STEM-Based Information Literacy Design to Prepare Learners in the Face of the Industrial Revolution 4.0: Literature Review

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Abstract. The world has now changed amid the development of technology and began to enter the era of industrial revolution 4.0, where information becomes the primary need and the effectiveness of time is taken into account. Thus, preparing learners to be able to compete globally, and master the development of technology is an essential thing for the life of society and the progress of a country. This article discusses STEM-based information literacy design to prepare learners in the face of the industrial revolution 4.0. The study included a) literation of information, b) research skills, c) free learning of life, d) STEM integrated learning, e) learners' skills, f) the era of the industrial revolution 4.0.

Keywords: Information Literacy, Research, Learners Skills, STEM, Industrial Revolution 4.0.

INTRODUCTION ~ World civilization is now developing technology and starting to enter the era of industrial revolution 4.0 or the fourth world industrial revolution where information technology has become the basis in human life (Kemenristek, 2018). Preparing human resources that can compete globally, and can master technological developments is the main thing in the future sustainability of the nation and country (Kanematsu & Barry, 2016). Based on some of these explanations, according to what was conveyed by Zhou et al (2015), in general there are five significant challenges that will be faced, namely aspects of knowledge, technology, economy, social, and politics. To answer these challenges, an important, planned and strategic effort is needed both in terms of regulators (government), academic circles, practitioners, and educators.

21st century teachers are required not only to be able to pursue and manage classroom activities effectively, but also needed to be able to build effective relationships with learners and the school community, use technology to support the improvement of the quality of teaching, and reflect and improve their learning practices continuously (Darling, 2006).

Therefore, improving the quality of learning is one of the challenges for teachers. 21st century professional teachers are teachers who have high creativity, are skilled in every teaching, able to build conducive situations in learning, flexible in developing the relationship between teachers and schools with a broad community, and a learning person who becomes an agent of change in the environment (Hargreaves, 1997, 2000).

Teachers can develop mobility that is adaptive to the times. Adaptive in the sense that it can adapt to the demands of the development of science and technology. Information literacy is one of the high-level thinking skills needed to develop and support academic,

professional and personal success (Shao & Purpur, 2016). The ability to evaluate, and organize and use information effectively for formal and informal learning, problem solving, decision-making in a case (Bruce, 2003). Training information literacy in learning and developing research skills independently can be done by teachers to learners (Schroeter & Higgins, 2015). The importance of relative technological development and research activities is an essential part of everyone's basic needs, because it will make a positive impact if learners can do research first before concluding something, research is a necessary condition to improve the quality of learning (Widodo, 2016: xxiv; Subekti & Martini, 2016: 602). The culture of research will train learners to create an answer to the problem, therefore teachers must be able to give learners something out of the box and not just race on printed books (Sutantro, 2013). Referring to staron's view (2011: 3) states the interconnectedness of sources that open opportunities to develop the ability of learners. Life-based learning includes the need for more excellent balance between creativity and standardization, innovation and uniformity, control and systems that govern open individuals. Life-based education focuses on learning from one's entire life at every second of time and the learning resources themselves.

The emphasis of life based learning is the development of science to contribute to the welfare and happiness of society in a balanced and harmonious manner, so that it becomes a reliable human resource. This expression is in line with the view (Firman, 2015) which reveals that efforts to face the era of global competition,

Indonesia also needs to prepare reliable human resources in STEM disciplines in quality and fulfilling in a kuantitias. STEM education has many potentially potential benefits for individuals and the nation as a whole (Beatty, 2011). Some sources (Partnership for 21st century learning) state, schools are challenged to find ways in order to facilitate successful learners in work and life through mastery of creative thinking skills, flexible problem solving, elaboration and innovation. Preparing for the future of learners as early as possible, the development of learners' skills is significant because in the future, they are expected to create their own jobs, and solve the problems of their lives. Skills must be balanced with qualified attitudes and knowledge that will be brought by learners in society.

Wagner (2010) and Harvard University's Change Leadership Group identified the competencies and survival skills required by learners in the face of life, the world of work, and citizenship in the 21st century emphasized on the following seven (7) skills: (1) critical thinking and problem-solving skills, (2) collaboration and leadership, (3) dexterity and adaptability, (4) initiative and entrepreneurial spirit, (5) be able to communicate effectively both orally and in writing, (6) be able to access and analyze information, and (7) have curiosity and imagination.

These changes are essential to bring about new forms of learning needed to address complex global challenges. Identifying the competencies of learners that need to be developed is very important to face the 21st century. Traditional approaches that emphasize the application of simple procedures will not develop critical thinking skills or the independence of learners. Every

individual must engage in meaningful inquiry-based learning, having truth and relevance value, to float the high-level thinking skills they need (Barron and Darling Hammond, 2008).

Today's world has entered the era of the industrial revolution 4.0 today. The changing world is now entering the age of industrial revolution 4.0 or the fourth world industrial revolution where information technology has become the basis in human life. Everything becomes borderless with unlimited use of computing power and data, because it is influenced by the development of the internet and digital technology as a backbone of movement and connectivity of humans and machines (Kemristekdikti, 2018). In accordance with this view (Zhong, et al., 2017) stated that the generation in the industrial era 4.0 holds a commitment to increase flexibility in the field of manufacturing, en masse, with better quality and productivity. As a result, the rapid changes experienced by society due to the rapid development of information technology bring many impacts on human life, in general positive and negative (Hariastuti et al., 2017). Based on the description above, the purpose of this article explores stem-based information literacy design to prepare learners in the face of the industrial revolution 4.0.

DISCUSSION
In this section is presented STEM-based information literacy to train the skills of learners. The study included (a) information literacy, (b) research skills, (c) free learning of 21st century life, (d) STEM integrated learning, (e) learners' skills, and (f) the era of the industrial revolution 4.0.

1. Information Literacy
Various definitions related to information literacy (LI). According to The Association of College and Research Libraries (ACRL) "Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produce and value, and the use of information in creating new knowledge and participating ethically in communities of learning" (ACRL, 2016). Other opinions suggest that investigation into digital literacy through a broader information literacy perspective will provide more valuable results. The theme of information literacy is (1) determining the nature and level of information needs needed, (2) accessing the necessary information, (3) using it effectively and efficiently, (4) the use of ethical and legal information (Coklar, et al., 2017), and (5) critically evaluating the information and sources and incorporating selected information into pre-possessed knowledge and value systems (Shao & Purpur, Other opinions state, information literacy skills are related to the ability to identify when information is needed, and competencies and skills to find, validate and use information in making informed decisions (Ukachi, 2015). With regard to the five information literacy, described into 10 literacy indicators in this study, namely: (1) recognizing sources of information, (2) identifying information types, (3) choosing how to access information over the internet, (4) rediscovering information online, (5) establishing criteria for assessing

information from the internet, (6) setting criteria for assessing information from books, (7) using new information to plan and create results, (8) communicate results or performance in writing, (9) understand the various ethical, legal and socioeconomic issues surrounding information and information technology, and (10) acknowledge the use of sources of information used.

2. Research Skills

The research skills of this century are known as the century of globalization and the century of information technology. Research skills in research are measured using writing and product tests by paying attention to 6 aspects of Research Skill Development (RSD) developed by Willison (2013: 906), namely (1) starting an investigation (asking questions or problem formulations, designing experiments, making hypotheses, and making predictions), (2) finding information or generating data (boolean truncation, file type, and phrase searching and collecting data), (3) evaluate information or data (evaluate information), (4) manage information or data (present data), (5) analyze, synthesize and apply new understandings (analyzing data), and (6) communicate research results (articles [read and write], posters [visual], and presentations [aural] with ethical, social and cultural awareness (using information legally and ethically).

Learners need to be taught to research first, just voice their opinions, so as not to be easily complacent by information that is not yet clear or hoax. The need for research skills will familiarize learners with literation in information

and knowledge. Research skills will train critical thinking, creative, and problem-solving skills in other terms, namely high order thinking.

3. Life-Based Learning of the 21st Century

Learning based on 21st-century life creates competition between human resources, especially job acquisition (Supahar & Istiyono, 2015). This problem is related to efforts to improve innovative learning, including life-based learning (LBL) or life-based learning (BBK), to prepare learners ready to face the challenges of their time. The formation of learners who are ready to meet the challenges of their time. The appearance of learners as whole human beings who have 21st-century skills. Life-based learning is the process of obtaining knowledge and skills to understand environmental events, skilled at solving life problems, living life in a balanced and harmonious manner (Sudira, 2015). This is certainly in line with the demands of life in the 21st century and the competence of learners relevant to the needs of society.

Communication skills in the spoken or written language through various media (multimedia) become essential (Sudira, 2015) in the face of the era of the industrial revolution 4.0. Life-based learning presents the concept that learning from life is real learning. In other words, the right school for man is his own life. Working in the 21st century requires creativity to think and work by collaborating with others (Sudira, 2015).

Leadership skills can be trained in life-based learning because learners will be required to always collaborate in

doing their tasks, the unification of thoughts and emotional training will indirectly train different self-knowledge in a community environment, they will learn how to treat others and strengthen that learners must learn from past life experiences so that in the future they can continue to learn from experiencers.

4. STEM Integrated Learning

The knowledge must inform the professional development of teachers for the implementation of the curriculum of best practices that exist in teacher professional development, with the purpose of STEM education, and also by the nature of problem-based learning (Asghar et al., 2012). Improving skills and skills for the younger generation of prospective workers is the responsibility of the world of education (Supahar & Istiyono, 2015). The main objective of education in STEM (science, technology, engineering, and mathematics) disciplines is scientific gain—further research to identify the discrete impact of specialized mentoring practices.

STEM learning needs to emphasize several aspects of the learning process (NRC, 2019, p.3-5), including (1) asking questions (science) and defining problems (engineering), (2) developing and using models, (3) planning and conducting investigations, (4) analyzing and interpreting data (mathematics), (5) using mathematics; information and computer technologists; and computational thinking, (6) building an explanatory (science) and designing solutions (engineering), (7) spread in arguments based on evidence, (8) acquire, evaluate, and communicate information.

The National Research Council (2011, p.17) states that in STEM learning, learners have the opportunity to learn based on science, mathematics, and engineering by addressing problems that have real-world applications. In STEM classes, learners are required to solve real-world problems and engage in ill-defined tasks into well-defined outcomes through cooperation in groups (Han, Capraro, &Capraro, 2015, p.1093). STEM education is becoming major popular in solving global issues and problems facing the world today, for example, global warming, air and water pollution, clean drinking water, and food security (Reeve, 2015, p.12). Reeve (2015) adopts the definition of STEM as an interdisciplinary approach to learning, in which learners use science, technology, engineering, and mathematics in tangible contexts that connect between schools, the world of work, and the globalized world. STEM provides teachers with the opportunity to show learners how concepts, principles from science, technology, engineering, and mathematics are used in an integrated way in the development of products, processes, and systems used in everyday life.

STEM integrated learning aims to prepare learners to solve problems in real life and their implementation by motivating and supporting learners to create creative and innovative projects as solutions to problems. In STEM integrated learning, learners will carry out engineering processes. According to Suwarna (2015), the engineering process has several stages that can be done repeatedly as a cycle, including

mind, design, construct, test/evaluation, and various solutions. First, on them try some ideas then learn from the mistakes and try again. Through the engineering process, learners are trained to use critical and creative thinking skills in creating a project as a solution to problems found in everyday life.

5. Industrial Revolution 4.0

   Kemendikbud considers the need to redesign the curriculum and include five abilities: the ability to think critically, creativity and the ability to innovate, communication skills, cooperation or collaboration, and confidence. It is believed to be the capital needed to face the challenges of the 4.0 industrial revolution in education.

   The development of today rests on cyber-physical systems where learning and culture must be able to adapt to these developments. The development of the internet of things has now been massive in this digital era; therefore, in order to keep up with the times and in order to maintain existence, learners must inspire learners in favorable terms so that learners have role models that can be a reference to undergoing life in the era of the industrial revolution 4.0. Kemenristekdikti by Mohammad Nasir in a press release no. 164/SP/HM/BKKP/IX/2018 revealed that the era of industrial revolution 4.0 generation of youth will be the hope of the nation in driving the nation's economic sector.

   Learning must exist in the virtual world because the growing learning technology can be done online without being face-to-face; following Muhammad Nasir's money, the

industrial revolution 4.0 Indonesia is a cultural revolution, a human revolution in various aspects of its life, not just a technological revolution. A revolution that brings new values and norms to everyday life. As a learner, of course, it must be a source of information for learners so that learners have lofty ideals, can collaborate and synergize as prospective digital leaders who are responsible for the integrity of bangs, human resources, and digital technology, open and transparent, and have an adaptive and agile creative and innovate culture that can penetrate change and development for national development.

CONCLUSION

1. Important points based on the literature review that the author has done: several points can be taken as follows.

   a. The change of the world is now entering the era of the industrial revolution 4.0 or the fourth world industrial revolution where the internet of things and information becomes the necessity of every human life.

   b. Information literacy is a way to practice high-level thinking skills, contributing to the demands of the 21st century and the 4.0 industrial revolution for the betterment of the nation.

   c. Life-based learning is a crucial knowledge learning for the welfare of a nation with prosperous human resources and awareness of the abilities of each individual.

   d. STEM integrated learning shows how concepts, principles from science, technology, engineering,

and mathematics are used in an integrated way in the development of products, processes, and systems used in everyday life.

e. The learner's skills are an overarching character that is easier to recognize than define. To prepare learners in the face of the demands of the times.

f. Generation in the industrial era 4.0 holds a commitment to lead in the digital era, existence is increasingly expanded to become a role model for the next generation.

2. Recommendations

Some of the recommendations that the author can give include:

a. In-depth research is needed on how to teach, measure, and evaluate it in implementing STEM-based information literacy in learners.

b. Develop learners' skills and implement them on STEM integrated problem-based learning and activities that learners can understand.

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