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Review Paper on Industrial Revolution to Industry 4.0 and Skills Required as Per the NEP 2020

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Abstract*: The 4.0 Industry is known in the present development and improvement of the process and every part of the life related with the interconnection, technology and network that provides security, simplification of process and connection of almost everything based on the internet of things. This kind of connections and networks allow the industry to improve the processes, the things can follow instructions throw internet of things and learn how to improve that processes making relations between the work or action realized with the ideal taking advantage of the big data analysis and give infinite possibilities to more efficient progresses. This paper review Industry 4.0 its role in education field & skills required for Industry 4.0*

Keywords: industrial revolutions, education field, role of AR/VR, skills required

I. INTRODUCTION

Producing various objects is old as mankind. Basically, every product recognized by individuals or groups can be adapted with a basic industrialized process. During times, humans managed to manufacture objects for their own usage or for profitable purposes, into small workshops and using basic tools.

First Industrial Revolution (Industry 1.0)

A first major shift came during the First Industrial Revolution (Industry1.0) in the 18th century where, instead of items being produced by basic means, processes were invented and allowed items to be produced by machines.

Fig.01

Second Industrial Revolution (Industry 2.0)

The next shift in manufacturing is the period between 1871 and 1914, known as the Second Industrial Revolution (Industry 2.0), as result of extensive railroad and telegraph networks, which allowed for faster transfer of people and ideas.

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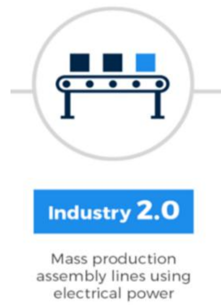

Fig.02

Third Industrial Revolution (Industry 3.0)

The Third Industrial Revolution (Industry 3.0), also known as the Digital Revolution, began in the '70s in the 20th century through partial automation using memory-programmable controls and computers. Industry 3.0use of digital logic, MOS transistors, and integrated circuit chips, and their derived technologies, including computers, microprocessors, digitalcellular phones, and the Internet

Fig.03

Fourth Industrial Revolution (Industry 4.0)

Nowadays everybody relates to The Fourth Industrial Revolution, known as Industry 4.0 - a union between physical assets and advanced digital technologies -like Internet of Things (IoT), Artificial Intelligence (AI), robots, drones, autonomous vehicles, 3D printing, cloud computing and others, that are interconnected, havingthepossibility to communicate, analyze and act

Fig.04

INDUSTRY 4.0

Definition. The term "Industry 4.0" was coined by German's group of mechanical engineers in the year 2011 to account for the broadcombination and adaptation of ICT in manufacturing industries. The definition of industry 4.0 is uncertain, and no single definition has been predictably adopted. The Institute of Technology Assessment (ITA) defined industry 4.0 as a systemic change bringing about extensive changes in the way works are done. However, it is stressed that industry 4.0 is not just about the introduction of a new technology linked with an incremental adaptation of work systems as in the previous three industrial revolutions, but about an assemblage of innovative technologies and forms of application, with discrete degrees of technical maturity and systemic effects.

INDUSTRY 4.0 & NEP 2020

The National Education Policy 2020 (NEP 2020) of the Government of India is a comprehensive policy that aims to transform the education system in India. It recognizes the importance of technology in education and emphasizes the need to integrate it into the teaching and learning process. Virtual Reality (VR) is one of the emerging technologies that can be used to enhance the teaching and learning experience, and NEP 2020 acknowledges its potential.

National Education Policy (2020) at para 23.8 highlights:

23.8. This policy has been formulated at a time when an unquestionably disruptive technology -Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged.

NEP 2020 identifies the need to use technology in education to enable students to develop 21st-century skills, such as critical thinking, creativity, collaboration, and communication. It also highlights the need to create a technology-enabled education ecosystem that can support personalized and adaptive learning.

National Education Policy (2020) at para 20.6 highlights:

20.6. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3- D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

One of the significant benefits of VR technology is that it can create a highly immersive and engaging learning experience. It can help students visualize abstract concepts, interact with 3D objects, and explore virtual environments, making learning more fun and effective.

NEP 2020 recognizes the potential of VR in education and highlights its use in several clauses. For instance, clause 24.4 states that 24.4.

Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(d) Content creation, digital repository, and dissemination: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

The National Education Policy 2020 (NEP 2020) recognizes the importance of integrating technology in education, including virtual reality (VR), to enhance the learning experience and promote digital literacy. NEP 2020 highlights the need for using technology to create personalized and adaptive learning experiences that cater to the diverse needs of students.

NEP 2020 emphasizes the importance of experiential learning, which involves learning through direct experience and reflection. VR technology offers an immersive and interactive learning experience that can simulate real-life situations and provide students with hands-on learning opportunities.

AUGMENTED AND VIRTUAL REALITY

Virtual Reality (VR) is a computer-generated environment that simulates a real or imaginary world, allowing users to interact with and experience it as if they were present within it. VR typically involves the user using-mounted display

(HMD) to block out the physical surroundings and replace them with a digital, three-dimensional environment. The user's movements are tracked in real-time, enabling them to navigate and interact with virtual world.

Augmented Reality (AR) is a technology that enhances the real-world environment by overlaying computer-generated content, such as images, videos, or 3D models. Unlike Virtual Reality, which entirely replaces the real world, AR preserves the physical surroundings while adding virtual elements. AR applications typically use cameras, sensors, and advanced algorithms to recognize the real-world environment and superimpose virtual objects onto it in real-timein the virtual world.

Use of AR/VR in Education:

Virtual Reality offers a powerful tool for education. It allows students to explore historical events, distant places, and scientific concepts through interactive and immersive experiences. This experiential learning approach enhances understanding and retention of complex subjects.

Fig.05 (This Photo by Unknown Author is licensed under CC BY-SA-NC)

Implications for Educational Policy and Practice

Virtual reality/Augmented Reality has the potential to transform educational policy and practice by providing immersive and engaging learning experiences for students. Here are some of the implications of VR/AR for educational policy and practice:

1. **Increased engagement**: VR/AR can increase student engagement by providing interactive and immersive learning experiences. This can lead to improved student motivation and learning outcomes.
2. **Personalized learning**: VR/AR can enable personalized learning experiences by adapting to the individual needs and learning styles of each student. This can lead to more effective and efficient learning.
3. **Access and equity**: VR/AR can provide access to educational experiences that may not be available in traditional classroom settings. This can increase equity by providing all students with access to high-quality educational resources and experiences.
4. **Teacher training**: VR/AR can be used to train teachers in new pedagogical approaches and instructional techniques. This can improve teacher effectiveness and lead to better student outcomes.
5. **Curriculum development**: VR/AR can be used to develop new curricula that are more interactive and engaging. This can lead to more effective learning and better student outcomes.
6. **Collaboration and communication**: VR/AR can facilitate collaboration and communication between students and teachers, as well as between students themselves. This can enhance learning and promote social and emotional development.
7. **Assessment and evaluation**: VR/AR can provide new ways to assess student learning and evaluate educational programs. This can lead to more accurate and meaningful assessments and evaluations.
8. **Resource allocation**: VR/AR technology can require significant investment in terms of hardware, software, and support services. Educational institutions must carefully consider how to allocate resources to ensure that VR technology is used effectively and efficiently.

Thus we can note that the implications of VR/AR for educational policy and practice are significant. To fully leverage the potential of VR/AR technology, educational institutions must carefully consider the benefits and challenges of its use and develop policies and practices that ensure equitable access and effective implementation.

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SKILLS OF INDUSTRY 4.0

Required Skills.

In the industry 4.0 revolution, all skills are required. This is fundamentally because all the previously disconnected technologies and applications have come into convergence. However, the opus of the existing workforce will need to change to match the skills required to support the success of industry 4.0. Further, the development of novel technologies such as smart sensors, intelligent assistant, robots, and automation will continue to demand change in the types of skills as well as the labour landscape.Eventually, there will be a great transition for job demand from lower-skilled to highly-skilled jobs. In order to clearly describe the skill requirements for industry 4.0, the present study broadly categorized the required skills in two groups: technical and personal (soft) skills. The technical skills are required for highly technically tasks while soft skills are for the most part essential for teamwork on the shop floor level and communication in daily business.

Building Skills into the Workforce of Industry 4.0.

There is a dire need to identify and develop the disciplinesand the required missing abilities in order to build suitableskills into the workforce of industry 4.0.

Higher education institutions (universities and technical colleges) play a censorious role in shaping the societal transitions requisite for industry 4.0 movements. However, today's higher education was developed in context of the previous three industrial revolutions which do not provide the necessary skills for shaping industry 4.0 movements.In addition, most manufacturing and service industries will no longer demand for specialist personnel but the generalists. Therefore, higher education especially the universities ought to properly and extensively educate and develop capacity for knowledge retention among the graduates to prepare them for a productive life necessary for the ever-changing labour landscape.

Additionally, skills of industry 4.0 can be built by developing new curriculum especially in the old field of studies such as industrial and mechanical engineering to incorporate industry 4.0 infrastructures. The development of these curricula can only be achieved through extensive research along this line. In the recent years, few research studies have been conducted in the area of curriculum development with industry 4.0 context.

Lastly, the most fascinating way of building the work-force of industry 4.0 technologies is the ability to harness theOperator 4.0 concept.The Operator 4.0 concept majorly aims to create human-cyber-physical production systems that improve the abilities of the operators. It represents the "operator of the future," a smart and skilled operator who performs "work aided" by machines if and as needed. Moreover, it is a new design and engineering philosophy for adaptive production systems that mainly focus on treating automation as a further enhancement of the human's physical, sensorial, and cognitive capabilities using human cyber-physical system integration.Theoperator 4.0 typology includes analytical, virtual, augmented, collaborative, heathy, smarter, social, and superstrength operators.

II. CONCLUSION

The present study identified differences in the view of previous researchers on the key technologies of industry 4.0.These differences were due to the different scopes of the case studies undertaken by the researchers. This is because industry 4.0 technologies are being adopted among countries or industries at different paces. Most investigations focused their case studies on countries like China, USA, Germany,

UK, South Africa, Korea, Russia, Philippines, and Malaysia. This accounts for the differences because these countries have different capabilities in terms of resources, knowledge, and finances to implement industry 4.0 technologies. Thus, 35 disruptive technologies were explored and 13 key disruptive technologies were identified. This implies that the rate of industry 4.0 adaptation has been increasing among countries and industries over the years. The race among countries and companies towards industry 4.0 will further increase the rate of adaptation of these technologies.

However, the more the industry 4.0 implementations, the more the skills required to support its growth will be needed. In essence, several frameworks such as Learning factory 4.0, Education 4.0, and Operator 4.0 have evolved to foster acquisition of the requisite skills of industry 4.0. Despite the tremendous efforts imposed by Western countries to ensure success in the industry 4.0 journey, most African countries seem unaware of this disruptive transformation. Thus, the capability and readiness of developing countries in adapting industry 4.0 in terms of the changes in the education systems and industrial manufacturing settings are also worth investigating.

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