Systematic Literature Review: Characteristics of Teachers in Aspects of the Industrial Revolution 4.0

Tan Wei Wei, Nurfaradilla Mohamad Nasri
Faculty of Education, National University of Malaysia (UKM), Bangi
Email: p111477@siswwa.ukm.edu.my, nurfaradilla@ukm.edu.my

Abstract
In the era of IR 4.0, the education system needs a transformation that can adapt to such rapid change. The role and characteristics of teachers have also changed in terms of meeting the requirements of the Industrial Revolution 4.0 aspect. This study aims to examine the trends of systematically published studies involving the role and characteristics of 4.0 teachers in the last five years, which are from 2018 to 2022. Qualitative methods are used by analyzing content and screening articles using PRISMA guidelines. Article searches are through Google Scholar database sources. A total of 24 articles were found after being screened according to the set criteria. The results of the analysis of this study found that 4.0 teachers need to meet digital literacy skills, lifelong learning skills, leadership skills, and personal attitudes. It is hoped that this study can provide guidelines to the Ministry of Education Malaysia (MOE) in formulating skills training programs for educators towards producing a useful generation in the era of IR 4.0. In addition, this study can help researchers to see research trends related to the characteristics and role of teachers in aspects of Industrial Revolution 4.0.
Keywords: Teacher 4.0, Characteristics, Industrial Revolution 4.0, Education 4.0, Literature Review

Introduction
The Fourth Industrial Revolution (IR 4.0) is rapidly evolving and is changing the practice of life for all of us. The Founder of the World Economic Forum (WEF), (Klaus Schwab, 2017) in his book has explained that this Fourth Industrial Revolution (IR 4.0) changed the way we work and live. These changes are driven by three key technology areas, namely physical, digital and biological, across the nine pillars of Industry 4.0, encompassing simulation and virtual reality, vertical and horizontal system integration, Internet of Things (IoT) industry, cyber security, cloud computing, additive manufacturing, supply chain, data analysis and robot automation.

The human resource profile associated with IR 4.0 is different from antiquity. In this era, more focused skills in terms of data analysts and technologists are needed as the demand for human resources has changed significantly. Husni (2018) believes that although IR 4.0 has a positive impact in the field of science and technology, we need to recognize that these changes also include morality, and in this context, Malaysia is still in its infancy. Therefore,

the desired characteristics of teachers also need to undergo transformation because teachers play a role in changing the minds and attitudes of the younger generation.

The vibrant Industrial Revolution 4.0 (IR 4.0) taking place around the world requires all parties to act quickly in tandem with the rapid development in technology products and smarter automation systems. The development and change of IR 4.0 that we can feel its existence is through the conversion of buying fast food at counters with employees have been replaced to kiosk systems. Thus, it we can see the impact of IR 4.0 can change the way we live but will also replace the human workforce to cause unemployment. The transformation that took place where IR 4.0 requires knowledgeable and highly skilled human resources (Khan & Nazmy, 2019). This is because competitive human resources are potential to lead our country in a more advanced direction and can follow the development of the IR 4.0 era. In addition, our country, which is heading towards a high-income economy, is very concerned with the skilled workforce to achieve that information. Therefore, IR 4.0 will not only have an impact on the industrial sector but also on the education sector.

In the era of IR 4.0, the education system needed a transformation that could adapt to such rapid changes. At the same time, the role of the teacher as an educator also requires a new definition to meet the needs of this era. Therefore, teachers and authorities should be aware of the requirements of teachers serving in the IR 4.0 so that teachers or authorities can undertake initiatives to improve the quality of teachers to require in the development of the era. Therefore, teachers who possess the desired IR 4.0 characteristics can produce human profile resources that are match with the demands of the era as well.

Industrial Revolution 4.0 which emphasizes the construction of virtual reality technology without much use of manpower certainly has an impact on various aspects of life (Đuricin & Herceg, 2018). In this context, the level of quality and professionalism of teachers has a close relationship and relevance to the efforts to improve the knowledge and skills of students in the face of the Industrial Revolution 4.0 era. Therefore, the quality and level of professionalism of teachers is one of the important aspects so as not to miss the impact of this latest development. According to Man et al (2017) statement, the school needs quality teachers to ensure the successful transformation of education management is achieved. The students' mastery of a weak field is often associated with a lack of teacher's competency or teaching competence (Adzhar & Radzi, 2020)

Teacher 4.0
Teacher 4.0 is a name or concept to suit for prospective teachers who can handle new technologies and who implement them efficiently in their classroom (Abdelrazeq et al., 2016). In the era of IR 4.0, the education system needed a transformation that could adapt to such rapid changes. At the same time, the role of the teacher as an educator also requires a new definition to meet the needs of this era. Professionalism is a measure of value to identify the credibility of a teacher. The Malaysian Teacher Standard (MTS) and the Integrated Education Service Officer Assessment (IAESO) have determined the professional work competency that teachers should have, as well as the criteria that teachers' training institutions should have met to assist teachers in achieving the required level of competence (Kementerian Pendidikan Malaysia, 2016). Thus, the level of professionalism of teachers should focus on producing a quality young generation. This statement is supported by the findings of the Shah and Halim (2018) study, what pupils get is not dependent on the school they attend but depends on the teachers in the school.

However, most teachers are unable to adapt in this era of technology. The application of technology is one of the ways of life in the era of IR 4.0, but teachers still have many shortcomings in following the development trail of the era. This is because most teachers are still unsure of the key characteristics and requirements of this IR 4.0 era towards a teacher. Indirectly cause teachers are not ready to face this 4.0 education. Thus, the desired characteristics in teachers in the IR 4.0 era will be reviewed in this study.

Objective

A survey with selected studies to examine the characteristics and roles of teachers in the era of the Industrial Revolution 4.0. The objective of the study was to identify

i. Identify the trend in studies of teachers in the era of the Industrial Revolution 4.0.

ii. Identify the characteristics desired in teachers in the era of the Industrial Revolution 4.0.

The questions in this systematic literature review are as follows:

i. What are the trend in studies of teachers in the era of the Industrial Revolution 4.0?

ii. What are the desired features of Teacher 4.0 in the era of the Industrial Revolution 4.0?

Thus, the study was conducted based on the set objectives. The findings of the study collected can answer research questions in line with the objectives of the study.

Method

This chapter will describe the research methodology adopted by this research. Besides that, this chapter will mention the selection and screening of articles to answer this research question. In addition, this chapter will also explain the process of systematic literature review that is used in this research.

Research Design

This research has used the qualitative method to get the most reliable findings. This study was conducted with reference to the PRISMA model guidelines (Systematic Reviews and Meta-Analyzes) to select articles used in the systematic literature review. The design of this research is a systematic study by analyzing past studies. According to Higgins et al (2019) systematic literature review is a systematic study aimed at combining the results of empirical studies that meet the criteria that have been determined to answer the research questions. Through a systematic review, the gaps and directions to be addressed in future studies can be clearly shown. A systematic review in the form of a systematic literature highlight method was used in this study to analyze the characteristics and roles desired in Teacher 4.0 in the era of Industrial Revolution 4.0. In addition, this systematic study is also an appropriate research method to contribute to an accurate scientific synthesis (Van et al., 2017).

A method called PRISMA has been used in this research to search for articles from the Google Scholar database to conduct a systematic survey. The advantage of using PRISMA in reviewing the literature is that it can save researchers time in reviewing the literature, search data through keywords that can limit the search in a field and help increase the results of literature highlights systematically and in detail. Besides, the PRISMA protocol helps to review a topic fairly and report the data perfectly because it is transparent and systematic. This is because the PRISMA Model can handle the information required step by step and at the same time can maintain the quality of the highlights that want to be produced (Mohamad, 2017).

According to Selcuk (2019) the PRISMA guide covers 4 main phases, namely identification, screening, eligibility, and inclusion. There is a PRISMA checklist to ensure the reliability of the reviews produced on selected topics. The inclusion criteria, the limitations

determined, the steps of the survey process, the data obtained and the analysis will be clearly reported in this paper. The search engine in the database used to find articles and journals is Google Scholar. These search engines were chosen because there are many articles that can be browsed online and are high-index databases.

Identification Phase

Firstly, the search is conducted based on keywords that are set based on the objectives of the study have been identified in the identification phase. The first keywords "teacher 4.0" search included in the Google Scholar search database, and a total of 542,000 articles were found. Then, keywords and phrases with almost the same meanings have been entered to find the articles that match the objective of this research. Among the keywords used are roles, characteristics, jobs, competencies, Industry Revolution 4.0, and Education 4.0. Table 1 shows the advanced search after the keywords is entered. The keywords were searched where are in the title of the articles to make sure the articles have found matched the objectives of this research. A total of 108 articles were found in Google Scholar after this identification phase on 26 May 2022.

Table 1
Keywords

Keywords (with all of the words)	Keywords (with at least one of the words)
Teacher	Role, jobs, Characteristics, Competencies
4.0	Industry 4.0, Education 4.0

Screening Phase

In the screening phase, the researcher included limitations to create restrictions on article search. Among the restrictions included are articles of an open-access nature published in the last 5 years, namely from 2018 to 2022. This is because the latest information on the characteristics and roles required on Teacher 4.0 in the Industrial Revolution 4.0 era from various past studies is available. In addition, the selected article writing sources were only articles written in English only. In addition, the selection criteria for selected articles also include only open access articles. The purpose is to simplify the process of acquiring and downloading articles. The readable full text also allows the researcher to conduct a preliminary survey to determine whether this article will be excluded in the search for this systematic study or not. Therefore, a preliminary survey can be conducted based on the article title, abstract and keywords.

After that, the study will conduct an evaluation step of the eligibility of the articles to be selected based on the criteria that have been determined. Other research writings such as unpublished books, reports or proceedings, theses and dissertations are not included in this selection and will be excluded. The screening process was carried out by rejecting articles that did not meet the writing criteria of this study.

Next, the list of articles will be evaluated to meet the criteria that have been listed. Articles that have all the criteria can be eligible to be included in the group of articles that will be analyzed in this study. Finally, a total of 56 articles met the selection criteria in this study. The required criteria are listed in Table 2.

Table 2
Criteria for inclusion and exclusion in the article selection process

Criteria	Inclusion	Exclusion
Opening access	open access	Except open access
Year	2018-2022	Before 2018
Document type	Journal articles	Conference papers, conference reviews, chapters in books, reviews, articles in the press
Keywords	Teacher 4.0, Role, jobs, Characteristics, Competencies, Industry Revolution 4.0, and Education 4.0.	Other than those listed
Language	English	Except English
Source type	Journal	Proceedings, book series, books

Eligibility Phase

After the screening process, the requirement data were proceeded to the eligibility phase which involves the process of reading the title and abstract that meet the objective criteria of the study. This eligibility process needs to be examined carefully and not in a hurry so that no articles that meet the writing and quality criteria are eliminated. However, this is a limitation of this study which needs some effort to examine quality articles from the Google Scholar database. There are some articles related to pre-service teachers, teacher's assistance, and teacher's leaders that have been excluded in this eligibility phase.

Included Phase

In total, 24 articles that fit the criteria of this systematic review were obtained from the Google Scholar database. The review protocol was developed to achieve the following goals:
1) to maximize the literature coverage
2) to identify and include the related work that can be classified as a study
3) to collect and synthesize meaningful data from the sources related to the defined research questions

This protocol specified the research questions, search strategy, inclusion, exclusion and quality criteria, data extraction, and methods of synthesis. The implementation procedure of this systematic study is as listed in the flow diagram in Figure 1.
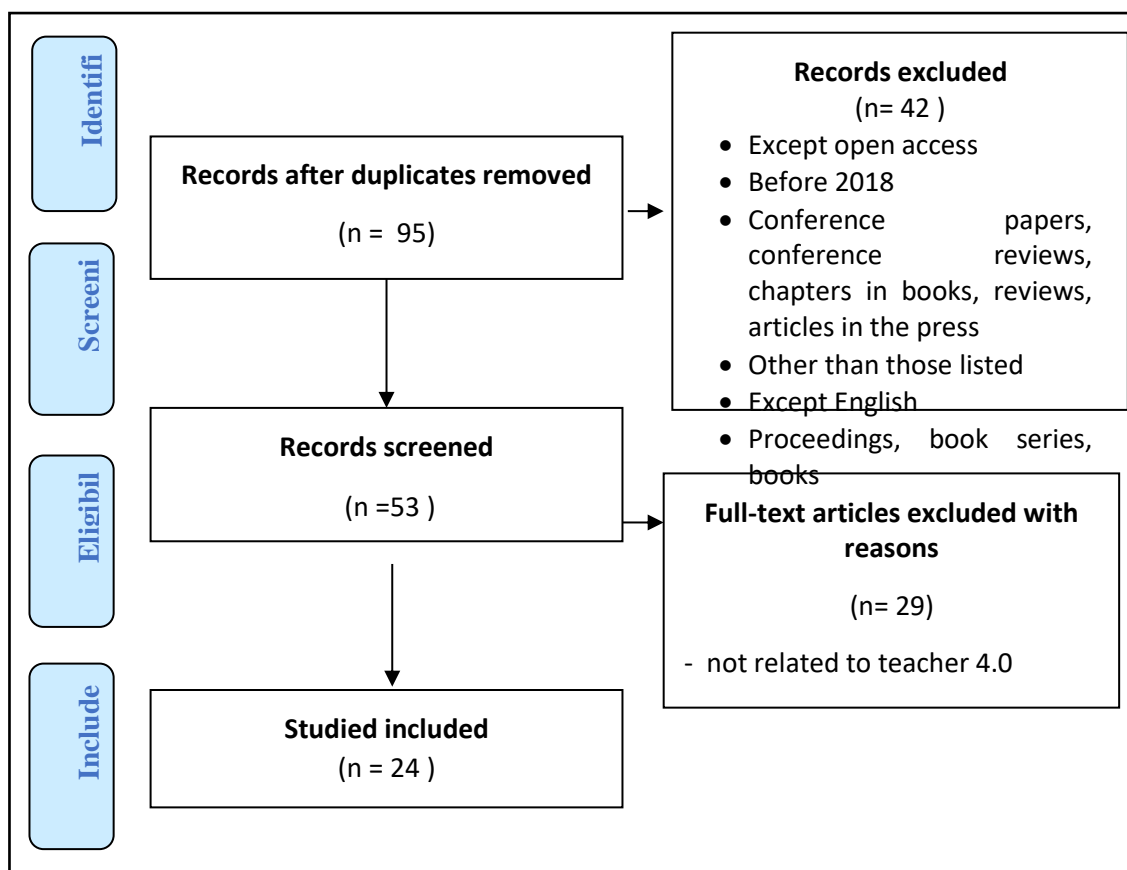
Figure 1 PRISMA Flow Diagram for the study

Findings of The Study
A systematic review was conducted starting with reading the previous abstract, then examining the content of the entire discussion of the article in depth. This is so because the researcher can identify the appropriateness of the article to the theme and question of the study. Qualitative analysis is done by analyzing the content to ensure that the article is relevant to the characteristics and roles of teachers required in Education 4.0.

Year of Publication
The following Table 1.2 has shown the distribution of 24 articles by year of publication. The trend to study the characteristics and roles of teachers required in Education 4.0 is unbalanced from 2018 to 2022. The number of studies found in 2018 was only 1 article, followed in 2019 by 7 articles and there were 9 articles in 2020. Next, 5 study publications were found in 2021. Moreover, only 2 study publications were found in 2022 so far.

Table 3
Publications per year

Year	Number of Articles		Articles
2018	1		(Afrianto, 2018)
2019	7		(Marhawati et al., 2019; Hidayah & Sholihah, 2019; Karamina et al., 2019; Laisa, 2019; Lase, 2019; Mulyadi, 2019; Torro et al., 2019)
2020	9		(Fawwazi et al., 2020; Sasmoko et al., 2020; Syah et al., 2020; Utami et al., 2020; Jafar et al., 2020; Ana et al., 2020; Cuong & Le, 2020; Peredrienko et al., 2020; Nababan et al., 2020)
2021	5		(Amaliyah, 2021; Himmetoglu et al., 2021; Noh & Karim, 2021; Ramirez-Montoya et al., 2021; Maknun et al., 2021; Akgunduz & Mesutoglu, 2021)
2022	2		(Mananay & Alda, 2022; Gonzalez-Perez & Ramirez-Montoya, 2022)

Study Location by Publication

Many countries have been involved in studies reviewing the role of 4.0 teachers in the last five years. There are a total of 15 studies have been conducted in Indonesia. While Malaysia, Mexico, and Turkey only 2 studies in their respective countries. Next, there is 1 study that has been conducted in Russia, Vietnam, and the Philippines.

Table 4 Publications per location

Location	Numbers of Articles	Articles
Malaysia	2	(Jafar et al., 2020; Noh & Karim, 2021)
Indonesia	15	(Afrianto, 2018; Ana et al., 2020; Besse Marhawati et al., 2019; Fahmi Johan Syah et al., 2020; Fawwazi et al., 2020; Hidayah & Sholihah, 2019; Karamina et al., 2019; Laisa, 2019; Lase, 2019; Maknun et al., 2021; Mulyadi, 2019; Nababan et al., 2020; Sasmoko et al., 2020; Torro et al., 2019; Utami et al., 2020)
Turkey	2	(Akgunduz & Mesutoglu, 2021; Himmetoglu et al., 2021)
Russia	1	(Peredrienko et al., 2020)
Vietnam	1	(Cuong & Le, 2020)
Mexico	2	(Ramirez-Montoya et al., 2021), (Gonzalez-Perez & Ramirez-Montoya 2022)
Philippines	1	(Mananay & Alda, 2022)

Research Approach

Qualitative approach is the most widely used approach in the study exploring the characteristics of teachers 4.0. There are a total of 19 qualitative studies. Meanwhile, there are only 1 quantitative study and 4 studies using the mixed method.

Table 5

The research approach used in the selected study

Approach	Numbers of Article	Articles
Kualitatif	19	(Afrianto 2018; Hidayah & Sholihah, 2019; Lase, 2019; Marhawati et al., 2019; Torro et al., 2019; Laisa, 2019; Himmetoglu et al., 2021; Nababan et al., 2020; Cuong & Le, 2020; Noh & Karim, 2021; Gonzalez-Perez & Ramirez-Montoya, 2022; Mananay & Alda, 2022; Karamina et al., 2019; Jafar et al., 2020; Utami et al., 2020; Maknun et al., 2021; Akgunduz & Mesutoglu, 2021; Mulyadi, 2019; Fawwazi et al., 2020)
Kuantitatif	1	(Ana et al., 2020)
Campuran	4	(Syah et al., 2020; Peredrienko et al., 2020; Ramirez-Montoya et al., 2021; Sasmoko et al., 2020)

Discussion

The figure below has shown the characteristics of teacher 4.0 has been divided into 4 themes, namely lifelong learning skills, leadership skills, technology skills and personal attitudes. These four characteristics are the characteristics that are desired in teachers working in IR 4.0. This is in line with Cuong and Le (2020) study statement that the key qualities desired in teachers in the era of the Industrial Revolution 4.0 were technological skills, instructional skills, lifelong learning skills and personal style. Teachers serving in the IR 4.0 era must have these key characteristics in order to weather the challenges and rapid change. According to Lase (2019) statement the competencies that teachers should possess are educational competence, competence for technology commercialization, competence in globalization, competence in future strategies, and counselor competence.

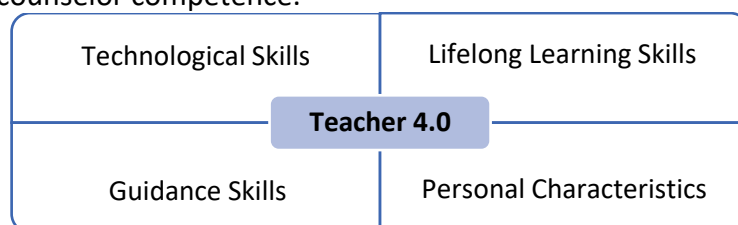| Technological Skills	Lifelong Learning Skills
Teacher 4.0	
Guidance Skills	Personal Characteristics

Figure 2.0 Characteristics and roles of teachers 4.0 (adapted from (Cuong & Le, 2020; Lase, 2019; Nurkholis, 2019; Ramirez-Montoya et al., 2021)

In addition, to implement learning in the era of Education 4.0, Nurkholis (2019)also stated that teachers need to improve the competence of teaching their students based on the internet of things, efficiently guide students with technology -based entrepreneurial attitude, problem solving skills, efficient to predict the future accurately and strategy, and become a counselor/psychologist. Thus, teachers in the era of Education 4.0 not only need to have Technology and Information skills, teachers also need to have efficient problem-solving skills.

Next, according to Ramírez-Montoya et al (2021) the elements that characterize Education 4.0 teachers are as follows:
(a) design strategies for competency -based training through active learning methods.
(b) have soft skills, such as digital transformation competence, reasoning for complexity, ethical and civic commitment, social intelligence, capacity for self -management,

inclusiveness and respect for diversity, social responsibility, and innovative entrepreneurship.

(c) have human sensitivity and train students to develop ethical behavior and social intelligence, integrating the educational environment and society; and

(d) use technology and use new tools that facilitate learning through virtual, artificial intelligence, digital technology, and educational applications.

Characteristics of Teacher 4.0: Technological Skills

In the rapid development of technology in IR 4.0, not only human resources require technological skills, but teachers as educators must also have stronger technological skills and skilled digital literacy. This is in line with the statement of Maknun et al (2021) that teachers need to possess new literacy skills namely digital, technology, human literacy, critical thinking, collaboration, communication and creativity in IR 4.0. With this, teachers can handle technology more effectively in learning activities and while carrying out assignments. Teachers must be able to leverage technology, use fun methods, enrich knowledge with a variety of reading material sources, and be able to conduct the study of (Nababan et al., 2020). This is so because digital literacy is an effective application if we are able to handle it more beneficially.

In addition, Teachers 4.0 should also adapt digital applications resulting from the IR 4.0 era into teaching and learning activities. The findings of the Akgunduz & Mesutoglu (2021) study also indicate the need to assist teachers in designing certain aspects of STEM instructional plans including the meaningful integration of mobile programming, robotic programming, and virtual reality into lesson content. With this, students can be exposed to the digital environment that is in line with the era of IR 4.0 indirectly students will not be outdated and can cultivate awareness to students related to the application of the era of IR 4.0.

Next, as a 4.0 teacher, teachers not only need to be proficient in handling technology, but teachers also need to be smart in using technology. This is because the information and data available in online databases is growing and the number is increasing. Therefore, teachers need to be savvy in this technological literacy so that the information obtained is genuine and the activities conducted are more diverse. Therefore, as a teacher one must be digitally proficient, which implies he or she should be open to trying and applying new digital and virtual things properly and be aware of what is going on in the cognits sphere, what resources. is the most sought after among its students, what educational and training tools have emerged or are just about to do so (Peredrienko, 2020).

Finally, as a 4.0 teacher, teachers not only need to have recognition in the academic field, teachers must also have the skills to master technological skills. This is in line with Laisa (2019) statement that to become a professional teacher in the 4.0 industry era by relying only on a bachelor's or master's degree without being able to master technology.

Characteristics of Teacher 4.0: Lifelong Learning Skills

The industrial revolution will not stop and will continue to grow, the demand for human resources will also continue to change according to the development of the era. Teachers as educators to shape the profile of the younger generation must also always be open and explore new knowledge without stopping. With this, teachers can face all the challenges that will be faced according to the era of globalization. This is in line with the statement of Utami et al (2020) that teachers as lifelong learners need to maintain their professional development

to meet the challenges in education 4.0. The American Training and Development Association in its survey of lifelong learning skills identified a set of seven skills expected from the future workforce These include; learning how to learn, read, write and computerize; communication skills; adaptive skills (personal management and professional growth), group effectiveness skills (interpersonal skills, teamwork and consulting); and influencing skills (organizational effectiveness and leadership skills).

A teacher who must face the changes and transformations of pedagogical trends and varying student behaviors should be lifelong learning skills. This is because teachers need to constantly explore effective communication skills and constantly improve themselves in terms of technology so as not to be outdated. With communication skills that are always effective and follow the trends of student conversation topics, a teacher is definitely that students love and cannot be replaced by artificial intelligence. This statement is supported by the findings of the study of Ana et al (2020) that the social competencies required for teachers are the ability to communicate efficiently, assertively and respectfully both oral and written communication skills, as well as the ability to communicate and improve oneself using ICT.

In addition, in the education sector in particular, educators today are required to make certain adjustments and changes to take advantage of all the potential benefits brought by the IR 4.0 era with the success of (Afrianto, 2018). This statement suggests that teachers need to constantly adapt and perform transformations of the mind from time to time to follow in the footsteps of the development of the era. Gonzalez-perez and Ramirez-montoya (2022) also state the Education 4.0 component is being used in the 21st century framework and which teaching and learning strategies are most successful for developing future skills. Therefore, teachers must possess 21st century skills as well as lifelong learning skills.

Characteristics of Teacher 4.0: Guidance Skills

As a 4.0 teacher, coaching skills or leadership skills are essential. This is so because teachers can guide students technologically and pedagogically, coordinate, motivate, lead, create student engagement in learning, help students achieve accurate information and help students set their goals. This is in line with the statement of Fawwazi et al (2020) teachers are increasingly eager to develop learning activities in the classroom as well as increasingly diverse learning media. Teachers are able to conduct interesting learning activities in order to attract students and help them achieve learning objectives.

In addition, teachers must be able to build students' skills in meeting a competitive and innovative workforce in the era of IR 4.0 (Noh & Karim, 2021). This shows that teachers need to have effective coaching skills in order to transmit knowledge through a variety of pedagogies. Through the findings of the study of Torro et al (2019) the implementation of child-friendly school programs in the era of IR 4.0, teachers need to have three significant important roles. Among them, teachers as caregivers, teachers as facilitators, and teachers as models. With this, teachers not only need to act as facilitators by teaching in terms of academics, teachers also need to take care of students' emotions in order to create a conducive learning environment. At the same time, teachers also need to behave pure and positive in order to be an example for students so that students also behave positively and morally.

The study of Jafar et al (2020)this shows that non -technical competence is as important as technical competence and is reinforced by the personal nature of teachers, their motives, and physical condition in the TVET teacher profession in the Industry 4.0 era. While Marhawati et al (2019) stated professional teacher empowerment is an effort to gain teaching

power in line with teacher professional demands through teacher quality improvement, critical thinking, and active participation in implementing IR 4.0 demands. Therefore, teachers in the IR 4.0 era must constantly train the skills of their respective teaching professions.

Teachers in the IR 4.0 era need to have coaching skills. This statement is also supported by Cuong and Le (2020) that the role of teachers is gradually increasing in Education 4.0 as teachers play a role as advisors. Teachers need self-improvement skills to guide students in handling big data and digital environments, learning how to learn and taking precautions for cybersecurity. In addition, the findings of Karamina et al (2019) stated that students still need teachers because of social studies learning that uses pedagogy of problem -based learning methods so that students can learn independently.

Characteristics of Teacher 4.0: Guidance Skills

The personal style of a 4.0 teacher is very important. This is because teachers need to have their own style and not from the usual because this is a privilege that cannot be replaced by robots or obtained from database sources. Therefore, as a teacher who is not put off by the development of the era, the teacher needs to have a collaborative, creative attitude and also a person who loves to joke. Teachers need to have technology -friendly skills and attitudes, collaboration, creativity, willing to take risks, have a good sense of humor and teach holistically (Lase, 2019).

According to the statement of Nababan et al (2020) that teachers are required to possess 21st Century character. 21st Century characterization includes critical thinking and problem solving, creativity and innovation, collaboration, communication, characteristics and citizenship. In order to build human capital that can meet the requirements of the 4.0 era, teachers need to have a creative personal style and be able to cultivate students' critical thinking. This statement is supported by Hidayah and Sholihah (2019) that teachers have the ability to think critically, and think creatively as an effort to improve the quality of a teacher's self in the 4.0 era. The character of citizenship is also very important for 4.0 teachers as noted by Sasmoko et al (2020), the results show that the character of the Indonesian nation should be attached to every vocational teacher in Indonesia. This is suitable for teachers in Malaysia too because we have a diversity of races, cultures, religions and so on.

Implications

The Ministry of Education Malaysia (MOE), State Education Department (JPN) and District Education Office (PPD) must take interventions to improve the four main characteristics and skills of teachers. This is because these authorities are responsible for providing opportunities in nurturing and producing excellent teachers and in line with the requirements of the times. Authorities can provide talks, briefings or sharing sessions in the development of teacher professionalism. In addition, the reduction of teacher burden also allows teachers to be more focused in the development of their own skills. Thus, be careful and beneficial planning by the authorities is very important in producing teachers who can face the challenges in IR 4.0.

Meanwhile, this paper can provide awareness to teachers to cultivate the desired characteristics in the aspects of Industrial Revolution 4.0. Teachers need to be aware that the demand for human resource profiles is constantly changing and even the characteristics of teachers. This rapid development of technology requires a teacher who is skilled in handling the application of technology in carrying out their assignments and teaching. In addition, teachers also need to be smart in digital literacy so as not to give false knowledge from inaccurate information. At the same time, teachers must always improve their own skills and

knowledge by being a lifelong learning so as not to be outdated. Teachers also need professional coaching skills to provide effective teaching and learning activities. In addition, teachers need to have their own personal characteristics and creativity so that they cannot be imitated. Therefore, teachers need to strive to improve these four characteristics because teachers are the workforce that contributes in this IR 4.0 landscape.

Finally, the education sector needs to undergo transformation to produce a young generation that can compete and contribute their energy in the era of IR 4.0. This is because an environment that is prepared to face IR 4.0 must be able to facilitate the younger generation of interest and more confidence to face the challenges that are in IR 4.0. Thus, teachers who act quickly for transformation encourage students to follow in the footsteps of the latest developments.

Recommendation

This systematic study uses only one local database, Google Scholar. Therefore, it is very likely that there are still studies on the role of Teacher 4.0 that are omitted or not listed in this database. Thus, article search needs to add other databases such as Research Gate, Microsoft Academic, Scopus and so on. This is so because broader search results can collect more and quality data which are several articles were left out because they were behind a paywall where most of them were published in the proceedings.

Next, a recommendation for researchers to study the level of knowledge about the characteristics of 4.0 teachers for the population of parties who are in the field of education. This is because the change in the needs of teachers in the era of IR 4.0 is important for all citizens in the education sector. Knowledge of the needs of these teachers allows the authorities, schools and teachers to make preparations and changes according to the needs of the characteristics of this 4.0 teacher. With the changes in teachers and the school environment, the younger generation is more interested and more confident to face the challenges in IR 4.0. Thus, research on the level of knowledge about the characteristics of 4.0 teachers on the population in the education sector can certainly provide a clear picture to the public. At the same time, further research can serve as a reminder to the public that these IR 4.0 challenges need to be faced by all of us in the future.

Conclusion

The human resource profile associated with the industrial revolution 4.0 (IR 4.0) is different from the past. With this, teachers as educators and human capital builders of future national leaders also need to undergo transformation according to the requirements of the era. Therefore, the desired characteristics in teachers in the aspect of IR 4.0 have been collected in this paper. According to the findings, the characteristics of teachers required in the aspect of industrial revolution 4.0 are technological skills, coaching skills, lifelong learning skills and personal style. Teachers must dare to jump towards transformation in adapting personal characteristics to the will of this revolution. Teachers not only need to be proficient in handling technology, teachers also need to be smart in doing digital literacy in finding correct and authentic information. In addition, teachers also need to have coaching skills in order to motivate students and create a conducive learning environment. In addition, teachers also need to have lifelong learning skills for constantly improve their own knowledge and skills. Finally, teachers need to have their own personal characteristics. With this, the teacher is not an answer search machine or a teaching machine that can be replaced. The implication of the study is that the education sector can determine all aspects of the needs that need to be

considered to face the onslaught of this IR 4.0 wave to produce a young generation that is able to compete and contribute their energy in the IR 4.0 era.

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