# Innovative trends that influence on teaching and learning process towards the revolution education 4.0

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**Abstract:** The aspiration of this work is to take up different innovative teaching and learning approaches in the era of the industrial revolution 4.0 (IR 4.0). Education 4.0 is a result of the revolution of industry 4.0 where technology and humans need to be coordinated to facilitate cutting-edge promises. The third industrial revolution was identified by information technology and the fourthindustrial revolution influenced by artificial intelligence including wrapping of different updates like driverless cars, smart sensors, robots, autonomous drones, internet of things. This rapid optimization and digitization entanglement on growth of the society, the impact of aging populations and growth within the society and higher education has an essential part to shape every aspect of our daily life. The different technologies and tools help us to make things easier than choosing different defendable approaches. This swift advancement is also impacting the higher education sector & the universities are making notable contributions to the education revolution 4.0 with their work in technological innovation in different areas. Hadoop, Hbase, Pig, Hive, Machine learning and other lots of tools allow academic researchers to significantly cut down on human errors and manual efforts. Taking the full benefit of the advanced technology is not only necessary to meet the industry standard but also need to make twin revolutions in

education and at the same time ensure quality, best experience and utilization of time. This paper contributes the research direction using innovative teaching methods including AR app in developing imagination to various views of Engineering drawing and the impact on the performance of the students in order to prepare future graduates to align with the technological advancement. The results are positive and the analysis shows the increase in percentage of passing by 16.30%

## 1. Introduction

Today technology is carrying an immense role in everyone's life, but because of connected culture it has impacted not only on our lives but also on the world of industry. Industry 4.0 is known for the raising unification of traditional practices, manufacturing and industrial platforms smart technologies (Massaro et al., 2021). Industry 4.0 is a form of technology encouraged with the advancement towards digitisation such as the Internet of Things, big data analytics,Artificial intelligence used by producers and manufacturers to investigate and improve their work (Moore, 2020). Thefourth industrial revolution, inspiring universities and educational institutions to help to produce the workforce for this new world and the undergraduate practice needed to match it. To grab thefull benefit of the scope generated by advancement in technology we need an identical revolutionin education in such a way that it ensures to meet not only the industry commitment but also utilize staff time, expenditure in plantation, facilities and best possible student practice. In 2018 Jisc promoted the concept of Education 4.0. Teaching transformed, personalised adaptive learning, Assessment re-imagined, intelligent and physical estates are the trends introduced by Jisc (Peberdy, 2020).

In this work we focused on enhanced learning technology to promote students' pan-domain thinking skills such as design thinking, problem solving, estimation, problem posing, data representation and analysis using AR app as a teaching methodology. The proposed work focuses on education 4.0, Indian education system, Methodology and analysis of the work.

## 1.1 Education 4.0

Education 4.0 is an effect of the demand for the Industrial Revolution 4.0, where individuals and technology are integrating together to produce new opportunities. Education 4.0 is the education with anytime anywhere, personal learning, flexible delivery, learning with peers and mentors, why and where instead of what and how, practical application, modular and projects, student ownership and performance should be evaluated not examined. Fisk in 2017 given justification about education 4.0 is that the new vision of learning encourages learners to acquire the skillsand knowledge that are required to determine the source (Lase, 2019). Education 4.0 is a broad term used by educational philosophers.

## 1.2 Requirement synchronization of Industry 4.0 with Education 4.0

Education 4.0 is described as different ways to integrate different digital technologies to generate solutions,solve various problems faced, find various prospects for innovations that can be applied to better survival of modern life. Table 1 shows the industry requirements that must be coordinated with education requirements to meet the demand of industry revolution 4.0 (Intelitek,2018) that shows the increased use of internet based technology and communication tools across industries. Many other industries like Healthcare 4.0,Technology 4.0 are changing the policies of doing business. Big data analytics, Robotics, Simulators, horizontal and vertical system integration,

synthetic biology, Artificial intelligence (AI), 3D printing or Additive manufacturing, Nanotechnology, Internet of Things (IoT), Cybersecurity, Cloud Computing, AR are the major driving technologies in Industry 4.0 & alignment with these technologies are needed to satisfy the need of Education 4.0 where curriculum is tailor-made, educators are mentors, and using tools to activate life-long learners.

**TABLE 1. Coordinating the industry requirements with education requirements (Intelitek,2018)**

| INDUSTRY | EDUCATION |
|---|---|
| Extensible production line | Tailor made learning path |
| On-line quality control | Formative Assessment |
| Workers monitor automation | Professors become mentors |
| Custom products | Divergence and pluralism |
| System Engineering | Education is the goal |
| Long Life learning | Continuous teachers training |

### 1.3 Evolution of Education 1.0 to Education 4.0

This section describes the expansion stages of Education 1.0 from education 4.0 and is tried to find out the response to the query whether this evolution is moving towards the modification directed by the technology in parallel with promoting the student and industry needs. Table 2 shows the comparative analysis of Education 4.0 with the previous three phases from Education

1.0 to Education 3.0 using different characteristics like Institution, Location, Content, Technology, e-Learning, Hardware & software ,Curriculum structure ,Gadgets , learning orientation, Teaching & Learning mode, Learning theory, primary role of professors, Primary roleof students.

**TABLE 2: Comparative analysis between education phases from Education1.0 to Education 4.0 (Mokhtar, Alshboul, & Shahin, 2019)**

| Characteristics | Education 1.0 | Education 2.0 | Education 3.0 | Education 4.0 |
|---|---|---|---|---|
| | | | | |

| Institution | Campus-based with fixed boundaries between institution | Increasing collaboration between universities | Loose institutional affiliations & relations | Jukebox Ala Carte Do it yourself (DIY) courses |
|---|---|---|---|---|
| Location | In a building; Brick & mortar | In a building plus online; Brick & click | Everywhere in the "creative society" | Anytime, Anywhere Any device, Any Platform |
| Content | Traditional copyright materials | Copyright and free/open educational resources for students within discipline | Free/open educational resources created and reused by students | User-generated content; DIY content; Personalize |

| Technology | Unheard of | Cautiously "adopted" | Ubiquitous | IoT, AI, VR, AR, MR, Simulations, Robotics, Block Chain |
|---|---|---|---|---|
| e-Learning | Computer-aided Learning | Blended Learning | Mobile Learning | Open Distributed Learning(Web 2.0), Virtual Immersive Learning(Web 3.0), Gamification(Web 4.0) |
| Hardware & Software | Are purchased at great cost and ignored | Are open source and available at lower cost | Are available at lowcost and are used purposively | Software-as-a Service (SaaS), Platform-as-a service (PaaS) |
| Curriculum structure | Rigid and fixed | Just-in-case | Just-in-time; Just- for me; Just-enough | Fluid and organic |
| Gadgets | Confiscated at the classroom door | Cautiously adopted | Bring Your Own Device (BYOD) | BYOD, Cloudbased, Gadgets on body |
| Learning orientation | Teacher Centered | Learner-centered | Learning-centered; PBL Experiential learning, Action learning | Challenge-based learning, Passion-based learning |
| Teaching & Learning mode | Pedagogy | Andragogy | Heutagogy | Cybergogy Peeragogy |
| Learning theory | Instructivism, behaviorism | Cognitivism | Constructivism | Connectivism |
| Primary role of professor | Source of knowledge | Guide and source of knowledge | Orchestrator of collaborative knowledge creation | Learning experience designer (LED) Resource expert |
| Primary role of student | Largely passive absorptive | Passive to active, emerging sense of ownership of theeducation process | Active, strong sense of ownership of own education, co-creation of resources and opportunities | "Digital natives" Creator of knowledge Self-explorer |

## 2. Indian Education System: An overview

In most of the countries today's education systems are based on Education 2.0, whereas some of the countries are moving towards Education 3.0. Current Indian system of education offered

from the Prussian system is framed to create good employees and faithful soldiers who instinctively follow orders and always need to be instructed. This system was not instinctively to teach students to think. In India, there is a shortage of skilled and employable engineers. Students are not interested in wasting 4 years at a sub standard institute. Nowadays, the more students are inclined towards other streams as compared to engineering streams, the statistics of the same are shown in Table 3 (Manish,2018); As per the world bank record, India has the third better education system after the US and China, however India falls behind in terms of expenditure per student and teacher. As compared to the other countries the quality of the education in India is consequently poor whether for primary or higher education. Innovation, Political interference, Structure of higher education are some of the critreation faced by the higher education system (Sharanabasappa & Kadamudimatha, 2017). Despite these challenges Indian system is trying to bring quality in education by providing integrated programs and considering many other solutions. Sharanabasappa et al. (2017) brought up some issues and challenges on higher education in India. One of the extensive challenges is to boost accessto higher education (Deshpande, 2011).

**TABLE 3: Number of students Enrolled in higher studies (Manish,2018; OECD, 2021)**

|  | Students in engineering and Technology(UG) | Students in Arts/Humanities/ Social Sciences(UG) |
|---|---|---|
| 2011-12 | 27,74,828 | 66,35,945 |
| 2011-13 | 34,71,488 | 81,98,107 |
| 2011-14 | 40,63,476 | 94,65,527 |
| 2011-15 | 42,27,528 | 1,07,07,305 |
| 2011-16 | 42,50,183 | 1,06,66,931 |
| 2011-17 | 41,61,252 | 1,05,65,728 |
| 2011-18 | 40,19,379 | 1,03,28,380 |

One of the major applicable questions is Whether India's higher education is "relevant to the era"?.

In contrast to lots of challenges higher education lacks satisfactory graduates due to drop out rates led by challenging curricula, insufficient basic knowledge acquired as well as lacking practical relevance of the study material. These extensive challenges result in a need to improve the quality of higher engineering education by having truly world class universities mechanism while increasing the number of students escorted to universities not only in India but outside India (Gupta, Levy, & Powar, 2008).

To address the above challenges in Indian education report on ,""Higher Education in India : Vision 2030", by FICCI mentions that different types of institutions have different focus and different outcomes and are available at different levels. With the increasing demand for knowledge different institutions should focus on different parameters as described in Table 4 (EY, 2017).

**TABLE 4: Parameters Need Focus:Higher Education in India:Vision 2030 (OECD, 2021)**

| Parameter | Focus |
|---|---|
| Research- Hub Institutions | 1. Research and Innovation as the major<br>2. Focus on addressing academic prerequisite should be demanding |
| Career-Focused Institutions | 1. Target on developing industry-ready graduates<br>2. Focus on addressing economic prerequisite |
| Foundation Institutions | 1. Delivering perceptive and comprehensive education aimed at offering wide range of courses<br>2. Focus on addressing Social prerequisite |

Including focus on above parameters needs technological change at a faster rate, meaningful and consistent changes are also needed to achieve more comprehensive and sustainable development

**Fig 1: Race between Education and Industry[ source: Goldin and Katz 2010, OECD, 2021**
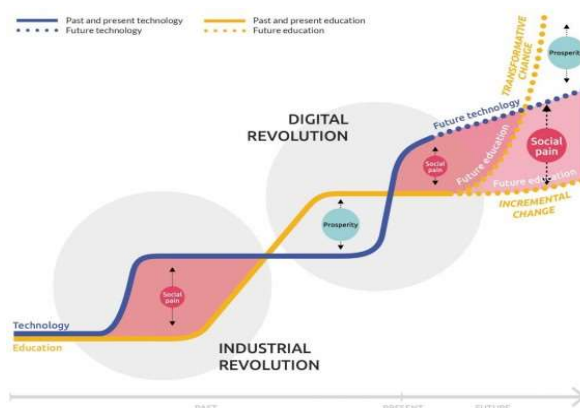


for all, not just for the honored few. To engage the education system with industry revolution needs

to meet up with transformative change as shown in figure 1.

## 2.1 Assistive Innovative Trends in Indian Education:

In recent era, technology innovated to gain access to the education process, and not only students

but also teachers began to make use of technology in elementary ways. Students have their own

approach to gain the information, options like learn virtually and different platforms like youtube,

Zoom, Google classroom (Mafa, 2018), then, moodle etc are available to communicate with

professors and other students. Nowadays education is no longer centered upon a back and forth

between students and professors but attracted a more networked approach where students have their own access to different information sources. The major points need to be considered while using assistive tools like how can we develop students to tackle social challenges,to prepare for jobs that have not yet been generated? How can we prepare the students to succeed on their choices. Assistive technologies help students to break barriers and reach students to get better results in education.

Lopez-Garcia et al. (2019) analyzed different trends like analytics technologies, adaptive learning technologies, Artificial intelligence and mixed reality in Mexico for distance learning education & concluded that focusing on the need for a redesign of the model adopted for teaching learning (Lopez-Garcia, Alvarez-Cedillo, Sanchez, & Vicario-Solorzano, 2019).

Halili (2019) described the use of technological advancement in the teaching learning process that supports industry revolution 4.0 includes augmented reality, 3D printing, cloud computing,virtual reality, hologram, multi-touch LCD screen, biometrics, internet of things, artificial intelligence,QR-code and big data.

Subramani & Iyappan (2018) mentioned in his work about synchronous models and asynchronous teaching models. To teach effectively to the students there are different technologies like voice threads to build student engagement,blogging,Prezi,Podcast in Classroom and screencast are available. Some popular social media communities like Facebook, MySpace,Youtube, Blogs,Twitter and Delicious deliver new educational experiences not only to the students but also to the teachers.

Mourtzis et al. (2018) proposed the concept of a teaching factory. The acceptance of cyber-physical systems and industry 4.0 technologies affect manufacturing education assuming the construction of radio-controlled car.In the proposed system IoT,NFC,AR,VR,Big data Analytics, process data gathering,Human- Robot collaboration different technologies have been integrated.

Ciolacu et al. (2018) proposed an early recognition system to focus on student success using Artificial Intelligence Methods. The performance of the system evaluated on three different courses using measures true positive rate, true negative rate and accuracy. It has been shown thatthey improved the failure rate in the examinations with almost 50%.

The importance of augmented reality in education is related to the way it is design, implement, and integrate into the learning environments (Whu et al., 2013). There are many domains where AR applicationshave been implemented and applied (Martín-Gutiérrez et al., 2015). Authors have concluded that after using AR in teaching students performance has been improved.Some of these implementation tried in the works (Chiang et al., 2014; Gopalan et al., 2016; Akçayır et al., 2016). The effect of Anatomy 4D mobile application has been evaluated on health science students in Turkey (Deshpande et al.., 2015).

Desphpande at al. (2015) showed enhanced use of technologies to improve teaching learning the previous studies it is accepted that collaboration of AR with traditional teaching learning processes gives improved performance. From the above study it concludes that augmented and virtual reality learning environments can give best assistance to students for achieve collaborative and cooperative studies

## 4.Method : AR-For Teaching Engineering Drawing

Institutions with higher education always have concerns about whether our teaching is adequate in impressing students into learning about core concepts? Are the students able to apply, develop and transfer the necessary concepts and skills to solve the real life problems? In this work the concept of digital engineering applied to teach the students. Digital engineering merges traditional engineering practices with data technology helps to continue product extension and productive manufacturing. Lots of digital technologies are impacting education like Model basedengineering

are used to explore, update and communicate the appearance of the system to the stakeholders instead of using traditional practices. Digital Thread helps to bridge digital information across design, manufacturing and inspection phases. Digital Twin promoted by the digital thread. The focus of the digital twin is to design, develop, product manufacturing in a virtual environment. Augmented Reality promotes engineers to visualize products and their interactions aforetime manufacturing. Artificial Intelligence improves the process of manufacturing, speed of computing machines through development of both hardware and cost constraints into innovative software.

Digital engineering increases the visibility over engineering processes to improve the learning quality. Creates an environment of standardized communication for all the students. It creates virtual environments to deliver best solutions to learn faster. Digital Modeling with the development of AR allows students to use mobile phones, tablets to immerse themselves with the learning environment.

- **AR in education: Reasons of Inclination**

Augmented Reality transforms the way teachers conduct lecturers. This not only helps professors to prepare lessons more interactive but also students make it easier to understand the concept. The benefits of using AR in education as follows

- AR is a modern way to communicate with the real world and can create experiences that would be possible in the real world.

- Augmented reality gives better experience in collaboration with traditional teachinglearning in education

- It allows students to use interactive ways to do practices without a teacher's assistance, creating fun and excitement in learning.

- Use of AR in education helps in understanding the content easily,long term memory retention over time, increased motivation and imaginative power of students in learning difficult courses.

- AR apps help students to capture the concepts easier and faster, this results in active participation in the class.

  • Increased sensory development

- Learning makes it less expensive as there is no need for repetitive buying of learning material.

- AR gives opportunity to the students to make use of knowledge grasped to solve the complex problems. It also helps to acquire knowledge of past, present and future occurrences

- **Challenges of using AR as a tool**

Use of AR is still facing some challenges because of lots of overcoming barriers (Martins, de Oliveira, & Guimarães, 2013; Martins, Gomes, & de Paiva Guimarães, 2015):

- Physical and technological issues like developing AR-apps require high technical knowledge and ample time to produce content.

- Sociocultural issues like difficulty in accessing new technology to the teachers and also need to promote awareness of how to use,and make sure that every

student has equal access to the educational tools.

- Pedagogical and Management issues like content development require ample time and effort so knowledge of the subject,teaching skills are also needed to develop the applications.At the same time training the teachers about the application is also needed. The use of technology should not be a barrier in the teaching-learning process.

- **Formal Setup**

EduvanceAR is a revolutionary platform that allows users to create AR apps without the prerequisite knowledge of the programming language.EduvanceAR app is used to teach engineering drawing concepts to the students that creates an improved experience of learning with better visualization and audio outputs by making learning fun. The students can easily learn solids, projections of circles, projections of Solids etc. Figure 2 shows the working of anEngineering drawing App for teachers. The teacher app module consists of - AR app,smart teaching box, controller. Figure 3 shows the working of an AR app for students. It includes holographic kit and programs. Following are the three steps to get started :

- Load the Engineering Drawing -AR app

- Load the pdf of the logo from the link and publish it. Use this image as a setup image tolearn.

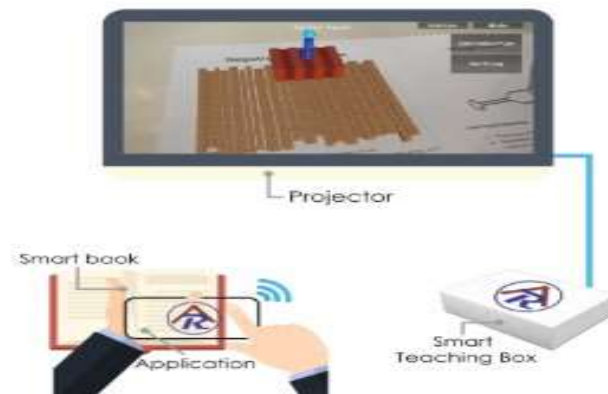- Start the app and settle it on the image to start learning.

**Fig 2: Working of Engineering Drawing -AR app For Teachers**



**Fig 3: Working of Engineering Drawing -AR app For Students**

- **Evaluation and Analysis**

Eduvance AR app has been used in Sem-II for Engineering Drawing from Jan 2019 to May 2019.

All the students are provided with a Career Analytics app, Login ID and Password withAR .

The app was very useful in developing imagination in students relative to various viewsof

Engineering Drawing. Figure 4 & 5 shows the projected output for step 8 and 11 respectively.
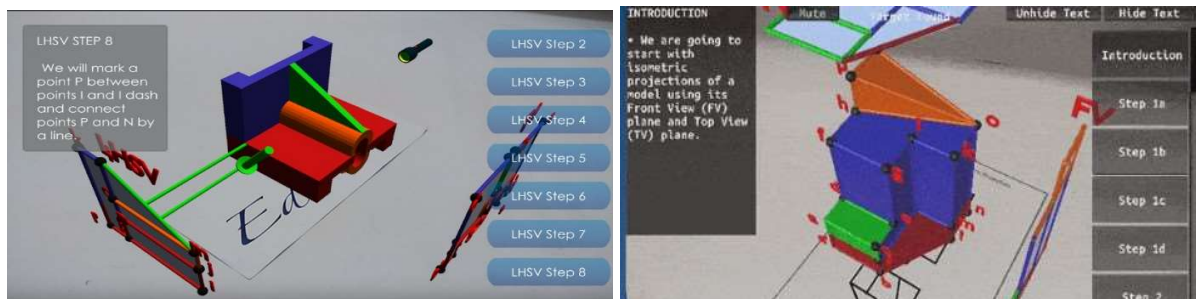
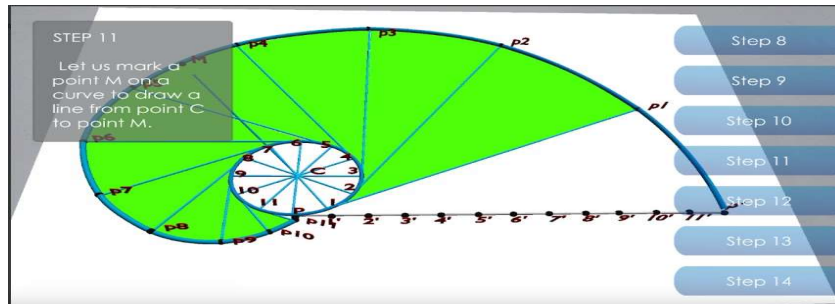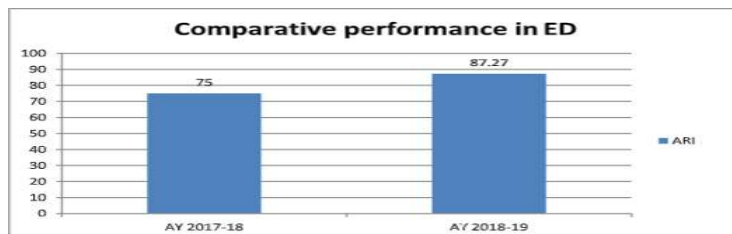**Fig 4: Projected output : Step 8**



**Fig 5:Projected output : Step 11**

We can say that it has a positive impact on performance of students in Engineering Drawing as for the Academic year 2018-2019 the result is 87.27% compared to previous year 2017-2018 which was 75%. The failure rate of the students has decreased from 25% to 12.73%.

And increased in percentage of passing by16.30%.

## 5. Conclusion

One of the most popular technologies in education 4.0 today is AR and has been adopted as a learning medium in the classroom. AR/VR technology supports learning effectiveness for the students. Learning medium used as AR/VR helps students to quickly improve understanding of 3D objects,images,videos,audios. With the help of technologies that have not yet been in education 4.0 educators prepare learners for new jobs. As 50% of the skill acquired during the first year to fourth year technical degree will be out-of-date by the time students complete their graduation. Though there are lots of challenges available in Indian education to meet the criterias of industry revolution. Indian higher education will overtake a critical role in driving thenation's talent competitiveness.However, the new digital-age education system suggests personalized and dynamic techniques for learning, innovative models of funding,better -equippedfaculty, new parameters to gauge students and faculty performance. The initial evaluation recommends that using AR technology is a simulating and suggestive tool for teaching and learning. It can be notable when used in coordination with a traditional system.

The greatest benefit of using AR in that it can be applied on a different platform for creating other applications for teaching and learning in other fields of higher education such as physics, electronics, chemistry, biology etc. AR is an accessible, economical, effective and essential tool for both learners as well as for educators.

## 6. Acknowledgements

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