Advancing Learning Math Industry Era 4.0

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Abstract. The emergence of the industrial era 4.0 is a challenge in welcoming and preparing mathematics learning. The purpose of this study was to determine the components in welcoming mathematics learning in the industrial era 4.0. This type of research uses descriptive qualitative with the method used is the study of literature/literature review from 2012 to 2019. From the results of the literature review, it is concluded that there are 3 components in welcoming mathematics learning in the industrial era 4.0. 1) HR Literacy, covering aspects; critical thinking, creative thinking, reflective thinking, mathematical imagination, mathematical reasoning, mathematical communication, and problem-solving. 2) Data literacy, including system aspects cyber-physical, internet of things, cognitive computing, and cloud computing. 3) Technology literacy, including aspects; Technology for doing mathematics, Technology for practicing skills, and Technology for developing conceptual understanding.

Keywords: Mathematics Learning, Industrial Era 4.0

1. Introduction

These guidelines, The term Industry Era 4.0 was first introduced in 2011 at the Hannover massacre industry exhibition in the city of Hannover, Germany. This is also a proposal for the development of economic policy concepts based on the latest technology strategies [1]. From 2012 to mid-2019, it attracted the attention of a variety of advanced research in all fields, because it required the ability to adapt to technological [2].

In Indonesia in 2018 and 2019, it showed the most significant number of previous studies. Industrial Revolution 4.0[3] revises and perfects the 3.0 industrial revolution. 3.0 industrial era depicts machines that move, computers and robots think automatically [4]. While Industry 4.0 is a blend of technologies that results in physical, biological, and digital dimensions to form a collaboration that is difficult to distinguish [5]. This is seen from the emergence of Technology cyber-physical, internet of things, cloud computing, cognitive computing as automation and exchange of data in manufacturing technology[6].

Before the researchers revealed the industrial era 4.0 long before humans had long implemented it in various sectors. The more the development of the 4.0 era, computing, and robotics technology replaced the role of humans who are unable to compete. The impact is that many middle to lower-level workers are on strike and losing their jobs we are feeling. Not only in Indonesia but even in superpowers and developing countries [7]–[9]. In America there was a decrease in the demand for...
labor in the agriculture sector (-39%), households (-6.1%), factories (-5.2%), transportation (-2.5%), and mining (-1.9%); with a total reduction of 56.7% of the total workforce needed [10]. But the industrial era 4.0 is also able to replace and add jobs that are more practical, effective and efficient. The presence of computer and internet technology also contributed 1.9 million jobs in the United States.

For millennials, especially educators, this is a big challenge to meet the changing world of the industrial era 4.0. The digitalization of information and the use of artificial intelligence, massively in various sectors of human life, including in the world of education, is a sign of the start of the industrial era 4.0 [5]. The education system has shifted a lot. Some tutorials do online learning. Track records of various school, teacher and student data that rely on the internet [11]. That is why digital technology is the thing that most influences the education system in the world today.

In the world of mathematics learning education is one of the tools to develop the industrial era 4.0. One example Many are found in various mathematical applications and software that can be learned online and offline. To facilitate the learning of mathematics, it is important to have a clear systematic component based on the demands of the industrial era 4.0. Concluding the above description, the purpose of this study is to describe the components of mathematics learning in the industrial era 4.0 based on relevant literature [12].

2. Method

To describe the results of the literature used qualitative descriptive methods based on desk analysis. The techniques used are;

2.1. Literature search technique

This stage searches and completes literature data using various search engines. There are 3 steps to using a search engine

2.1.1. Enter the entire title

2.1.2. Enter keywords

2.2. Literature Determination Technique

After carrying out stage 1, a feasibility test is then conducted which aims to see the validity assessment criteria. This assessment is referred to as a systematic review that tries to gather all relevant evidence based on predetermined eligibility criteria [13]. The results of this feasibility test are used to reveal the following answers;

2.2.1. How to provide understanding for teachers and students related to Literature in the 4.0 industry era?

2.2.2. What should be prepared in mathematics learning in the 4.0 industry era?
3. Result and Discussion

3.1. Literature search results

From the search engine results (-51) right in the middle of 2019. While in 2018 there is 46 literature. The entire literature is grouped based on the similarity of viewpoints and the similarity of literature. The selected literature became the main data source in this study, among others;

3.2. Answers to the determination of literature

In this stage, the answers to the problem formulation will be described above

3.2.1. How to provide understanding for teachers and students related to Literature in the 4.0 industry era?

3.2.1.1. What is literacy

Welcoming the era of the industrial revolution 4.0 teachers and students need to understand the latest information, updated studies, and relevant research and literature related to the industrial era 4.0. Literacy is a culture of literacy in reading and writing so that teachers and students are not oppressed by changes in the world of education, both models, techniques, methods, and approaches used are not expired. The purpose is given literacy as a provision to face the era of disruption caused by changes in life patterns that are massively globalized.

Welcoming the new industrial era / 4.0 humans are required to have homogeneous literacy competencies. Like a) Human literacy, where they must be able to communicate, collaborate and innovate critically and creatively. b) data literacy competencies, including the ability to read, analyze and make conclusions based on data and information obtained or referred to as big data. c) Technology literacy to understand how machines work and how they are implemented. This competency must refer to previous literacy.

3.2.1.2. What is Industrial Era 4.0?

Industrial Era 4.0 is a change in human activity that is globally disrupted. Industry 4.0 is also referred to as a term used to refer to an era where there was a combination of technology that resulted in physical, biological, and digital dimensions forming a combination that was difficult to distinguish (Schwab, 2016

The industrial revolution has changed 4 times. The 1.0 industrial revolution began in 1784 marked by the emergence of steam machines and looms with production mechanization to support the effectiveness and efficiency of human activities. The 2.0 industrial revolution began in 1870 with the emergence of electrical energy characterized by mass production and quality standardization. The 3.0 industrial revolution began in 1969 with the advent of computers and the flexibility of manufacturing-based automation and robots.
The industrial revolution 4.0 was first introduced in 2011 at the Hannover Messe Industry exhibition in the city of Hannover, Germany. For proposals to develop economic policy concepts based on the latest technology strategies that revise the industrial revolution 3.0. This is marked by an increase in the digitalization of manufacturing driven by four factors: 1) Cyber-physical technology, which is increasing data volume, computing power, and connectivity. 2) Internet of things, namely the emergence of analysis, ability, and business intelligence. 3) Cloud computing, namely the occurrence of new forms of interaction between humans and machines, and 4) Cognitive computing, namely the improvement of digital transfer instructions to the physical world, such as robotics and 3D printing.

Human life has been monitored by the development of technology-based on computing and unlimited data, but what serves as a benchmark for the Industry 4.0 era is the role of its human resources. To make a superpower, what must be changed first is an education system that can compete globally. Therefore, education also contributes through learning constructs that are problematic in daily life to develop the realm of knowledge and skills and attitudes in students in a sustainable way throughout their lives.

The emergence of several various industries and companies in Indonesia is currently being discussed. The lower-middle-class economy will be increasingly oppressed, because of the loss of livelihoods. Everything is done using Gawai through the application, so that the era is conjured up with everything difficult to be easy, far to be close. For example, in Indonesia, the creation of the Gojek company was followed by similar companies that were no less easy in service[14].

Not wanting to lose, even in the field of education, the very tight competition will be found. Many educational institutions are gradually losing students. Because many schools are using the industrial era of 4.0, private and private institutions began to close books. Due to the presence of the teacher's room which is trending to learn where and whenever. Therefore the teacher must understand various ways of presenting material that is integrated with technology using the right approach and model. Likewise with learning mathematics that can use technology creatively and appropriately, it can enrich the material. This era will also disrupt various human activities, including the fields of science and technology (science and technology) as well as the fields of primary, secondary, and higher education.

3.2.2. What are the components of mathematics learning in the 4.0 industry era?

After doing literacy on the industrial era 4.0 society, especially for teachers and students can draw conclusions, filter various literature, understand the advantages and disadvantages, and understand the positive and negative effects of mathematics learning. The presentation of the mathematics learning component of the industrial era 4.0 and its aspects is as follows;
### Table 1. HR Components of Mathematics Learning in the Industrial Era 4.0

| Aspects                           | Purpose                                                                 |
|-----------------------------------|-------------------------------------------------------------------------|
| Mathematical reasoning            | To provide an inductive and deductive understanding of mathematics     |
| Mathematical communication        | Communicate mathematics verbally and non-verbally. Followed by the ability to visualize and represent. |
| Critical thinking                 | Menstimulus focus, reason, inference, situation, clarity, overview (FRISCO) in every mathematics learning |
| Creative thinking                 | Able to innovate and be competitive, both in formal and informal mathematics |
| Mathematical imagination          | As one of the problems solving students and teachers, because of the emergence of sensory, creative and recreative mathematical imagination. |
| Reflective Thinking               | Accustomed to thinking critically and creatively                       |
| Problem Solving                   | Apply collaboratively, both to the use of models, approaches, strategies, and methods that are appropriate to the 4.0 era. |

The above aspects are known in learning mathematics with the term high order thinking skills (HOTS) because thinking is complex in finding and solving problems.

### Table 2. Data Components of Mathematics Learning in the Industrial Era 4.0

| Aspect               | Purpose                                                                 |
|----------------------|-------------------------------------------------------------------------|
| Cyber-physical       | Able to combine mad learning mathematics through, internet of things, cognitive computation, and cloud computing. |
| Internet of things   | Able to implement mathematics learning by utilizing internet networks   |
| Cognitive Computing  | Able to create a 4.0 era mathematics learning media with existing technology |
| Cloud Computing      | Able to use various other activities to produce mathematics learning in 4.0 era |

The four aspects in the data component of mathematics learning in the 4.0 industry era above will be able to train teachers; a) prepare their students to be able to work, while the work is currently not available; b) preparing children to be able to solve problems for which problems have not yet arisen, and c) preparing children to be able to use technology whose technology has not yet been discovered.

### Table 3. Technology Components of Mathematics Learning in the Industrial Era 4.0

| Aspects               | Purpose                                                                 |
|-----------------------|-------------------------------------------------------------------------|
| Technology for doing mathematics | As an alternative tool to substitute learning media for doing mathematical activities |
| Technology for practicing skills | As a learning environment to hone certain mathematical skills |
| Technology for | As a learning environment to develop students' conceptual |
developing conceptual understanding of certain mathematical concepts

The three aspects above will produce output; a) teachers who can master and utilize digital technology in learning. Teachers are required to change the perspective of education both learning methods and educational concepts following the demands of the industrial revolution era 4.0[15]. This requires students to have skills, knowledge, and abilities in the fields of technology, media, and information, learning and innovation skills as well as life and career skills.

4. Conclusion

Industry era 4.0 is the emergence of cyber-physical technology, internet of things, cloud computing, cognitive computing as automation and data exchange in manufacturing technology. The occurrence of digitalization of information and the use of artificial intelligence (Artificial Intelligence) on a massive scale in various sectors of human life, including in the world of education, is a sign of the start of the industrial era 4.0. In the world of mathematics learning education is one of the tools to develop the industrial era 4.0. There are 3 components in welcoming mathematics learning in the industrial era 4.0. a) HR Literacy, including aspects; critical thinking, creative thinking, reflective thinking, mathematical imagination, mathematical reasoning, mathematical communication, and problem-solving. b) Data literacy, including aspects of cyber-physical systems, internet of things, cognitive computing and cloud computing. c) Technology literacy, including aspects; Technology for doing mathematics, Technology for practicing skills, and Technology for developing conceptual understanding.

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