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### A Systematic Review of Pedagogical Practices in the Education 4.0

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#### Abstract:

Demands of the twenty-first century and industrial's needs are obviously changing, while many jobs and skills were not needed or, to some certain levels, are irrelevant in the job market, rendering some graduates locally and internationally unemployed, which leads some time to an economic dilemma. The current rising in technological evolution in the business world is known as the Industry 4.0 revolution. Simultaneously, education 4.0 is designed to bridge the gap between graduate job market requirements, the technology landscape changes, and the content of learning in institutions of learning globally. The primary purpose of this study was to perform a literature review to identify and classify the pedagogical practices that were most effectively used in education 4.0 to promote the acquisition of 21st-century skills among graduates. Mainly, a systematic review approach was used to explore past studies on Pedagogical Practices in Education 4.0; from 2018 to 2022 applying the PRISMA method in the review process. The study identified the stimulation of students - instructors' readiness and involvement as crucial elements to facing the challenges of education 4.0. It is a critical factor in obtaining education 4.0 resolution skills and enhancing character education in developing soft skills, curriculum design, learning modules, assessment strategy, and classroom experience. In conclusion, effective integration of education 4.0 into the learning institutions is visible with a paradigm shift by infusing education 4.0 elements into the curriculum, its pedagogical practices and stimulating enthusiasm among students and instructors. Thus, an adequate budget must be allocated to learning institutions with innovative monitoring systems, especially for developing countries, not to lag behind developed

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nations permanently. The novelty of this study is that it focuses on exciting literature on effective pedagogical practices to encourage graduates to acquire Education 4.0 technological skills using the PRISMA technique.

**Keywords:** pedagogical practices, Education 4.0, 21st-century skills, graduates, Industry 4.0 revolution.

## 教育4.0中教学实践系统回顾

### 摘要:

21世纪的需求和工业需求正在发生明显变化，而许多工作和技能在就业市场上是不需要的，或者在某种程度上与就业市场无关，导致一些毕业生在本地和国际上失业，这导致一段时间内经济困境。商业世界中当前兴起的技术演进被称为工业4.0革命。同时，教育4.0旨在弥合毕业生就业市场需求、技术格局变化和全球学习机构学习内容之间的差距。本研究的主要目的是进行文献综述，以确定和分类在教育4.0中最有效地用于促进毕业生获得21世纪技能的教学实践。主要是采用系统回顾的方法来探索过去关于教育4.0教学实践的研究；从2018年到2022年，在审查过程中应用系统审查和元分析方法的首选报告项目。该研究确定了学生的激励——

教师的准备和参与是应对教育4.0挑战的关键因素。它是获得教育4.0解决技能和在开发软技能、课程设计、学习模块、评估策略和课堂体验方面加强品格教育的关键因素。总之，教育4.0有效融入学习机构是可见的，但通过将教育4.0元素融入课程及其教学实践并激发学生和教师的热情，范式发生了转变。因此，必须为具有创新监控系统的学习机构分配足够的预算，特别是对于发展中国家，以免永远落后于发达国家。这项研究的新颖之处在于它侧重于关于有效教学实践的激动人心的文献，以鼓励毕业生使用系统评价和不懈分析技术的首选报告项目获得教育4.0技术技能。

**关键词:** 教学实践、教育4.0、21世纪技能、毕业生、工业4.0革命。

### 1. Introduction

In 2016, Klaus Schwab was the one who first coined the term "Industrial Revolution 4.0." He is a well-known German-born economist and the founder of the World Economic Forum (WEF), who claims in his book, the Fourth Industrial Revolution, that the fourth industrial revolution will radically alter how people live, work and interact.

In 2018, former Malaysian Higher Education Minister Datuk Seri Idris Jusoh emphasized the theme "Higher Education 4.0: Knowledge, Industry, and Humanity" to kick-start the education 4.0 movement in Malaysia. He believes incorporating IR4.0 into Malaysia's tertiary education system will help learning institutions remain relevant and competitive as Industry 4.0 takes hold. Higher education institutions are being urged to overhaul their educational systems and take steps to embrace teaching and learning 4.0, assigning the UPSI as the only Malaysian university of education to take the lead (Halili, 2019). The advanced application of technology 4.0, such as 3D printing, augmented reality, virtual reality, cloud computing, holograms, biometrics, multi-touch LCD screen, internet of things, artificial intelligence, big data, and QR-code, is one of the underpinning technological aspects in teaching and learning 4.0 (Halili, 2019).

According to Halili (2019), Education 4.0 includes four elements: revamped learning areas with multi-tiered collaboration tables and a smart board. Second, incorporate various pedagogies, including heutagogy,

pedagogy, and cybergogy. Third, use a fluid and organic curriculum that higher education institutions must absorb as new ideas without being constrained by existing teaching methods. Fourth, technological improvements should be included in the teaching and learning processes.

Education 4.0 equally focuses on the notion of "evaluation without examinations," which means that no assessments or examinations are included in classroom learning activities or are relaxed. Students must also be prepared for Industry 4.0, where the acquisition of soft skills through industry-university collaboration. This will allow the industry and academia to work together to meet the demands of the industry, which may assist in reducing the unemployment rate among graduates (Halili, 2019). A need for a review of education 4.0 exists for enlightening educationists on how to integrate the industry's needs into the school learning experience and classroom practice. It is based on this notion; this study seeks to; examine the concept of education 4.0 and industrial revolution 4.0, study appropriate learning design and learning objects in education 4.0, investigate education 4.0 and 21st century skills, explore education 4.0 and students' authentic input, Teacher's Competence in Education 4.0, investigate the integration of the education 4.0 framework into the school system, and study the impact of education 4.0 on education stakeholders.

## 2. Research Methodology

This study applies a systematic review approach to assess previous studies on Pedagogical Practices in Education 4.0 from 2018 until 2022. This research applies the PRISMA 2020 checklist for systematic literature (Tugwell & Tovey, 2020). The PRISMA checklist has been a preferred methodology for systematic literature review. The study progressed with a systematic literature review by undergoing the following criteria: rationale, objectives, eligibility criteria, information sources, search strategy, study characteristics, individual study results, and discussion. The literature review began by scanning Internet databases for scholarly publications from journals and conferences, such as ScienceDirect (Elsevier), Emerald Insight, sustainability, and Scopus. Initially, forty publications focused on education 4.0 were gathered, and only thirteen were selected for a systematic review applying the PRISMA checklist, 2020. Although, another eight publications published before 2018 were also used as an additional literature review of the research since they were relevant to pedagogical practices in the Education 4.0 Revolution and provided unique information to this study, indicating that nine articles out of the 40 papers grouped were finally excluded from the review because they were irrelevant to the scope of the study. Finally, the author(s), title, year of publication, name of publication, abstract, and full text were all collected from each work.

## 3. Results of the Study

### 3.1. The Concepts of Industrial Revolution 4.0 and Education 4.0

The world has entered the fourth industrial revolution, marked by increased connectivity, interaction, and development of digital technologies, machine learning, and virtual reality. Digitalization undoubtedly impacts numerous industries; given the increasingly convergent borders between humans, students, robots, and other resources, none of us can resist these transformations. Thus, adequate human resources must be prepared to adapt and compete globally. A strategy to balance the development of IR 4.0 is to achieve better quality resources through education.

Education 4.0 is a school of thought that fosters critical and creative thinking in the classroom. Thereby, novel learning is promoted, mainly through innovative technological tools and resources. This connotes a change in a traditional classroom setting because children will not only learn using pencils, textbooks, or essays. Instead, Education 4.0 enables faraway students to connect to the Internet and enroll in courses through a range of open online courses, video chats, or voice calls to acquire a more contemporary material on the subject matter. Education 4.0 was identified as a response to Industry 4.0, resulting in a significant increase in the usage of Internet technology and cross-

communication tools in education, Healthcare, and other sectors to shift the modus of Operandi in the sectors to a technological-traditional approach. Furthermore, the coming of the Fourth Industrial Revolution has been attributed to market expansion, internationalization, and emerging global competitiveness. Industry 4.0 was influenced by the three earliest technical transformations: steam power, the revolutionizing power of the nineteenth century; electricity, which reshaped for most of the twentieth century; and the computer epoch of the 1970s (Sharma, 2019; Sudlow, 2018).

The competence of educators, such as teachers and lecturers, determines a country's performance in addressing the Industrial Revolution 4.0. Teachers must possess competence skills and adjust to new technology and global concerns. Throughout this scenario, every educational institution must plan detailed educational knowledge and literacy because the old literacy method of learning is based on reading, writing, and mathematics, which must be supplemented with emerging literacy that emphasizes data literacy, computing, and human resources (Lase, 2019). In this regard, the capacity to read, evaluate, and use data in a digital environment is known as data literacy. Technology literacy is the capacity to comprehend mechanical and technological systems in the workplace, and human resource literacy is the capacity to interact appropriately, without being stiff (Aoun, 2017; Sudlow, 2018).

Education is critical for producing innovative, creative, and competitive youth. These characteristics are essential to maximizing the use of technology as an educational instrument that provides results that can adapt and change the course of time. Therefore, Education 4.0 is an academic answer or reaction to the Fourth Industrial Revolution, in which humans and technology work together to make new creative and inventive possibilities. Additionally, learning institutions' critical-creative mind for futuristic learning practices will allow the students never again perceive knowledge, its dimensions, and learning skills as mere requirements to be obtained before graduation. Instead, they must be able to examine and finish given tasks skilfully and independently (Fisk, 2017).

Furthermore, nine tendencies are associated with Education 4.0. First, learning can occur at any time and in any location. E-learning systems provide excellent chances for self-paced and distant learning. Second, learning would be tailored to the needs of each learner. Third, learners have the option of choosing how they wish to learn. Fourth, more project-based learning will be introduced to students. Fifth, outdoor activities such as internships, mentoring initiatives, and collaborative projects will provide students with more hands-on learning opportunities. Students will be introduced to the interpretation of data, where they will be challenged to apply their theoretical knowledge to numbers and use their reasoning skills to create inferences from provided sets of data based on logic and trends. Seventh, students

will be evaluated differently, and traditional assessment systems may become obsolete or insufficient. Eighth, students' input will be considered while developing and upgrading the curriculum. Finally, as students grow self-sufficient in their learning, teachers will be forced to take on a new role as facilitators who guide engagement in the learning process (Lase, 2019).

In the Education 4.0 trend, the duty of educators, teachers, or lecturers to learners is a transition role; they must play a role in assisting the shift rather than seeing it as a threat to established teaching methods. Community members who adapt to this educational paradigm will obtain comprehensive skills and knowledge and unleash their full creative potential. Education 4.0 was defined by the industrial-technological disruption and the world market needs; the question is, which aspect of education needs restructuring to attain education 4.0?

### 3.2. *Appropriate Learning Design and Learning Objects in Education 4.0*

Learning outline or design assumes a more significant part in higher institutions, no matter what techniques are used. Holistic traditional approaches are not now wholly fitting since the students have innovative technologies, such as smartphones, WhatsApp, tablets, Facebook, laptops, and others. These advancements assist them with getting information either in or out of commonly perceived learning structures upholding a methodology that puts the students at the point of converging their learning materials. Considering such developments appropriately in learning design and learning objects is highly demanded in Education 4.0 (Goodyear, 2015).

Williams et al. (2020) argue that learning outcomes must be incorporated into learning objectives, practical activities, and assessments. These are important to implement Education 4.0 successfully, it will only benefit everyone if pedagogically adequate resources are designed and developed because learning objects are a crucial part of a university's digital education structure. Jisc (2014) claimed that a learning object is "an accumulation of one or even more digital assets that constitute an educationally meaningful stand-alone unit." Learning objectives must be linked to course activities and assessments (Williams et al., 2020).

### 3.3. *Education 4.0 and 21st Century Skills*

In the Era of Education 4.0, learning material is expected to promote deep learning, reduce learning tragedies, and develop 21<sup>st</sup> century skills among students (Table 1). As a technique of instilling 21<sup>st</sup> century abilities in students, the content we study in school should appeal to their senses, needs, and interests (Lase, 2019). The 21<sup>st</sup> century skills to be mastered for future jobs are critical thinking and problem-solving, communication and cooperation, creativity and innovation, flexibility and adaptability, initiative, social and cultural engagement, productivity and accountability, leadership and responsibilities, and

information literacy are all examples of work and life skills (Lase, 2019).

Table 1. Top 10 skills between 2015–2022 (Schwab, 2016; Gray, 2016; World Economic Forum, 2020)

In 2015	In 2020	In 2025
1. Complex Problem Solving	1. Complex Problem Solving	1. Analytical Thinking and Innovation
2. Coordinating with others	2. Critical Thinking	2. Active Learning and learning strategies
3. People Management	3. Creativity	3. Complex Problem Solving
4. Critical Thinking	4. People Management	4. Critical Thinking and Analysis
5. Negotiation	5. Coordinating with others	5. Creativity, Originality, and Initiative
6. Quality Control	6. Emotional Intelligence	6. Leadership and Social Influence
7. Service Orientation	7. Judgment and Decision Making	7. Technology use, Monitoring, and Control
8. Judgment and Decision Making	8. Service Orientation	8. Technology Design and Programming
9. Active Learning	9. Negotiation	9. Resilience, Stress Tolerance and Flexibility
10. Creativity	10. Cognitive Flexibility	10. Reasoning, Problem-Solving, and Ideation.

Individuals between the ages of 18 and 23, referred to as Generation Z (Gen Z). This age group has transformed due to technological breakthroughs when appropriate technological tools are used (Lase, 2019). Lase further expatiated that Gen Z enjoys group discussions and interactive learning environments. Learning is limitless for them because they study anywhere, at any time and have unrestricted access to fresh material. They value learning that entails active team participation and learning outside the classroom. Gen Z students enjoy using digital tools and want them to be easily accessible whenever needed, with few barriers to entry. Thus, the youngsters from Generation Z must be prepared to thrive in Industry 4.0 through education 4.0 (Kozinski, 2017).

Mendikbud RI Muhadjir Effendy, speaking at the University of Yogyakarta's National Education Day (Hardiknas) 2018, remarked that the presence of the industrial revolution 4.0 has caused the globe to endure increasingly rapid and competitive changes in the global educational system and that the program needed to be revised by adding five competences, which are: first, students are capable of critical thinking. Second, students are required to be creative and original in their thinking. Third, competence and communication skills. Finally, students have confidence and the ability to work and collaborate (Lase, 2019). The World Economic Forum ranked the top ten skills for the future in 2016, while the ability required for workers is creativity (Lase, 2019). Workers must be more creative to gain from the tremendous mobility of new products, emerging technologies, and new working methods.

Although robots can assist in getting to the intended location and destination more quickly, they cannot be as innovative as humans. Negotiation skills and cognitive flexibility deteriorate over time, and big data-based decision-making is the focus now.

People expect artificial intelligence computers to be on a company's board of directors by 2026, according to a survey conducted by the World Economic Forum's Global Agenda Council on the Future of Software and Society. This year, active listening, which was regarded as core day skill, will drop out of the top 10. Emotional intelligence, which is not in the top ten today, will be one of the most critical abilities for everyone in the future (Gray, 2016). Wahyuni (2018) discussed the five competencies that instructors must prepare for education 4.0. The first is educational competence, the second is technology commercialization competence, and the third is globalization competence. Competence in future strategies is the fourth, and counselor competence is the fifth.

### **3.4. Education 4.0 and Students' Authentic Input**

Students' participation in creating their learning signifies a more robust student voice and true collaboration because it first recognizes students' contributions. Involving them in the design of their learning will reflect a deeper student voice and factual partnership. Second, it aligns with the education 4.0 curricular structure and demonstrates a social constructivist approach to education (Williams et al., 2020). Recognizing student participation and embedding it in learning and curriculum design is necessary to promote inclusive learning that recognizes each learner's needs. The challenges are how to encourage a sufficiently loud student voice, guaranteeing the physical learning environments that show students' central importance to their learning, and the active participation of educators, supervisors, and institutions in 21st Century learning activities (Brooman et al., 2015; Woolmer et al., 2016).

Healey et al. (2014) argue that "properly involving students, staff, and partners in learning and teaching is undoubtedly one of the most critical challenges facing tertiary education 4.0 in the twenty-first century." Another approach to attain an authentic student voice is for scholars to collaborate with students on pedagogical research projects that look into the design of learning components appropriate for Education 4.0, with the dissemination of the findings providing measurable evidence of success for all parties (Williams et al., 2020).

### **3.5. Teacher's Competence in Education 4.0**

Teachers in IR 4.0 must not get complacent with their current conditions; they must strive to become more capable of producing higher-quality human resources (Lase, 2019). In addition to the skills described by Wahyuni (2018), other skills that teachers will need to face in the era of Edu 4.0 are being comfortable with technology, collaboration, innovative,

creative thinking in the classroom, outcome-based learning, community-based learning, and meaningful learning. Teachers could also use Flipped Classroom, Social Media Integration, Khan Academy, Project-Based Learning (PBL), Moodle, Schoology, and PLATO Academy in teaching and learning.

Note that if the same skills used by teachers in the industry of 1.0, 2.0, or even 3.0 are the same skills to be used precisely by today's teachers to teach students of the era of Edu 4.0, our educational system will tend to lag behind the countries that are prepared to deal with changes in industrial 4.0. This is because teachers' quality must match the level of performance required from new graduates who will apply for jobs in this era, the epoch of industrial 4.0.

At the 2018 World Economic Forum annual conference, Jack Ma (CEO of Alibaba Group) remarked that education is a major concern in this century, and we shall face enormous difficulties within the next 30 years if we do not transform how we handle teaching and learning in learning institutions (Whiting, 2018).

Students cannot compete with robots if education and learning are overloaded with knowledge, overpowering the content of knowledge or planned curriculum as currently implemented in our system (Nababan et al., 2020). As a result, for students to overcome computer intelligence, teachers must minimize the supremacy of teachers' knowledge content and allow the highest level of inclusive learning, learners' autonomy, and self-efficacy. This effort is required for students to compete and develop industry-based employment 4.0. This is critical for teaching and learning since computerized robotic robots have displaced some jobs globally due to the Fourth Industrial Revolution.

### **3.6. Integration of Education 4.0 Framework into the School System**

Numerous frameworks involve digital tools and media in the teaching and numerous learning processes involve several parties, such as students, educators, educational administrators, curriculum planners, and others. The frameworks can be used to enhance the efficiency of the pedagogical process in the era of education 4.0. The frameworks as claimed by Mat Jam and Puteh (2020) are:

1. Pedagogical ICT License in Europe (EPICT). It validates teachers' digital competencies using the DigCompEdu European Framework. The EPICT provides training for in-service teachers to maintain their professional development by emphasizing the pedagogical integration of ICT in their classrooms.

2. Teachers' ICT Competency Framework (ICTCF). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) developed the ICT Competency Model (ICT-CF) for pre-service and in-service teachers to use ICTs throughout the educational system. This framework was developed in response to recent technological advancements in education and learning.

3. Teachers' Common Digital Competence Framework (CDCFT). This framework is a reference framework for teachers to develop their digital competencies. It consists of five competence categories with 21 competencies divided into six proficiency levels. This framework is based on the European Digital Competence Framework for Educators (EDCF) and the European Digital Competence Framework for Citizens (DigCompEdu).

4. Technology, pedagogy, and content knowledge (TPACK). The framework connects Technology, pedagogy, and content knowledge to help teachers and students use technology effectively in their classrooms.

5. Africa's ICT-Enhanced Teacher Standards (ICTeTSA). It uses information and communication technologies to provide a framework for teacher professional development in teaching and learning. The framework is divided into six domains: instructional design processes, facilitation and inspiration for student learning, innovation and creativity, creating and managing an effective learning environment, assessment and communication of student learning, professional development and modeling ethical responsibilities, and finally, understanding the content of teaching.

6. Teachers' Professional Standards in Australia (APST). Accordingly, it provides guidelines for preparing, supporting, and developing teachers' professional expertise in Professional knowledge, professional practice, and professional engagement. These are the three realms of teaching. These standards include seven principles that explain how teachers should conduct themselves.

7. Practical Guidelines for Teachers Using the Technology-Enhanced Teaching Self-Assessment Tool (TET-SAT). The TET-SAT stands for Mentoring Technology-Enhanced Pedagogy. Digital pedagogy, digital content consumption and production, digital communication and collaboration, and digital citizenship. These are the four digital competency areas assessed by TETSAT, with another fifteen sub-areas of competency in Technology-Enhanced Teaching.

### **3.7. Impact of Education 4.0 on Education Stakeholders**

#### **3.7.1. Students**

The essential goal of Education 4.0 for all academic institutions is to motivate students and improve their learning outcomes. Students are the essential stakeholders in the learning community. Therefore, students are the primary beneficiaries of Education 4.0. Effectively, students can connect via technology with several parties, including instructors, parents, and management (Sharma, 2019).

Further, Kassim & Phua (2018) equally outlined the benefit of Education 4.0 to the students, such as as:

Learning Flexibility - Learners can have their pacing of learning situations with interactive methods at any time and from anywhere; as such, the learners become

teachers of their own learning.

Personalized learning - instilling a strong sense of independence in students, which will be fostered throughout the personalized learning process. Project based learners provided more projects, case study based learning modules, and hands-on action. This helps students develop teamwork and time management skills, which they can apply in future situations and jobs.

Mentoring opportunities - even if the education system is virtual one, learners would be mentored with the help of the teachers. They assist learners in adapting to the system.

Student ownership - in this system, students are the proprietors of their topics. They are in charge of the learning process from the start to finish.

Kassim and Phua (2018) argued that Education 4.0 would boost inclusive learning among the Generation Z by promoting Imbibing, Iterating, Interpreting, and Innovating learning activities with interest. Adapting to these has become a primary concern for this generation of students born with technology. Instilling information and skills in today's students is vital because they are more easily bored. If we continue to teach them using traditional ways, they will only be able to concentrate for a few minutes before losing interest. Gamification is becoming more popular as a method of attracting students to study since they learn when they are having fun.

Innovating learning activity methods help students develop problem-solving skills through hands-on activities and exercises because they will not be skilfully strong if just taught theories. The attractive tools can increase learners' interest in learning new materials and their desire to adapt. They will be more motivated to learn if they work in a group. Finally, but certainly not least, innovation will increase their confidence to handle projects successfully.

#### **3.7.2. Teachers**

Teachers can eventually teach students in Education 4.0 by using resources to help them achieve a particular learning goal. Education 4.0 enables instructors to work more efficiently by delivering the best methods and practices. Teachers can communicate with pupils more effectively and swiftly with the help of school administration systems. Education 4.0 promises to boost productivity by boosting teacher capabilities and student learning results (Nababan et al., 2020).

Since Education 4.0 emphasizes new concepts such as Cloud Computing, Machine Intelligence, Big Data, Cyber Security, and cybernetic learning activities adaptation (Kassim & Phua, 2018), teachers are encouraged to include these virtues in the curriculum and their lesson plans, making the learning system more accessible and helpful to learners. In addition, instructors should return to their informative practices and improve their teaching performances to meet the prerequisites of Education 4.0 through the Education 4.0 training packages.

### 3.7.3. Managers and Administrators

Education 4.0 benefits not only instructors, trainers, and students, rather, managers, and non-educators, like administrators, can also profit from it. This is because Education 4.0 emphasizes maximizing the usage of technological instruments and resources. These technologies include school management platforms which are frequently developed to improve the productivity of educational institutions and address the financial responsibility for work and management issues.

Education 4.0 creates a well-organized system that clearly produces better financial returns. It is still

possible to achieve the benefits that all schools required by decreasing inefficient management expenditures. In Education 4.0, management can be transformed into a more efficient workplace and execute a more productive business model.

## 4. Discussion of Results

The findings are based on relevant literature reviewed according to the title of the study, which is pedagogical practice in Education 4.0. The table 2 below presents the author(s), year of publication, title, and contributions of each work.

Table 2. Discussion of results

S/N	Author and title	Contributions
P1	Swartz (2021) Ethics in engineering education 4.0: The Educator's perspective	Most engineering students said that employing an educational framework in the classroom has the following drawbacks: When employing technology for educational purposes, there is a lack of face-to-face engagement in practical laboratory work, the integrity of engineering evaluations is harmed because of online techniques, and educator and student confidentiality is another issue. They also agreed that compassion and co-creation, simplification, learner engagement, and contact with engineering students should all be incorporated into learning task design as universal principles.
P2	Goh & Abdul-Wahab (2020). Paradigms to Drive Higher Education 4.0	According to the study, contemporary teaching staff may not possess the pedagogical practices to teach in this "computerized" world and be proficient at leading their students into the new phase of technology-driven experiences. Higher education institutions must shift from the conventional way of learning and conducting research toward autonomy through technology.
P3	Al Muhsin et al. (2020). The Implementation of SCL in Teaching Arabic for Islamic Finance: A Dynamic Approach in Preparing for Education 4.0	With these technological and innovative advances, education should correspond with market requirements regarding learning approaches, methodologies, modules, course assessments, and job preparedness, among other things.
P4	Lê (2020). Orientation for Education 4.0: A New Vision for Future Education in Vietnam	Education 4.0 classrooms should strive not to produce certificate-oriented learners but learners with appropriate 21 <sup>st</sup> century skills needed to pilot the revolution of industry 4.0.
P5	Tangahu et al. (2021). Modern education in revolution 4.0	For long-term growth and development, pedagogical techniques should instill High-Order Thinking Skills in the teaching and learning of Science, Technology, Engineering, and Mathematics (STEM).
P6	Barreiro (2022). Education 4.0 and its impact on the educational system during the pandemic and post-pandemic Covid 19 in Ecuador	Education 4.0 sees the implementation of new educational techniques aimed at meaningful learning and equipping individuals with the soft skills they should face global issues.
P7	Heriyanto et al. (2019). Character education in the era of industrial revolution 4.0 and its relevance to the high school learning transformation process	The findings of this study revealed that instructors' lack of awareness of IR 4.0 influenced the implementation of the character education strategy.
P8	Sharma (2019). Digital Revolution of Education 4.0.	According to the study, teachers must revisit their instructional practices and refresh their learning experience to meet the requirements of Education 4.0 via smart classrooms.
P9	González-Pérez & Ramírez-Montoya (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review.	The study argued that since there are no educational models to integrate education 4.0 in classrooms and schools, it proposed educational models to promote complex-reasoning capabilities and auto-systemic cognition to encourage problem-solving skills and tackle societal needs among students and instructors.
P10	Ahmad et al. (2019). Factors Influence the Students' Readiness on the Industrial Revolution 4.0	The study has shown a need for readiness to learn and relearn among graduates to overcome the new technology since the willingness to acquire soft skills among graduates is low.
P11	Pardiñan & Loremia (2020). Digital Pedagogy Analysis on Technology Trend Relevant to Education 4.0	In the era of education 4.0, it is claimed that tactics for using technology in a computer-assisted classroom environment may be considered to boost the possibility of encouraging learner engagement and deep learning.
P12	Nguyen (2020). Higher Education in the Fourth Industrial Revolution Age	In the era of education 4.0, specific changes are required in the areas of strategy and philosophy toward sustainable education, the renewal of training programs, the innovation of training models, the enhancement of the application of science and technology in education, the promotion and organization of a team of administrators and lecturers with high qualifications and experience, the promotion and organization of scientific research and technology transfer activities, and the strengthening of international educational cooperation.
P13	Hussin (2018). Education 4.0 Made Simple: Ideas for Teaching	The instructor must develop a content-based technology that follows the subject's pedagogical practice, student learning style, and the psychological state of the learner.

P1 & P13 claimed that despite the significance of education 4.0 in promoting industrial revolution 4.0, it lacks real classroom experience. It also lacks the hands-on experience for subjects that require practical phases during the instructional process. They explained further that the evaluation process is questionable and its confidentiality is not guaranteed. However, instructors must show empathy, effective learners' engagement, pedagogical content knowledge of the subject matter, and the learning style of the learners must be the critical factors to be considered in instructional design for education 4.0.

P2 and P8 argued that existing teaching staff in higher educational institutions has low pedagogical practices in integrating smart classrooms and other technologies in the instructional process, even though technology-driven classrooms promote learners' autonomy, students' voice, and learning flexibility.

P3 & P6 asserted that the instructional system in a higher institution must adapt the learning content, methodologies, and assessment criteria to meet the labor market needs and coping strategies despite the dynamic global challenges. P4, P5 and P11 stress that the integration of education 4.0 must produce competent graduates with the 21st century skills such as critical thinking and problem solving, communication, collaboration, leadership, creativity, and innovation required to meet the industrial demands of the global economy. The acquisition of these soft skills will be possible when classroom learning and instructional objectives are developed considering bloom higher-order thinking objectives in the STEM subjects to enhance learners' engagement, deep learning, and unfolding of the latent potentials of the learners.

P9 claimed that there is a dearth of the educational model to integrate education 4.0 into the school system. The model must be developed to promote complex-reasoning capabilities and auto-systemic cognition that will resolve the challenges of our immediate community and society. Also, & P10 argued that student readiness must be stimulated to adapt and overcome the challenges of technology-driven solutions. According to P12, the successful implementation of education 4.0 needs changes in the areas of strategy and philosophy toward sustainable education, the renewal of training programs, the innovation of training models, the enhancement of the application of science and technology in education, the formulation of a team of administrators and lecturers with high qualifications and experiences, the promotion of scientific research and technology transfer activities, and the strengthening of international educational cooperation.

Finally, P7 asserts that instructors' lack of awareness of the impact of the Industrial Revolution 4.0 negatively influenced the implementation of character and moral education in the school system. This is worrisome because it has tremendous undesirable implications for nation-building.

## 5. Conclusions and Novelty of the Study

Effective integration of education 4.0 into the learning institution systems is necessary but not sufficient conditions to promote the acquisition of 21st century skills among graduates. Thus, there must be a paradigm shift in instructional design, learning modules, assessment strategy, and classroom experience. In proper integration of the education 4.0 revolution, it is critical to stimulate and reawaken readiness in both students and instructors to get set to overcome the challenges of using technology to drive the pedagogical system. In conclusion, the integration of education 4.0 must see the development of character and moral education in learning institution systems since skills alone are not enough to guarantee the global community's desired challenges of today.

This research investigated the effective pedagogical practices used in learning institutions to promote the acquisition of Education 4.0 technologies and skills among graduates. Although, numerous researchers have conducted some studies on Edu 4.0, few of them focused their studies on Edu 4.0 pedagogical approaches. In this paper, the education 4.0 pedagogical approach in relation to appropriate learning design, learning skills, students' authentic input, Teachers' competence, integration of teaching and learning frameworks into the classrooms, and institutions' stakeholders was reviewed exclusively using the PRISMA systematic review method. Thus, these serve as a novelty of the study.

The implication of this systematic review on effective pedagogical practices used to transfer Edu 4.0 skills to graduates is tremendous, whether at individual levels, such as students, at institutional levels, such as lecturers and tutors, at academic administration stages, such as Deans, Heads of departments, and coordinators, or at public levels, such as Ministries of Education globally. This research may also serve as a stepping stone for futuristic researchers to comprehensively study the effective pedagogical practices of Edu 4.0 in schools and higher learning institutions universally.

### 5.1. Limitations and Further Study

Since this study is fully based on a literature review, further research should separately investigate education 4.0 pedagogical practices at school levels, university levels, and inclusive education classroom levels. Also, the thoughts of stakeholders on Education 4.0 should be considered in further studies, such as lecturers, teachers, students, and administrators.

The outcomes may differ if this study only reviews exciting literature on effective pedagogical practices in specific learning environments according to continents such as Africa, Asia, Europe, or the USA. Therefore, it is categorically suggested that future studies consider different learning institutions according to their continents to see the pattern of specific pedagogical practices used among institutions to transfer Edu 4.0 skills to graduates geographically.



This study reviews exciting literature on effective pedagogical practices employed by educational institutions to encourage graduates to acquire Education 4.0 technological skills considering appropriate learning design, students' authentic input, teaching and learning frameworks, and others using the PRISMA systematic review technique. Thus, these serve as a novelty of the study since only few researchers focused their studies on the pedagogical approaches of Edu 4.0.

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## Authors' Contributions

All authors collaborated in searching and downloading the articles used in this study. Then, the main researcher developed the abstract, introduction, and parts of the result; the second and third co-authors finalized the result of the study. The fourth and fifth co-authors worked on the discussion table, while the sixth and seventh co-authors worked on the paraphrasing, editing the content of the study in line with the reference preparation.

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