	0.000	0.188	Reject	
			0.373		

After a proper analysis, we found that 20 barriers have been accepted which are bifurcated into 5 aspects i.e Technology Access(A1), Technology Awareness (A2), System moderated Motivation (A3), Digital illiteracy (A4) and Educator's self-efficacy (A5). After further analysis, we ranked the barriers and concluded with the following most prominent barriers. Technology Access (A1) comprises BA1, BA2, BA4, BA5, BA21 and BA26 ranking as 19,19, 14, 14, 12 & 6 respectively. Technology Awareness (A2) comprises BA23, BA25 & BA28 with 7, 16& 10 ranks respectively. System Moderated Motivation (A3) comprises BA7, BA13, BA16, BA17, BA33 holding the ranks of 12, 1, 2, 3 & 7 respectively. Further Digital illiteracy represents BA10, BA14 and BA19 with 10,7, 18 ranks respectively. Lastly, BA12, BA15 and BA18 are ranked as 3,3 & 17. The above analyses highlights that, Inequitable involvement (BA13) of stakeholders stands to be the most prominent barrier to Technology Empowerment. The incorporation of Artificial Intelligence (AI) and Learning Analytics (LA) into the educational system represents a novel approach to digitalization, as posited by Tsai and Gasevic (2017). Further, Constraints in the acceptance of technological advances (BA16) highlights that, integration of new advanced technology in the teaching learning processes causes reluctance among the educators in adoption of Technology (Avella et al., 2016). Therefore, this barrier has a strong standing amongst the topmost influential barriers to technology empowerment. Furthermore, the inability to adapt to changing circumstances as a result of limited time and an excessive workload, presents BA17. The barrier of Insufficient accountability (BA12) is observed to hold the third position among the most significant obstacles to the empowerment of technology. According to Mercader and Gairín (2020), the lack of technological proficiency among educators in the Indian educational system results in a reluctance to embrace new methods of knowledge dissemination. The incorporation of information and communication technology (ICT) in academic settings is impacted by the degree of self-efficacy that educators perceive and their disposition towards utilizing technology as a tool for facilitating instruction (Singhavi et al. 2019). According to Lantada (2020), sustainability is a prominent characteristic of building education 5.0. Lack of teacher self-efficacy (BA15) has been identified as a significant obstacle affecting the sustainable empowerment of academics in the realm of technology.

4. Conclusion

The implementation of Technology Empowerment for Academicians has demonstrated a significant advancement towards the enduring integration of Education 5.0. The obstacles hindering the empowerment of technology impede the education system's ability to achieve sustainable development objectives that strive to cultivate proficient educators. Therefore, the current research endeavors to examine the perspectives concerning experts regarding the challenges that impede the attainment of high levels of technological empowerment among educators, with the aim of identifying the primary obstacles. The present study five distinct domains, namely Technology Access, Technology Awareness, System Moderated Motivation, Digital Illiteracy, and Educator's Self-Efficacy. Using FDM, the present study evaluated the viewpoints of experts concerning the degrees of significance of hindrances that impede the attainment of accurate and dependable outcomes, which have practical and conceptual ramifications. The present research has determined that the motivation moderated by the system and the self-efficacy of educators are the most significant factors, followed by digital illiteracy, which collectively exert an adverse impact on the technology empowerment of academic professionals. Specifically, among the 58 identified barriers, 11 are deemed significant barriers. These include inequitable involvement, constraints in the acceptance of technological advances, insufficient accountability, Excessive Workload, and Lack of teacher self-efficacy, which are considered the most crucial technology empowerment barriers for educators. The aforementioned obstacles exert a substantial influence in impeding the durability of the educational framework, thereby necessitating educators to be highly attentive to the objectives of sustainability.

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