Education 4.0: Revolutionizing Learning by Transitioning from Chalkboards to Innovative Technology in India

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Abstract
Education 4.0 is spearheading a crucial revolution within the Indian education sector. This study decisively identifies key success factors that higher education teachers in India must adopt to effectively prepare students for the demands of Industry 4.0. We explore critical elements necessary for implementing Education 4.0 to overcome existing challenges and meet educational requirements. Our background research encompasses over 50 journal articles on Education 4.0, Industry 4.0, and Teacher 4.0, analyzed using the qualitative data analysis (QDA) software NVIVO 11. The survey, conducted between April and June 2022, engaged 103 undergraduate and graduate students from Delhi. Utilizing an exploratory factor analysis (EFA) approach, we established five distinct factors and 24 statements pertinent to our study. The variables identified—Education 4.0, learning culture, flexible environment, Artificial Intelligence, and MOOCs—highlight essential findings. Our survey reveals that vocational training is indispensable for aligning with industry expectations under the MOOCs variable. Moreover, engaging in peer discussions is proven to enhance higher-order thinking within the learning culture variable, and leveraging global connections significantly boosts job prospects. Notably, the integration of chatbots within the Education 4.0 framework is vital, as they increase productivity and improve communication through tailored learning experiences facilitated by Artificial Intelligence. These elements are non-negotiable for ensuring students are industry-ready. This study is poised to provide actionable insights for policymakers and academic institutions in India, advocating for a self-directed, transformative approach to learning. We propose robust methods and strategies to revolutionize the Indian education system, ensuring that future graduates and postgraduates are fully equipped to excel in Industries 4.0, 5.0, and 6.0.

Keywords: *Education 4.0, Industry 4.0, Teacher 4.0, challenges and requirements, India.*

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Introduction

In India, there are 260 million pupils enrolled in more than 1.5 million schools, while 39000 colleges serve 27.5 million undergraduates and 4 million postgraduates. State and central organisations foreign boards, and the University Grants Commission, having three-tier structure, are in charge of running schools. Colleges, universities (Education statistics, MHRD 2017, Report). Operation Digital Blackboard was launched in 2019 by the HRD Minister of India, which gave birth to "flipped learning" something novel and forward-thinking. Every country is responding to this urgent need by shifting its focus to improving student learning outcomes.

This paper provides an overview of current trends in education 4.0 with alignment to Industry 4.0. The study's goal is to discover what strategies and solutions can be provided to Indian teachers in order for them to contribute to the development of industry-ready students. The HRD Minister has already demonstrated the importance of implementing the Education 4.0 concept. This paper proposes methods to make education 4.0, such as the flipped classroom approach, BYOD, and MOOCs, as well as the challenges that India may face.

India's telecom market has evolved from a state-owned monopoly to a competitive landscape since the early 1990s, driven by liberalization (Mittal & Kathuria, 2009). With over 1.3 billion people, India is one of the largest telecom markets, marked by rapid mobile phone penetration due to affordability, technological advancements, and rising connectivity demand (Telecom Regulatory Authority of India, 2023). Mobile phones are now essential for communication, internet access, and financial services (World Bank, 2023). However, challenges such as network infrastructure gaps, the digital divide, and affordability issues persist, especially in rural areas. The government has initiated policies to address these challenges, promoting digital inclusion and economic growth (India Brand Equity Foundation, 2023; NITI Aayog, 2023).

Education Revolution	Methods	Technology
Education 1.0	• Dictation • Instructivism • Direct transfer of information	• Not allowed during education process
Education 2.0	• Progressivism • Begins to open to internet access	• Limited access
Education 3.0	• Knowledge producing • Co-constructivism	• Full access for knowledge • Construction and transmission
Education 4.0	• Innovation producing • Replacing classrooms	• Always changing • Leaners as major source technology evolution

Figure 1: Education Revolution

The Indian education is being involved since Education 1.0, the teaching process without technology, Education 2.0 with limited access of technology, Education 3.0 had increased access

of technology and Education 4.0 which involves internet, mobile technology, social media platforms making, learning at any time, from any location, and shifting teachers' roles to programme and consultant (FICCI, 2017).

Theoretical Background

- **Industry 4.0:** Advanced analytics, Big Data, robotics and automation, artificial intelligence, the Internet of Things (IoT), and process digitization are all components of Industry 4.0, which spans the value chain of any company. The quality and quantity of output could be improved with the aid of advanced analytics. The focus of the approach would change to data analytics-based defect prediction and prevention. Robotics and automation adoption would result in a shorter production cycle, a shorter time to market, and an inefficient use of resources. Different business operations being digitalized would result in cost savings and improved consumer and staff experiences. IoT would improve supply chain efficiency and shorten lead times by connecting people and machines together.
- **Education 4.0" Peter Fisk:** is my vision for the future of education, which responds to the needs of "industry 4.0" or the fourth industrial revolution, where man and machine align to enable new possibilities. We must Harnesses the potential of digital technologies, personalized data, open-sourced content, and the new humanity of this globally-connected, technology- fuelled world to establish a blueprint for the future of learning and play a better role in society. Student's interest in specialisation in higher education is proved to be important in the 4.0 for this responsibility lies on secondary schools to prepare students so that they can further make decisions about which college major will best suit their future career goals (Rilma Maya Dela, Tony Wijaya,2022).
- **Teacher 4.0:** Teachers who can effectively integrate new technology into their lessons under the term "Teacher 4.0" will be in high demand in the future. The Teacher 4.0 tracks the progression and rate of development of various technologies. Additionally, it takes into account the requirement for creating a concept to handle the technological complexity it brings for integrating all of the many technologies in a didactic teaching scenario. The usefulness of flipped classrooms in medical education was studied in 46 studies with a variety of learning outcomes in recent systematic review by (Chen, Lui, and Martinelli, 2017).
- **Flipped Classroom:** The flipped classroom consists in inverting the classic teaching model, replacing the conventional master class a lesson with a set of online materials, which can be videos, readings, etc., that the student must consult or visualize prior to the classroom sessions. The classroom sessions are transformed into practical sessions, with individual or group activities, where the teacher acts as a guide. In this way, the inverted class is a teaching method in which the roles of teachers and students change: The master

class is moved to the student's home, and the student works in with the material provided by the teacher for later in the class group approach specific issues, practical aspects that may have particular difficulty, teamwork and other more collaborative dynamics. Student learning outcomes are found to have positive results in previous studies.

- **Flipped Learning:** Flipped learning allows for a variety of learning styles; a teacher develops adaptable approaches that let students select the time and location of their study. Additionally, teachers who flip their classes are flexible in how they assess students' learning and what they anticipate from them in terms of timeframes for learning. Flipped Learning is fully student focused approach. Understudies take part effectively and create a commonly showing learning environment. In this type of learning, the teacher continuously monitors the students, evaluates their work, and offers feedback and teachers have less obviously prominent roles, yet they are still crucial. The "flipped classroom" method has gained popularity lately (Bergmann and Sams, 2012), especially in higher technique to try to make their classes more active. The learner of today is not constrained by an instructor-led educational approach and instead draws his knowledge from a variety of sources at his own speed. In addition to pursuing academic success, they also hope to improve their employability. Because of this, universities are preparing to collaborate with business houses to educate students who are prepared for the future workplace. They check their curricula against industry best practises and partner with top-tier businesses to provide students with industry-based interactions and exposure. Universities are now asked to adopt MOOCs (Massive Open Online Courses). For the upcoming universities, academic research, management development programmes, and consulting are the most importance. Universities are putting their efforts to manage societal concerns in addition to the challenges related to employment. Finding answers to the societal challenges requires on-going effort from the academic community, business community, and students. Therefore, University 4.0 must create moral leaders in business and technology. Universities must collaborate with the neighbourhood, business community, and general public. Universities must get ready and create a more solid, modular education system. To meet the needs of the sector and the employers, this is necessary. Haber, J. (2014). MOOCs. MIT Press.
- **BYOD:** Bring your device is a good pedagogical strategy for online learning. Schools should establish a setting where students can bring their PDA devices into the classroom and engage in fruitful online conversations and work together on projects to exchange knowledge and expertise.

Research Methodology

To solve all issues and requirements to make Education 4.0 perfect, the major core components of the initiative are examined in this study. There was a review of several research on Industry 4.0, Teacher 4.0, Education 4.0, and other solutions that may be used in India. NVIVO 11's qualitative data analysis (QDA) software suite took into account more than 50 highly indexed journal publications. 103 graduates and undergrads from the city of Delhi participated in a quantitative web survey that used a technique to gather primary data. Between April and June 2022, the study was conducted. Data dimension reduction using EFA in SPSS is employed.

Data Analysis and Interpretation

Qualitative Analysis

An extensive analysis of the existing literature on education 4.0 has been covered. Research papers have been retrieved from various online sources such as JSTOR, Google scholar, SAGE, Springer, Inderscience, Science Direct, Emerald and conference proceedings etc. Various related key words such as education 4.0, Learning culture, Flexible environment, artificial intelligence and its applications in the education sector, Moocs etc. and combinations of these were used to locate the relevant studies for analysis. Keeping the study's objectives and scope in mind, research papers in the field of education have been included Quantitative analysis is done using NVivo 11 by QSR international. This software package helps to import, sort and analyse text documents, audio files, video files, spread sheets, databases, digital photos, documents, PDFs, bibliographical data, web pages and social media data. Word Frequency search query helped in understanding the literature from a bird's eye (Sivakumar, P. S. (2020))

Figure 2: Word Cloud of Most Frequently used words

Table 1: Word frequency Query Result

S. No	Word	Length	Count	Weighted Percentage (%)
1.	Students	8	4779	1.54
2.	Learning	8	4159	1.34
3.	Education	9	3840	1.24
4.	Research	8	2877	0.93
5.	Student	7	2353	0.76
6.	Teachers	8	2021	0.65
7.	Teaching	8	1957	0.63
8.	Teacher	7	1417	0.46
9.	Technology	10	1372	0.44
10.	Development	11	1297	0.42
11.	Based	5	1198	0.39
12.	Professional	12	1164	0.38
13.	School	6	1057	0.34
14.	Online	6	1054	0.34
15.	Knowledge	9	1047	0.34
16.	Classroom	9	985	0.32
17.	University	10	981	0.32
18.	Higher	6	910	0.29
19.	Science	7	824	0.27
20.	Educational	11	811	0.26
21.	Study	5	802	0.26
22.	Skills	6	784	0.25
23.	Class	5	775	0.25

24.	Content	7	747	0.24
25.	India	5	697	0.22
26.	Staff	5	665	0.21
27.	Using	5	612	0.2
28.	Group	5	609	0.2
29.	Experience	10	560	0.18
30.	Model	5	554	0.18
31.	Journal	7	548	0.18
32.	Studies	7	548	0.18
33.	Flipped	7	536	0.17
34.	Industry	8	534	0.17
35.	Video	5	530	0.17
36.	Process	7	528	0.17
37.	Program	7	510	0.16
38.	Course	6	507	0.16
39.	Universities	12	501	0.16
40.	Different	9	498	0.16
41.	Support	7	493	0.16
42.	Effective	9	485	0.16
43.	Practice	8	484	0.16
44.	Social	6	471	0.15
45.	World	5	463	0.15
46.	Information	11	460	0.15
47.	Schools	7	452	0.15
48	Across	6	447	0.14
49.	Curriculum	10	443	0.14

50.	Courses	7	438	0.14

The top three words from the literature are "students, learning and education" which actually sums up and reinforces the central idea of the literature studied. NVivo allows users to auto code based on theme or sentiment. The following table summarizes the themes identified by Auto coding query of NVivo 11.

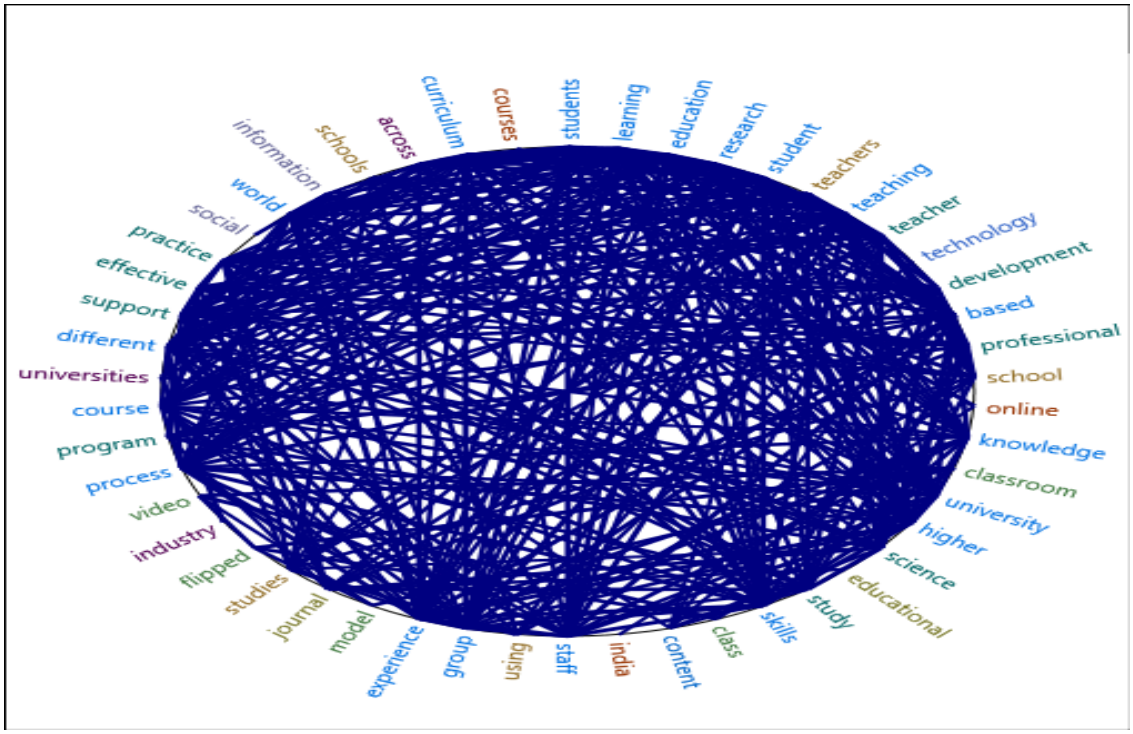

Figure 3: Circle Graph

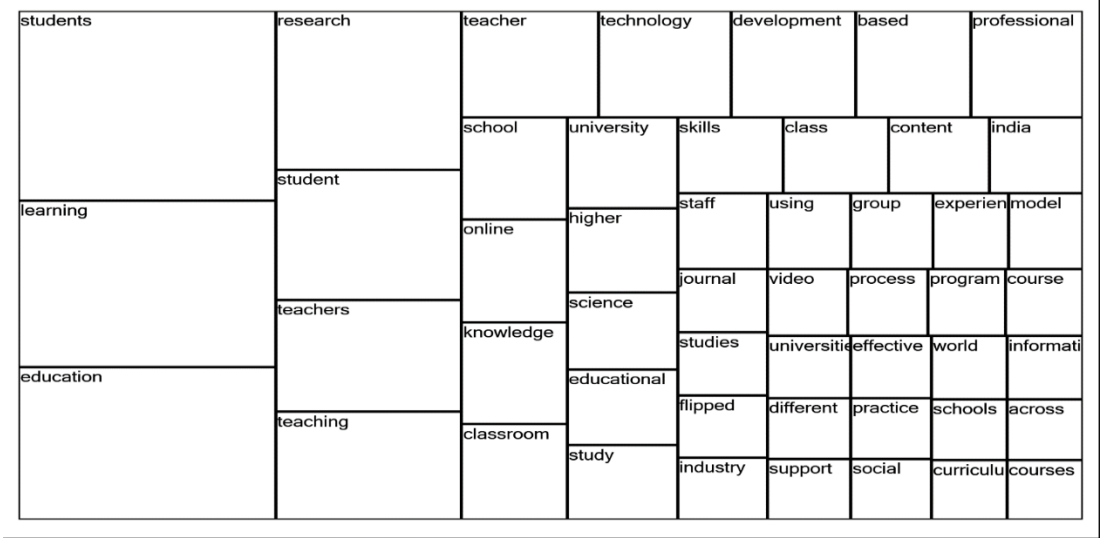

Figure 4: Horizontal Dendrogram

Data Analysis & Interpretation

The Kaiser-Meyer-Olkin (KMO) Test is a measure of how suitable the data is for Factor Analysis. The value of KMO is **0.745** which proves that the data collected is valid.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.745**
Bartlett's Test of Sphericity	Approx. Chi-Square	863.906
	Df	276
	Sig.	.000

The Barlett's Test of Spherecity is done to check for any null hypothesis and here the correlation matrix does not have an identity matrix because the significance value is less than 0.05. This results that the factor analysis done will be useful for the data. For better measurement of factor analysis communalities should be 0.4 or greater.

Table 3: Rotated Component Matrix

Factors	Items	Component						
		1	2	3	4	5	6	7
Education 4.0	Advancement in education module helps in better job prospects.	.137	-.058	.138	.644	.082	.203	.040
	Shift from traditional classroom teaching methods is essential for better job prospects.	.384	-.223	.336	.323	.075	-.056	.482
	Teaching learning through smart Technology helps in better job prospects	.031	.350	.159	.356	-.059	.353	.574
	Education through World-wide links leads in better job prospects.	.048	-.018	.024	.771	.088	.015	.001
Learning Culture	Online class assignments: Online class assignments help to apply concept.	.327	.207	.008	-.015	-.059	.743	.033
	Case studies: Solving case studies improves analytical ability.	.246	-.098	.108	.231	.515	.517	-.145
	Online test: Online test is a better way of remembering a concept.	.683	.272	-.146	.218	-.097	.207	-.074
	MCQ: MCQ based assessments leads to better remembrance of subject.	.330	.161	.123	.223	-.008	.151	-.716
	Discussion forums: Discussion forum provides a platform to discuss on some specific topic.	.417	.389	.226	.388	.015	-.311	-.006
	Digital slides show: PowerPoint presentations provided by faculty are better way of learning	.496	.257	-.334	.229	.164	.393	-.182
	Role play: Role play approach leads to better Demonstration of the concept.	.089	.543	.033	.034	.573	.161	-.069
	Group discussion: Discussion with peers increases high order thinking	.008	.069	.153	.109	.826	-.015	.004
	Video Collection: Related video helps in getting more perspectives of the subject.	-.021	.466	.287	.534	.159	-.261	-.129

Flexible Environment	Pre-reading material: I am ready to spend adequate time on accessing pre-reading material on ERP system provided by Institute.	.160	.737	.100	.067	.113	.257	-.124
	Flexibility: Can Re-read the pre reading material any number of times from any where	.139	.748	-.019	-.103	.063	.003	.075
	Student- centered learning: Self-learning becomes much easier if provided with pre-given content of the subject.	.299	.465	.486	.033	-.005	.026	.017
AI	Gestures: Do you recommend smart augmented devices to capture movements of mentor and mentee	.717	-.044	.265	-.002	.122	.230	-.123
	Augmented textbook: Virtual 3d content is more useful and interesting in understanding the subject.	.341	.242	.036	.047	.554	-.105	.365
	Teacher student online communication: Query handling online is quicker and easier through Chatbot.	.684	.265	.104	.096	.051	.047	.046
	Customized learning: Customized learning helps to reduce gaps hence improving weaker areas.	.398	.257	.582	.285	.005	-.125	.067
	Chatbot: Chatbot helps in increasing productivity and improve communication through customized learning.	.747	.048	.236	.030	.235	.019	.001
MOOC	Vocational Training: Vocational training is essential part to meet industry expectation.	.038	.048	.810	.103	.104	.059	.047
	Professional certification: Mooc courses or short-term courses helps me to strengthen my resume and skill set.	.244	.052	.535	.068	.391	.073	.062
	Live projects: Live projects undertaken during graduation/post-graduation helps in availing better placement	-.221	.110	.430	.219	.345	.466	-.097

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 12 iterations.

The results show that Vocational training, education through World-wide links leads in better job prospects. Group discussion with peers increases high order and Pre-reading material are

relevant factors. MCQ based assessments leads to better remembrance of subject is not an important factor. The results of EFA can be used further for forming factors.

Findings and Discussion

Educators of the future, needs to develop their learning and teaching pedagogy. Considering all the parameters enclosed in data analysis and interpretation part can be taken for further studies to find relationship of variables. The results of EFA have shown that Vocational training is essential part to meet industry expectation also staed in literature review (Jan Beseda Zbynek Machat 2014). Education through World-wide links leads in better job prospects (Rilma Maya Dela, Tony Wijaya,2022). Group discussion with peers increases high order thinking as per the result of the study. Pre-reading material helps to spend adequate time on accessing pre-reading material on ERP system provided by Institute and provides flexibility which can Re-reading any number of times from anywhere (Bergmann and Sams, 2012). Online class assignments help to apply concept. MCQ based assessments leads to better remembrance of subject is not an important factor. The results of EFA can be used further for forming factors.

Scope

Future research in the flipped classroom can consider students' perspectives and compliance with the flipped classroom requirement. Variables such as time spent in class and time spent outside of class can also be considered. Future researchers can assess the impact of flipped classroom learning on knowledge acquisition. A study can be conducted to measure attitude change as a moderator in research. Students' knowledge retention and knowledge transfer to professional practice can also be taken into account.

Conclusion

The COVID-19 pandemic has widened the education gap. Education 4.0 is a preferred method of learning that aligns with the impending fourth industrial revolution and 5.0 or 6.0 is next on the list. Governance and political control are must only then looming societal challenges can be addressed. Some steps in the path of 4.0 are Smartboard installation, that can be done in phased manner, approved by the Central Advisory Board of Education. The digital blackboard campaign similar to the government's 60 year’s old blackboard campaign will be run. To generate funds, the central and state governments can merge with municipal bodies and can seek corporate social responsibility (CSR) and public participation. The government must train all untrained teachers because according to Union Minister Upendra Kushwaha there are around 14 lakh untrained teachers in India. Education 4.0 is in response to Industry 4.0 and will define the University of the Future. Education 4.0 treats each student as an individual, realising that each person will have different learning requirements and objectives.

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