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Enhancing Self-Regulated Learning for Secondary School Through Education 4.0 Teaching Module

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Abstract

Education 4.0 is a learning approach that corresponds with the Fourth Industrial Revolution and focuses on reimagining education in light of cutting-edge technology and technologies. The goal of this research is to find out how secondary school teachers perceive about various aspects of Education 4.0. An essential Education 4.0 model was used to organize the empirical study that yielded a literature-based conclusion. In order to attract secondary school teachers, a snowball sampling method was employed. The data for the study came from a set of in-depth, semi-structured interviews and was analyzed using a content-analysis technique. The objective is to implement the foundations of the Education 4.0 revolution in Malaysia's educational system. According to findings, the primary features of Education 4.0 include: open access; customized education; mental transformation; integration of digital technology into education; seamless learning environments; lifelong learning; exploratory education; transdisciplinary learning; and more. Cooperation-communication skills, technology skills, learning skills, and personal traits were identified as top priorities in Education 4.0. Therefore, the teachers of the Education 4.0 model need to be well-rounded individuals with expertise in technology, mentorship, continuous education, and personality development.

Keywords: Education 4.0, teacher, student, Industry 4.0, Malaysia

Introduction

Several facets of social life, including employment, education, management, and everyday living, have undergone quick and profound changes due to the industrial revolution. (Blinder, 2006). From the middle of the 18th century until the turn of the 21st century, the innovations spawned by the Industrial Revolution went through four distinct stages (Bloem et al., 2014; World Economic Forum, 2017). The "Machine Age" refers to the first Industrial Revolution, the "Electricity Age" to the second, the "Electronics Age" to the third, and the "Internet Age" to the fourth (Peters, 2017). In the fourth decade of the Industrial Revolution, we have seen the most significant rate of development and transition yet. Cyber-physical systems are at the forefront of innovation in the fourth stage of the industrial revolution (Bloem et al., 2014; Peters, 2017). The term "Industry 4.0," coined by a German working group of leaders from academia, business, and politics, describes the fourth industrial revolution that developed with cyber-physical systems (Hermann et al., 2016).

The use of the internet in manufacturing is the single most significant technological advance driving Industry 4.0. (Drath & Horch, 2014). Contributing to the growth of Industry 4.0, cyber-physical systems highlight the technology that augments and expand human potential simply by being routinely used (Ballantyne et al., 2017). Due to cyber-physical systems, the "internet of things" idea is essential for Industry 4.0 since it allows "things" or "objects" to function connectedly (Hermann et al., 2016). Furthermore, industry 4.0 is distinguished by several features, the most notable being the fastest rate of change ever recorded (World Economic Forum, 2017) (Ballantyne et al., 2017). Thus, it is probable that the alterations brought about by Industry 4.0 would need modifications to many facets of a social life besides the industrial sector.

Conversely, the Industrial Revolution ushered in a time of rapid social and technological transformation, with repercussions felt in almost every facet of daily life. Technological advances in manufacturing have altered the skillsets necessary to thrive in today's economy, so everyday life has been forced to adapt. Moravec (2013) classifies our current societal and industrial states as "Society 1.0," "Society 2.0," and "Society 3.0.". Furthermore, education is one aspect of society that these changes have profoundly impacted. As a result, the definitions of terms like "content," "concept," and "content" in the context of education have shifted as the production process has evolved and its effects have rippled out into society. Education 1.0, 2.0, 3.0, and 4.0 refer to different stages of change that have occurred or are anticipated in education (Harkins, 2008; Moravec, 2013). "Education 1.0" is tailored to the demands of an agrarian society. In the past, teachers relied on face-to-face interactions between themselves and their pupils to facilitate the transmission of knowledge. "Education 2.0" refers to a learning style tailored to the requirements of modern industrial society. The educational process aims to equip students with skills that will be useful in their professional lives. "Education 3.0" has reshaped the educational system by using modern technological advances to serve the public better. And last, the 21st-century "Education 4.0" model was created to cater to the requirements of the innovation period. In this process, students are required to develop and adopt new technologies that will aid in the growth of human civilization (Puncreobutr, 2016). "Download education" describes Education 1.0, "open access education" describes Education

2.0, "knowledge-producing education" explains Education 3.0, and "innovation-producing education" represents Education 4.0 (Harkins, 2008; Moravec, 2008).

The effect of Industry Revolution 4.0 has had on Education can never be ignored. With education 4.0, there's a cultivating peer-to-peer learning atmosphere with students being able to learn collaboratively and from each other. The role of teachers is that of facilitators. The curriculum and learning outcomes focus on complex 21st-century skills including problem-solving, critical thinking, creativity, people management, teamwork and collaboration, emotional intelligence, judgment and decision-making, service orientation, negotiation, and cognitive flexibility (Tarigan & Fadillah, 2023) Figure 1 illustrate the context from Education 1.0 to 4.0.



Figure 1. Dramatically different learning in Education 4.0

Despite this, concepts like meaning, technology, teaching, schools, and teachers have all been rethought in light of Education 4.0, which Harkins (2008) describes as an "innovation-creating process." In this way, individuals or groups foster innovation-focused activities that contribute to constructing meaning. Students contribute significantly to the innovation-creating process by driving the pace of technological progress. Positive feedback loops in innovation improve education. Concurrently, instruction becomes a constant presence in every phase of living, from waking to sleeping to working. Human bodies host institutions of education that are connected around the world. As a result of this shift, schools will become cutting-edge institutions that will gradually replace traditional lecture halls. In the 4.0 version of education, teachers are understood to be anyone and everywhere who can spark new ideas.

Education 4.0 may be considered a paradigm shift that reframes traditional education ideas to meet better the demands of the Fourth Industrial Revolution (also known as "Industry 4.0"). Questions like how to resolve the inconsistency between schooling and information technologies, how to incorporate education and technology into today's already busy and demanding educational programs, and many more were all considered throughout the Education 3.0 process (Ballantyne et al., 2017; Collins & Halverson, 2010; Sendov, 1987). On the other hand, the answer to the issue of whether teaching methods and administrative procedures are essential for education 4.0 is just too nebulous to be satisfying.

To meet the demands of the Fourth Industrial Revolution (4.0), a new paradigm known as "Education 4.0" emerged. The approach is an example of the kind of cutting-edge pedagogy used in Education 4.0. Students can access digital resources outside class time, such as films, presentations, and e-materials, to help them learn and prepare for class so that they may engage in critical thinking, analysis, and problem-solving throughout class time (Youngkin, 2014, p.368). Blended learning incorporates online learning resources while modernizing the classroom experience (Garrison & Kanuka, 2004; Gogebakan-Yildiz et al., 2016). To sum up, the learning strategy promotes student agency, emphasizes hands-on experience, allows differentiated instruction, and allows flexible class time scheduling.

Consequently, it is safe to say that this approach conforms to the standards of Education 4.0. Furthermore, blended learning is made possible by an advanced form of Education 3.0 and distance education. Questions like how to resolve the inconsistency between schooling and information technologies, how to incorporate education and technology into today's already busy and demanding educational programs, and many more were all considered throughout the Education 3.0 process (Ballantyne et al., 2017; Collins & Halverson, 2010; Sendov, 1987). However, the issue of whether teaching and administration methods are essential for education 4.0 has no concrete, effective solution.

Therefore, one of the most effective methods of equipping students with the kinds of abilities they will need to thrive in the 21st century's rapidly evolving economic, social, and technical landscapes via formal education. Education 4.0, which emphasizes a curriculum designed to increase both Industry 4.0 producers and users, as well as educational innovation and the development of innovative expertise, are explored in this setting. Education geared at producing workers for the Industry 4.0 economy places a premium on equipping students with the knowledge and abilities necessary to succeed in the modern workplace. Individual skills, interpersonal skills, life skills, applied skills, labor skills, non-cognitive skills, learning and innovation skills, knowledge, media and technology skills, life and career skills, and so on are all 21st-century skills (Partnership for 21st Century Skills-P21, 2009). The qualities of an educational curriculum that aims to produce innovators are comparable to those of 21st-century skills, which stress creativity and learning skills in addition to social and emotional abilities. The educational and management methods and practices that best prepare students with these competencies remain the subject of ongoing research and debate. However, to adapt, though, teachers will need to rethink certain long-held tenets of the classroom. As a result, teachers must provide their students with the knowledge and abilities demanded by today's dynamic technological landscape (Bakhmat et al., 2022). Students should graduate from both their general and vocational education programs with the skills necessary to enter the work market.

Literature Review

Major trends of Education 4.0

Figure 2 provides an illustration of the patterns of Education 4.0 and a summary of the priorities for each of the Education 4.0 trends. This illustration is based on the introduction to education 4.0.

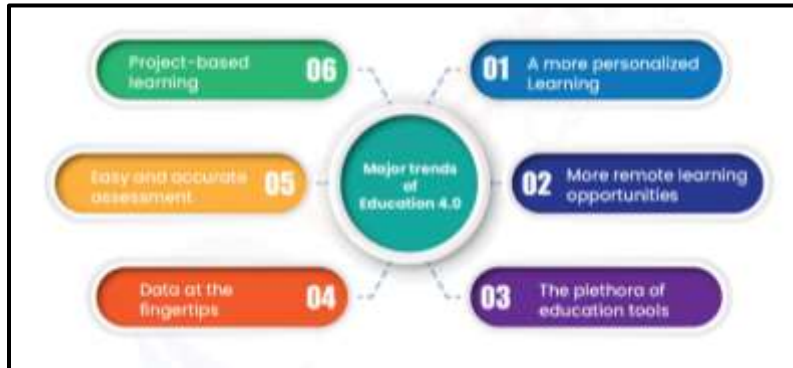


Figure 2. Major Trends of Education 4.0

(i) A more personalized learning

Education 4.0 values the uniqueness of each student and their particular learning speed. A tailored method of instruction will have a stronger influence on students' ability to effortlessly attain their goals. With Artificial Intelligence and Cloud Computing, there are a variety of technologies that may adapt the entire teaching process to the demands and learning pace of each individual student (Tan, 2023). The teachers, on the other hand, will be able to quickly identify students' strengths and problems and give immediate feedback.

(ii) More remote learning opportunities

Education 4.0 is based on making learning accessible everywhere and at any time through a collection of e-learning tools that enable remote and self-paced learning. Active Blended Learning (ABL) is gaining popularity, as students engage in active learning outside of the classroom. Hence, individuals become proficient in both practical and experience learning.

(iii) The plethora of education tools

Education 4.0 provides students with a clear path by making tools and strategies accessible in their learning environment. This means that students will be allowed to select the methods and resources they will use to gain information. Notable examples include collaborative and engagement tools, flipped learning, and blended learning (Basitere et al., 2023).

(iv) Project-based learning

The project-based learning method that Education 4.0 promotes encourages students to study in an engaging manner. It eschews theoretical knowledge and encourages students to acquire time management skills, organizational skills, collaboration skills, and time management skills, all of which will be essential for their future work (Wright-Brough et al., 2023).

(v) Easy and accurate assessment

Education 4.0 introduces a more realistic method of evaluation. There are online and offline exams, and students' projects, assignments, and fieldwork are evaluated (McKoy & Merry, 2023).

(vi) Data at the fingertips

Education 4.0's data analytics and reporting provide a deeper understanding of the students' learning path (Alenezi, 2023). The statistical analysis enables instructors to determine the precise standing of their pupils and assist them accordingly.

Self-Regulated Learning

Self-regulated learning (SRL) is an approach that emphasizes the development of students' ability to set goals, monitor progress, and regulate their own learning (Bahri et al., 2021). In Malaysia, SRL has gained increasing attention as an effective approach to improve learning outcomes and enhance students' ability to learn independently. Due to the modifications made to the learning models as a result of the Covid-19 pandemic, students' self-regulation learning practises have been impacted globally (Viberg et al., 2020). Students were forced to transition to highly independent and self-study methods (Stradiotova et al., 2021). The capacity of a person to grasp and manage his or her learning environment is known as SRL (Al Mulhim, 2021). Since SRL is crucial for academic success, a good SRL ability will affect learning outcomes (Eva et al., 2023).

SRL skills are anticipated to help learners in a variety of ways because they enable them to monitor the metacognitive, motivational, and behavioural elements of their learning. For instance, Ghasemzadeh, et al. (2019) contend that as students become more accountable for their learning, their overall learning outcomes and perceptions of self-efficacy improve. Similar findings was made by Zalli et al. (2020), who discovered that students' happiness with online learning is influenced by self-regulation, which acts as a mediating variable. Hence, determining a student's level of SRL is crucial, especially in online learning contexts where students are encouraged to independently manage their learning development. Despite much research on the subject of SRL, the majority of the studies have mostly focused on face-to-face learning.

Several researchers claim that SRL can improve several aspects of student' writing ability in connection to language abilities (Ariyanti et al., 2018; Mbato & Cendra, 2019). For instance, Ariyanti et al. (2018) found that SRL learners put up more effort in their writing instruction and produced better writing outcomes. For students to successfully complete their undergraduate theses, motivation and help-seeking are crucial, and SRL is related to these in terms of emotional learning (Mbato & Cendra, 2019). As a result, SRL is discovered to be essential for a variety of learning processes, including students' writing proficiency. Also, SRL and students' success in online learning are closely related.

Different people will employ various tactics because SRL in learning necessitates a specific approach (Eva et al., 2023). According to earlier research on online learning,

using SRL techniques including metacognition, planning, time management, and effort management boosts academic performance (Zalli et al., 2019). According to a different study, SRL techniques like time management, planning, and self-evaluation were discovered to significantly affect students' learning pleasure (Mahmud & German, 2021). Overall, SRL is gaining increasing attention in Malaysia as an effective approach to improve learning outcomes and promote independent learning among students. The government, universities, and other stakeholders in the education sector continue to work towards promoting the development of SRL skills and integrating SRL into the education system.

Thus based on the elaboration, SRL and Education 4.0 anticipates radical educational changes, focusing on 21st-century skills and innovation in education from the mid-2000s. As a result of these adjustments, Education 4.0's core ideas and methods may be more clearly defined. Therefore, establishing a theoretical framework for implementing education might be seen as essential for societies to shift to Industry 4.0 and experience economic and social growth and development. Nonetheless, in the world's scholarly literature, there are few discussions of Education 4.0's theoretical framework (Harkins, 2008; Peters, 2017; Puncreobutr, 2016; Wallner & Wagner, 2016). Moreover, the studies themselves treat Education 4.0 as if it were a theoretical concept.

Nevertheless, it is believed that the content and qualities of Education 4.0 need to be operationalized to drive the implementation, especially when considering the societies' subjective, cultural, and economic structure and the distinctive characteristics of their educational systems. Hence, recommendations for actual implementation would be prepared to ease the transition to Education 4.0 in line with the structure and operation of the Malaysian education system. Furthermore, identifying features of Education 4.0 would add to the research on the topic. Thus this paper aims to identify the elements of Education 4.0 from the perspectives of educational science professionals, including school teachers' views. Based on the literature mentioned above, below are the research questions that are planned to be addressed by this paper.

1. How to define the characteristics of Education 4.0 in Malaysian Education?
2. How to define the teacher of Education 4.0?
3. How to define the student of Education 4.0?

Research Methods

This section stresses on the mainstream research method on Education 4.0. In the field of education 4.0 testing and assessment, the quantitative research method seems to be used rather than the qualitative research method. Bujang et al. (2020) commented that, "The Education 4.0 has been traditionally dominated by a quantitative paradigm." Because Education 4.0 testers carry on using statistical means of test validation. However, quantitative research technique is not the only method utilised in validation studies, rather multiple other methods are used in language testing for exploring test validity. Qualitative research techniques, therefore, such as introspection and retrospection are extensively used in test validation

(Savicki & Price, 2021). Therefore, a significant shift is noticed in the field of Education 4.0 research. Miranda et al (2021) stated that the most significant development in Education 4.0 testing is the start of using qualitative research methodologies for designing, describing, and validating Education 4.0 in particular.

Even though past studies (e.g., Alda et al., 2020; Wulff et al., 2022) would argue that the quantitative research method is still powerful in regard to Education 4.0 assessment research because the researchers of Education 4.0 around the world mostly employ the quantitative research techniques for their research. Almost all the studies, for example Queirós et al. (2017) involved quantitative research strategies. So, it is evident that the qualitative research is yet a dominant method of research in the field of Education 4.0 research. Therefore, this study employed a qualitative approach to investigate how the notion of Education 4.0 has been received in the Malaysian educational system. To paint a more accurate and complete picture of a phenomenon or event, researchers often turn to the qualitative research approach, which uses techniques including in-depth interviews, surveys, and document analysis (Yildirim & Simsek, 2011, p.39). The study used one qualitative research paradigm, the preliminary qualitative research design. To this end, basic qualitative research—the most popular qualitative research design in education—seeks to investigate how people make sense of the world through the lens of their own experiences, how they form their perceptions of it, and the significance they ascribe to the events that occur in their lives (Merriam, 2009, p.23) as the study aimed to understand how academics who are themselves specialists in the area of education conceptualize the idea of Education 4.0, a basic qualitative research methodology was deemed to be the most suitable approach.

The sample size might change depending on the unit of analysis that is being used. On the other hand, according to the norms of qualitative research, the size of the sample could not be relevant at all. Miles and Huberman (1994) stated that the ideal number of informants for a case study is between 5 and 20. Following Miles and Huberman's recommendation, ten rural secondary schools in Malaysia will serve as the study group for this investigation. The rural secondary schools being selected for this study because, to shed light on the educational divide that exists between students in urban and rural areas of Malaysia, and to identify the factors including parental human capital (such as education, occupation, and family size), financial capital (such as income and educational expenditure), and social capital (such as age, sex, religion, educational track, class size, and student-teacher ratio-that contribute to this spatial academic divide).

Despite the importance of identifying the problems of spatial disparity in academia and sorting out the determining factors driving such inequality, almost no initiative has been taken by the government and its development stakeholders. Form 4 and Form 5 students are also seen as having an advantage over college and university students in terms of the time they have to begin exploring the continuous learning process. Vocational schools in Malaysia serve an important role in preparing students for successful careers in the industrial sector. There are benefits to obtaining a degree in a certain trade. By focusing down on one career, students may become experts in their industry and pave the way for a fulfilling and varied professional future. As more and more students learn to value vocational education, they will discover

several benefits otherwise unavailable to them. In addition, with Education 4.0, every teacher has the opportunity to positively impact their students' futures. Teachers may revolutionize their teaching methods and equip their students with 21st-century skills by adopting the usage of Education 4.0 technologies in the classroom.

The snowball sampling technique was used to choose participants for the research group. The snowball sampling technique selected because the process to select a rural secondary school depends on the school principal. The school principal have to propose the intention via reseracher of this study to the state education department. An efficient way to access crucial circumstances or persons from whom more in-depth information may be gleaned is through snowball sampling (Patton, 2014, p.237). Thus, the teachers who participated in this study were chosen using a snowball sampling strategy to ensure that they were all familiar with the idea of Education 4.0. Teachers on the faculty range in age from 26 to 50 and experience from 2 to 20 years.

Data Collection and Analysis

The research was conducted with the use of a semi-structured interview guide. The flexibility of the semi-structured interview allows participants to provide fresh interpretations for the study issue while still providing the framework necessary to answer the interview questions (Galletta, 2013, p.1-2). The interview guide was designed to reflect the focus of the research, which was on the human capital implications of "Education 4.0" in schools. The literature on Education 4.0 was thoroughly researched throughout the design of the data-collecting instrument. After reviewing the available literature, five open-ended questions and probes were included in the preliminary interview form (Example of the open-ended questions – (i) "What are the defining qualities of Education 4.0 in the Malaysian Education System?" (ii) "How exactly does one characterize a teacher of Education 4.0 in Malaysia?". (iii) How to characterize the students in the 4.0 educational 4.0 model?", (iv) "How teachers deal with technological changes and advancements, as well as digitalization the 21st century learning?", (v) "How important are Education 4.0 for the teachers and students adopting the usage of Education 4.0 technologies in the classroom?" Upon the feedback from two academic experts in Industry 4.0, the document was reorganized to reflect their recommendations.

Volunteer teachers were contacted in advance to set up appointments for the interviews. First, researchers presented themselves and explained the study's rationale to participants. Next, participants' demographic information was collected through a series of questions. The researchers used an online data-gathering tool to ask participants free-form questions. The duration of each interview was between 25 and 35 minutes. Interviews were supplemented with probing questions to elicit in-depth responses to the inquiries. A summative content analysis which involves counting and comparisons, of keywords and content, followed by the interpretation of the underlying context pertaining to Education 4.0 was employed to analyse the participant's answer. Furthermore, content analysis was utilized to evaluate the collected data for the study. Certain words in a text are summarized into smaller content groups using a systematic and renewable method called content analysis.

To ensure the validity, dependability, and transferability of the findings, internal validity, triangulation, member verification, peer review, and researcher biases were constantly monitored. In addition, data accuracy was ensured through triangulation and auditing. In addition, peer briefing sessions were utilized to confirm the external validity. These various techniques allowed for the generalization and transferability of the stated findings to other scenarios that were comparably comparable. Hence, case study readers should assess the relevance of the example to their context of interest (Merriam & Tisdell, 2015).

Results and Discussion

The findings of the study based upon the information gathered as a result of the methodology discussed below.

Characteristics of Education 4.0

The first sub-question investigates teachers' impressions of the characteristics of Education 4.0 Education 4.0's foundational features. The first part of this question was answered by conducting analyses based on the responses of interviewees knowledgeable in Education 4.0 among secondary school teachers. Figure 3 displays the outcomes of the statistical analysis. Open access, customized education, mental transformation, digital technology integration, seamless learning environments, lifelong learning, exploratory education, and transdisciplinary education are some of the primary components which describe Education 4.0, as seen in Figure 3. Examples of what might be considered "open access" include MOOCs and other forms of freely available online courseware. Personalized education encompasses a wide range of practices, including but not limited to developing tailored course materials, implementing adaptive learning environments, and learning analytics. Teachers stressed the need for philosophical transformation of human resources as part of the enormous scope of mental change. Technological advancements like smart campuses, augmented reality, cloud information technologies, and virtual reality was proposed for the classroom as part of the more significant movement to incorporate digital technology.

The concept of a "seamless learning environment" was introduced, detailing how education may extend outside the classroom and be pursued at any time. One of the central tenets of Education 4.0 is lifelong learning, which has been linked to metacognition, long-term viability, and progressive improvement. Lastly, we discussed exploratory education, which involves a shift from memorization to practical, real-world exercises.

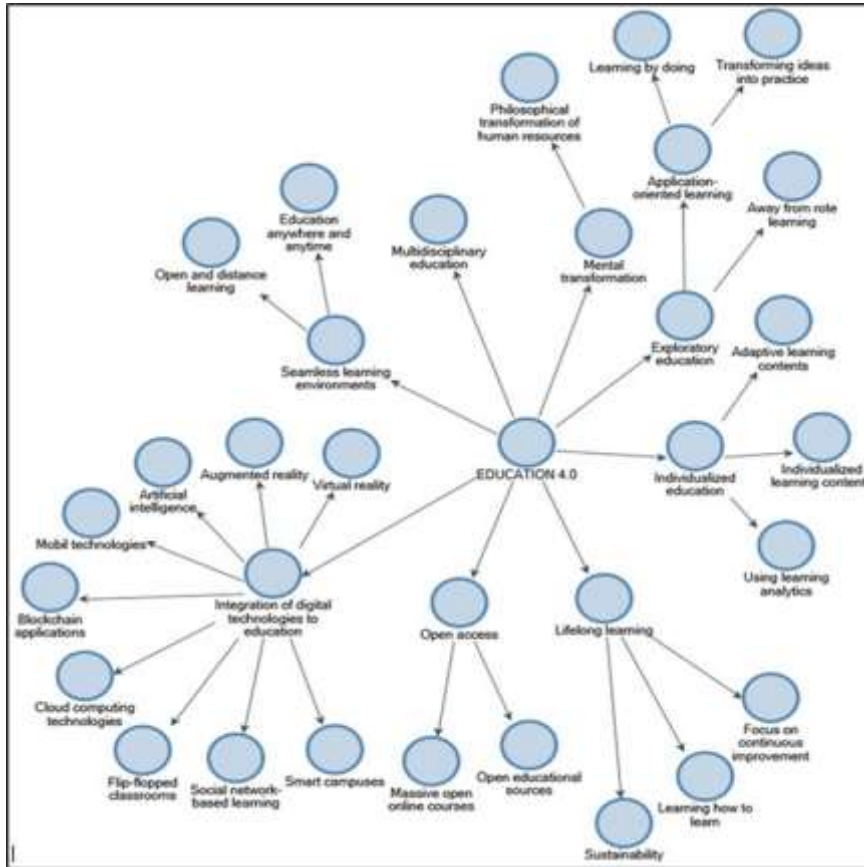


Figure 3. Essential characteristics of Education 4.0

The Qualifications Expected from the Student of Education 4.0

The second sub-question of the study concerns opinions on what kind of skills and knowledge an Education 4.0 student should have. Analysis results are shown in Figure 4.

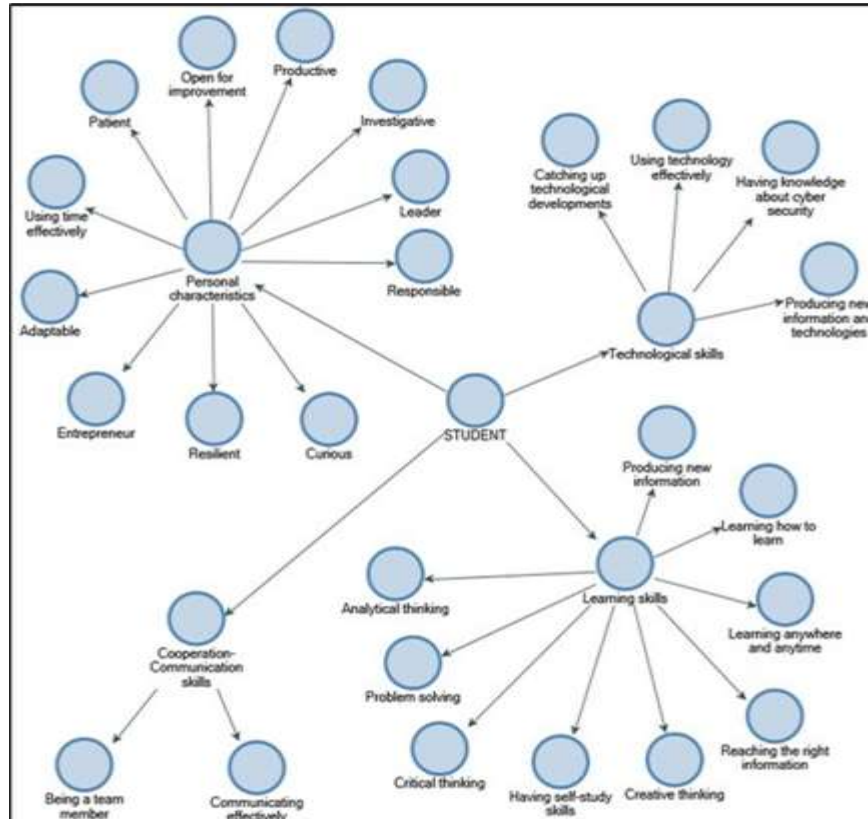


Figure 4. Defining the teacher of Education 4.0

When the attributes associated with students in Education 4.0 were analyzed (Figure 4), they fell into four categories: cooperation-communication abilities, technical skills, learning skills, and personal traits. Working successfully in a team and expressing oneself clearly are examples of collaboration-communication abilities. Technological skills include various mindsets and actions, including cyber security, information and technology creation, efficient use, and keeping up with the latest advancements in the field. Studying, gaining new knowledge, and using one's mental faculties are all components of "learning skills." Analytical thinking, problem-solving, critical thinking, creative thinking, knowing how to tell reliable sources apart from propaganda, learning how to learn on one's own, coming up with new information on one's own, and being able to do so in any environment and at any time all fall under this category. Participants highlighted the importance of leadership, curiosity, responsibility, adaptability, responsibility, resilience, initiative within research, entrepreneurship, openness to development, productivity, and adaptability.

The Qualifications Expected from the Teacher of Education 4.0

The study's third sub-question focuses on participants' perspectives on the credentials necessary for Education 4.0 teachers. Skills in technology, counseling, lifelong learning, and personality traits are shown in Figure 3 to be the most important for a teacher in the Education 4.0 paradigm. It was found that the student's technical abilities were comparable to those listed

under the topic of technological competence. Yet, it was concluded that teachers in the Education 4.0 era need specific technical abilities, such as managing virtual student groups and integrating technology into the teaching and learning. Personal traits of the teacher of education 4.0 were identified to be similar to those of the students: they should be interested, patient, open to change, flexible, and investigative. In addition, education 4.0 emphasized the need to instill in students a desire to study throughout their lives. This is why CPD and other forms of ongoing training for teachers are hallmarks of the Education 4.0 model. Finally, guidance abilities were identified as the essential talent for a teacher in the Education 4.0 paradigm. Here, we highlight the importance of guiding students not only technologically and pedagogically but also emotionally, coordinating, motivating, leading, creating a participatory learning environment, facilitating access to the appropriate information, and assisting students in establishing and achieving their own goals. Faculty members' perspectives on the qualities an Education 4.0 teacher should possess follow (Figure 5).

There is widespread agreement in the academic literature that Education 4.0 is the educational equivalent of Industry 4.0. Therefore, educational reform is needed to accommodate the needs of Industry 4.0, particularly regarding the workforce (Anggraeni, 2018; Hariharasudan & Kot, 2018; Hussin, 2018). Education 4.0, however, is hard to define and analyze since it does not yet exist. Industry 4.0 has the same issue. Plenty of theoretical research has been published, but actual experiments are hard to come across (Wallner & Wagner, 2016, p.157). Because of this, it won't be easy to implement Education 4.0 unless it has been formally defined and practically studied. So, this research aimed to identify the minimum requirements for the human components of Education 4.0, namely the teachers.

People are the backbone of Education 4.0; they are the ones who will grow up to be the workers of Industry 4.0. The primary purpose of this research was to learn what participants saw as the essential features of Education 4.0. So, the primary criteria were settled upon as follows: the incorporation of digital technology into education; seamless learning environments; customized teaching; exploratory education; and lifelong learning. According to the research, the primary need for Education 4.0 is using digital tools in the classroom (Benesova & Tupa, 2017; Hariharasudan & Kot, 2018; Wallner & Wagner, 2016). According to this research, all of Education 4.0's other requirements stem from this fundamental competency (Hariharasudan and Kot, 2018). One of the most crucial tenets of the 21st-century educational paradigm, innovation-based education, is using digital tools in the classroom (Gulicheva et al., 2017). These tech-enabled classrooms are defined as "globalized," "automated," "virtual," "networked," and "flexible" (Wallner & Wagner, 2016). This is true for any seamless learning environment, but it is particularly relevant for those promoting learning at any time and place (Anggreani, 2018; Wallner & Wagner, 2016).

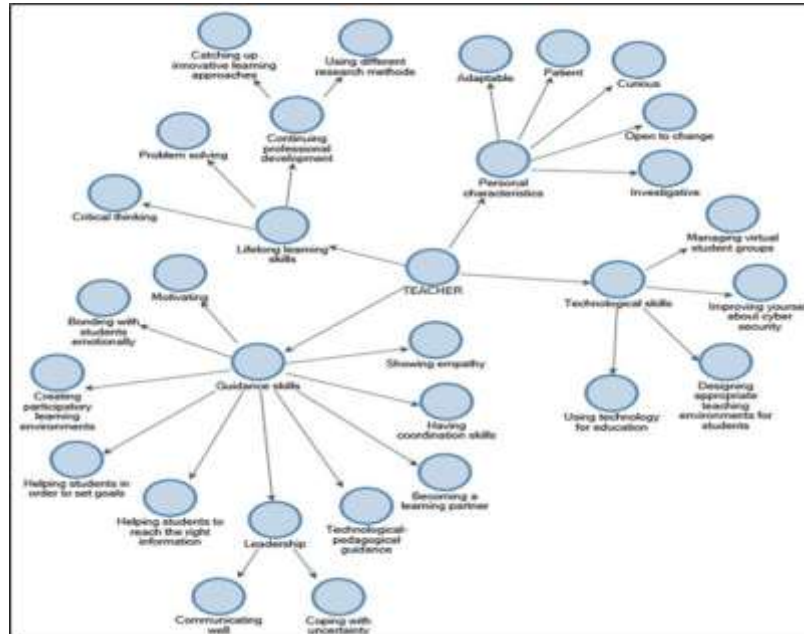


Figure 5. Defining the student of Education 4.0

The other research on Education 4.0 defines its primary qualities as identical to those found in this one, except for technological integration and seamless learning settings. They include various scheduling options, students' active participation in curriculum creation, instructors' role as guides, and the acquisition of transferable skills and knowledge via real-world application (Hussin, 2018). Nine comparable categories are used by Sadiyoko (2017) to characterize Education 4.0's qualities (Anggreani, 2018). The conclusions of this research are similar, including the rates mentioned above, but the participants do not mention evaluation criteria or student participation in the curriculum-building process. Conversely, they highlighted the value of continuing education throughout one's life. Several studies have also highlighted the significance of lifelong learning in Education 4.0. (Hariharasudan & Kot, 2008; Wallner & Wagner, 2016). As a result, the barriers of conventional educational institutions need to come down if we're going to realize Education 4.0 and shape the future via its description. It's also vital that people of all backgrounds and ages have equal access to educational opportunities. Second, the research seeks to identify, from the participants' perspectives, the skills and knowledge that students will need to succeed in Education 4.0. As Education 4.0 is essential for increasing the human resources of Industry 4.0, this is undoubtedly one of the most pressing concerns raised in the literature (Benesova & Tupa, 2017).

Hence, determining student credentials means defining the human resources required by Industry 4.0. Learning skills like problem-solving, analytical thinking, critical thinking, etc., and personal qualities like responsibility, adaptability, resilience, curiosity, etc., are crucial for students in the Education 4.0 model. As a result of the technological emphasis of Education 4.0, most research discussing students' abilities in the associated literature (Hariharasudan & Kot, 2018; Hussin, 2018) focuses on technical competence. However, research shows that kids born in the 2010s, sometimes known as Generation Z, already possess the technical abilities

necessary for Education 4.0. Students of Generation Z thrive in group projects and discussions, and they expect the same from their educational institutions (Hussin, 2018). The relevance of learning skills such as knowledge production and life-long learning activities, as well as cognitive skills such as non-linear thinking and social skills such as adaptability to multicultural learning situations, has been emphasized in several studies (Hariharasudan & Kot, 2018; Wallner & Wagner, 2016).

Education 4.0 includes self-directed study, originality, problem-solving, critical thinking, communication, and teamwork (Salmon, 2019). Skills like this make students significant and irreplaceable assets for the companies of the future (Hariharasudan & Kot, 2018). Several of the talents stated in the literature and by the participants in this research are similar to those sometimes referred to as "21st-century skills.". Skills necessary for success in the twenty-first century include openness to other cultures, the ability to learn and innovate in the face of new challenges (such as critical thinking, problem-solving, creative thinking, etc.), proficiency with digital technologies (such as media and information literacy), and the dispositions of adaptability, responsibility, flexibility, and initiative in one's work and personal life. Similar findings have been reported elsewhere (Larson & Miller, 2011; Puncreobutr, 2016; Trilling & Fadel, 2009). In addition, more intangible qualities, such as the ability to communicate effectively, are equally as important as hard facts. As change is at the heart of the Industry 4.0 age, meeting the challenges of this new era requires cognitive processing, knowledge production, and flexibility.

The third sub-question seeks to specify the kinds of teaching credentials that will be necessary for an Education 4.0 environment. Technology competence, guiding competence, lifetime learning competence, and personal traits, including curiosity, patience, openness to change, adaptability, and investigation, are identified as the primary qualifications of instructors of Education 4.0 in this research. It was established that the qualities demanded of students in Education 4.0 are identical to those of teachers in Education 4.0, except for counseling abilities, which were found to be unique to teachers in Education 4.0. Rather than the traditional authoritarian teacher, Kilic (2018) argues that a mentor teacher role will be crucial in the Education 4.0 era. The abundance of information available to pupils is a primary factor in the growing significance of instructors' advising abilities. As a result, it is argued that under the Education 4.0 model, teachers' primary role is not as subject matter experts but rather as facilitators of students' access to and use of this new knowledge (Wallner & Wagner, 2016). That way, they may learn to evaluate information from various sources and determine what is reliable and what is not. Teachers in the fourth iteration of the education reform movement are urged to help their pupils take responsibility for formulating their learning objectives.

With this direction, students can zero in on what they're good at and what they want out of life. Instructors can provide them with personalized learning experiences that are hallmarks of the Education 4.0 paradigm (Wallner & Wagner, 2016). Using cutting-edge technology and a fresh approach to teaching, Abersek and Flogie (2017) argue that modern teachers can and should provide students with personalized instruction as part of Education 4.0. So, it is reasonable to assume that guiding abilities will feature highly among the requirements for a teacher in the 4.0 educational model. The survey also identified lifetime learning capabilities as

a necessary quality in an Education 4.0 instructor. Teachers in the modern day are responsible for not just passing on knowledge but also instructing their students on how to find new sources of knowledge and information. If teachers are lifelong learners, they will be curious about new ideas and have the skills to absorb further information throughout their careers (Yaman & Kilic, 2015). Learning models that allow for study at any time and in any place—including, but not limited to, e-learning, online education, and lifelong learning—are central to the vision of "Education 4.0." (Kilic, 2018).

Here, teachers' lifelong learning was stressed to better respond to the ever-evolving nature of the information they impart. Teachers in the era of Education 4.0 are expected to be computer savvy and to use their knowledge of new tools in their lessons. Cagiltay et al. (2007) state that students' propensity to utilize technology and students' requests and expectations of the usage of instructional technologies in the courses are the driving forces behind the increased incorporation of technology into classrooms. This new set of expectations may be traced back to the fact that today's pupils are primarily members of Generation Z, the first generation to grow up completely immersed in technology (Prensky, 2001). Education 4.0 is defined as an educational strategy aiming to increase students' proficiency in using digital technology at all grade levels and in the classroom. As such, the focus on digitally capable instructors to accomplish Education 4.0 in the literature (Hariharasudan & Kot, 2018 Buyukozturk) lends credence to the results of this study. Thus, it may be claimed that one of the requirements of Education 4.0 is instructors' use of technology-based pedagogy in the classroom. In view of limitation, geographic dispersion influence the findings of the study since the selected school is at rural area. Furthermore, the interpretation and views of informat in rural area different compared to the secondary school at urban area. Future reserach expected to focus on increasing the number of informat and might thnik of including student and parents to generalize the finding of the study.

Conclusions

This research, which analyzes the foundations of Education 4.0 from the perspective of human resources, highlights the need to incorporate technological advances into the classroom to put the vision of Education 4.0 into action. Thus, it is essential to achieve digital transformation in education to guarantee the education and technology integration necessary for Education 4.0. Furthermore, research on Education 4.0's curriculum's content, goals, learning experiences, and evaluation might also be recommended for its realization. Moreover, research might be recommended to analyze the preparation levels of the Malaysian Education System for Education 4.0 in the context of the credentials given here.

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