Conference Paper

Integrating Information Technology and Stem Learning Models in Industrial 4.0 Revolution

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Abstract

At present the world is entering the era of industrial revolution 4.0 which is closely related to information technology on the basis of human life (Kemenristekdikti, 2018a). With these changes, of course the world of education must also immediately respond to these changes. The steps that can be taken is by integrating information technology with innovative learning models. As a teacher in the Indonesian era 4.0 gave birth to a term known as Teacher 4.0 Challenges & Requirements. To become a 4.0 teacher must have 3 components, namely: 1) Human - Based & Didactical Challengee; 2) Organizational Challengee and 3) Technological Challengee. (Abdelrazeq, 2016). To support these competencies, one of the learning models that can be used is the STEM-based learning model. STEM Education is a combination of areas of Science, Technology, Engineering, and Mathematics (STEM) (Duran, et al., 2016). This paper aims to: 1) explain the perception of information technology and STEM learning for prospective economic teachers. 2) describes the efforts to integrate Information Technology and STEM-based Learning Models in the face of the Age of Industrial Revolution 4.0.

Keywords: Industrial Revolution Era 4.0, Information Technology, and Innovative Learning Models, STEM, Teacher Competencies 4.0.

1. Introduction

Changes that occur in our lives can not be avoided. As at the moment we are facing the Industrial Revolution Era 4.0. The Industrial Revolution 4.0 was marked by the development of the internet of or for things followed by new technologies in data science, artificial intelligence, robotics, cloud, three- dimensional printing and nanotechnology. (Ghufron, 2018). Furthermore Industry 4.0 is a comprehensive transformation of all aspects of production in the industry through the merger of digital and internet technologies with conventional industries. (Merkel. 2014). In the current era it is also necessary to support fast information such as the writings of Schlechtendahl et al (2015) which focuses the definition on the speed element of information availability, which is an industrial environment in which all entities are always connected and able to share

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information with one another. Through changing conditions in the era of the industrial revolution 4.0, the face of education is certainly also undergoing change. Education that used to only focus on learning outcomes and improve the quality of students, now must also move towards the sophistication of information technology used in the learning process. This is of course with the presence of millennial generations who become students, the face of education must also prioritize the use of information technology in every learning activity.

Information technology also known as Information and Communication Technology (ICT) is part of Science and Technology (Science and Technology). Information and communication technology has two aspects, namely information technology and communication technology. Information technology is all things related to the process, use as a tool, manipulation, and management of information. Meanwhile, communication technology is all matters relating to the use of tools to process and transfer data from one device to another. As stated by Eric Deeson, Harper Collins Publishers, Dictionary of Information Technology, Glasgow, UK, 1991 (Kurniawan, 2019) states that "Information Technology (IT) the handling of information by electric and electronic (and microelectronic) means." handling includes transfer. Processing, storage and access, IT special concern being the use of hardware and software for these tasks for the benefits of individual people and society as a whole ".

From this understanding Information and Communication Technology has several benefits, namely: (1) with the presence of ICTs Information that is needed will be more quickly and easily accessible for educational purposes; (2) ICT can be used as a medium for consultation with experts, namely consultation with experts in their field can be done easily even though the expert is located very far away; (3) With the presence of ICT, online libraries can be realized so that libraries are presented in digital form; (4) the existence of ICT is useful for conducting online discussions conducted through the internet; (5) through ICT increasing Innovation in learning for example by conducting e-learning innovations that further facilitate the educational process; (6) The progress of ICT will also enable the development of virtual classes or teleconference-based classes that do not require the educator and students to be in one room; and (7) through the application of ICT systems Administrative systems in an educational institution will be easier and smoother. With the benefits of ICT in learning, of course, must be supported by the competencies of a teacher in the era of the industrial revolution 4.0.

As a teacher in the era of RI 4.0 gave birth to a term known as Teacher 40 Challenges & Requirements. To become a teacher 4.0 must have 3 components, namely: 1) Human - Based & Didactical Challengee; 2) Organizational Challengee and 3) Technological

Challengee. (Abdelrazeq, 2016). To support these competencies, one of the learning models that can be used is the STEM-based learning model. STEM Education is a combination of Science, Technology, Engineering, and Mathematics (STEM) areas (Duran, et al., 2016). This paper aims to: 1) explain the perception of Information Technology and STEM Learning for prospective economics teachers. 2) explain the efforts to integrate Information Technology and STEM-based Learning Models in the face of the Industrial Revolution Era 4.0. Eight standards and characteristics of learning that seek to develop STEM education, namely (1) asking questions (for science); (2) developing and using models; (3) plan and carry out investigations; (4) analyze and interpret data; (5) using mathematics and computational thinking; (6) building explanations (for science); (7) make an argument from evidence; (8) obtain, evaluate, and communicate information.

2. Research Methods

The method used in this research is concurrent mixed methods. In this method the researcher uses quantitative data obtained from a questionnaire about STEM information and learning perceptions for prospective economics teachers and qualitative data from observations and interviews / interviews about efforts to integrate Information Technology and STEM-based Learning Models in the face of the Industrial Revolution Era 4.0. A brief description of variables and indicators and methods of data collection can be seen in the table below.

As for the field of research, the steps can be seen in the figure below.

3. Research Results and Discussion

Based on data retrieval and analysis that has been done can be seen, namely:

3.1. Information Technology Perception and STEM Learning for prospective economics teachers

3.1.1. Information Technology

TABLE 1: Variables, indicators, data collection methods and research objects.

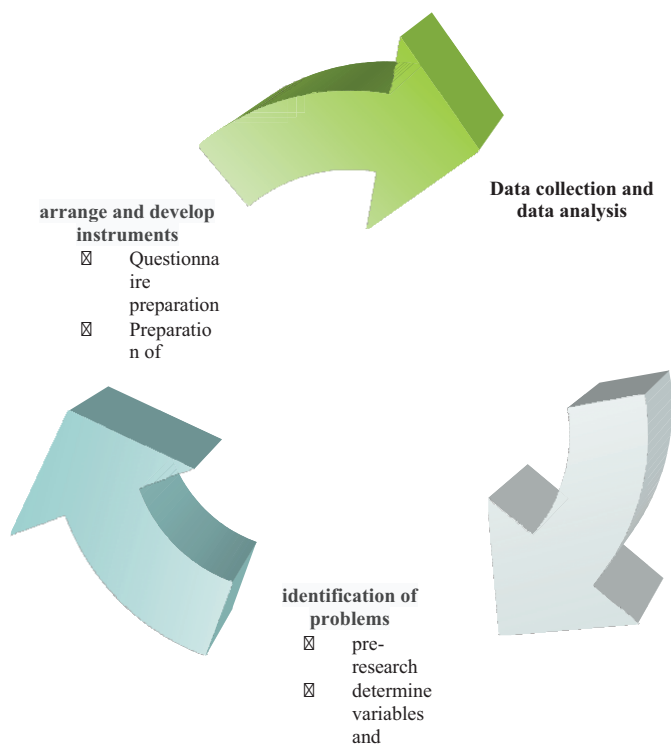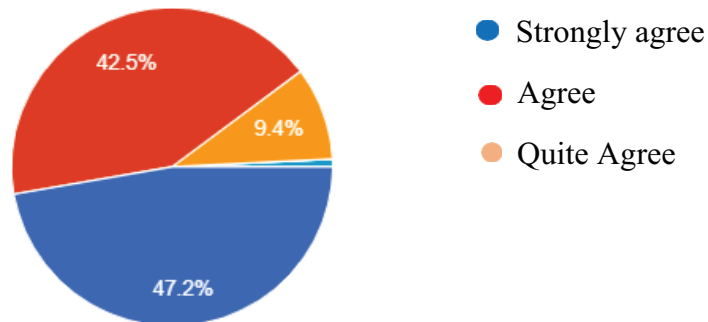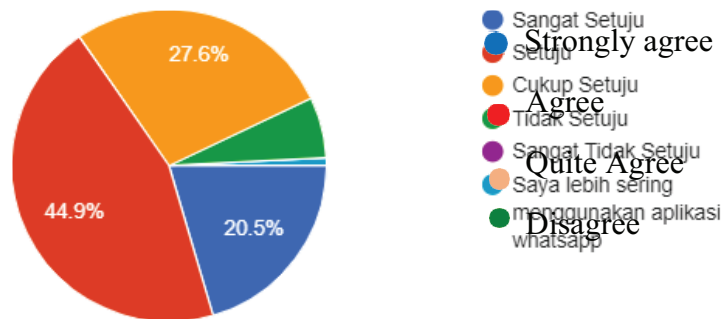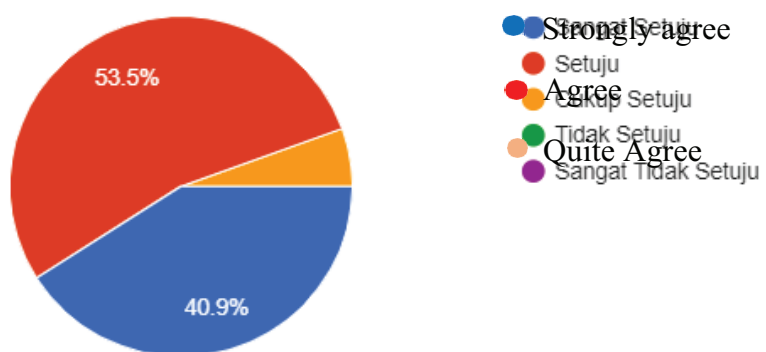| No	Variable	Indicators	Data Collection Methods	Object of research
1	Perception about Information Technology in economic learning	•Social media in the learning process •Use of communication media (Google meet) •ICT based learning •Technology-based economic knowledge	Questionnaire	128 respondents came from S1 Economic Education Study Program students at East Java State University
2	STEM Learning Perception	•Interactive media in learning •Characteristics of the STEM learning model Suitability of STEM with the Industrial Revolution Era 4.0	Questionnaire	128 respondents came from S1 Economic Education Study Program students at East Java State University
3	Integrating Information Technology and STEM Learning in learning	•Forms of integration of information technology and STEM Learning •Constraints and solutions for Integrating Information Technology and STEM Learning in learning	Interview and observation	Interviews and observations with 3 respondents who came from S1 Economic Education study programs at UM, UNESA, and UNEJ.

arrange and develop instruments
☒ Questionnaire preparation
☒ Preparation of

Data collection and data analysis

identification of problems
☒ pre-research
☒ determine variables and
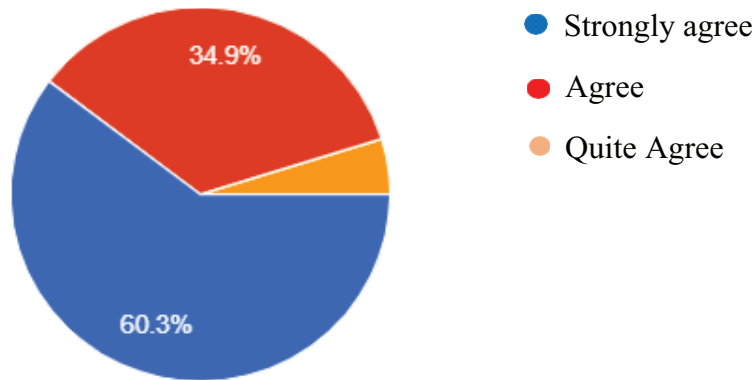
Figure 1: Research steps.

Social media in the learning process

- ● Strongly agree
- ● Agree
- ● Quite Agree

42.5%

9.4%

47.2%

Use of communication media (Google meet)

- ● Sangat Setuju
- ● Strongly agree
- ● Setuju
- ● Cukup Setuju
- ● Agree
- ● Tidak Setuju
- ● Sangat Tidak Setuju
- ● Quite Agree
- ● Saya lebih sering
- ● menggunakan aplikasi
- ● Disagree
- whatsapp

27.6%

44.9%

20.5%

ICT based learning

- ● Sangat Setuju
- ● Strongly agree
- ● Setuju
- ● Agree
- Cukup Setuju
- ● Tidak Setuju
- ● Quite Agree
- ● Sangat Tidak Setuju

53.5%

40.9%

Technology-based economic knowledge

128 respondents who gave responses about information technology which consisted of indicators: 1) Social media in the learning process; 2) Use of communication media (Google meet); 3) ICT based learning; 4) Technology-based economic knowledge. Respondents on average answered strongly agree with the existence of information technology which is a skill that must be possessed by prospective economics teachers in the era of the industrial revolution 4.0. This is in line with research from (Muhali: 2019) about the skills needed in the 21st century. One of the skills that must be possessed by students is information, media and technology skills meaning students must be information literate, media literate, and ICT literate. Therefore, as a teacher also requires technology upgrades to make students have these skills.
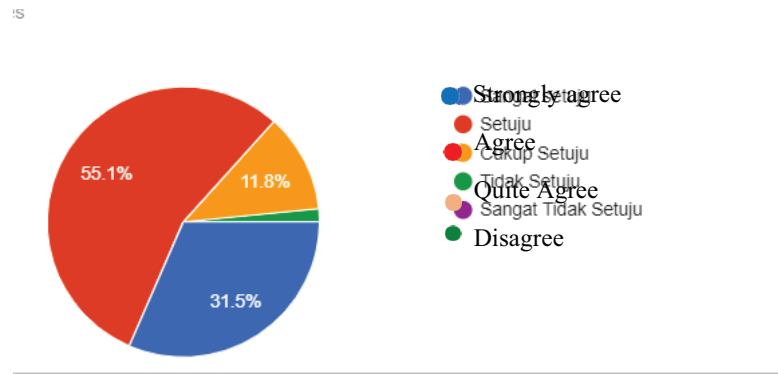
3.1.2. STEM learning
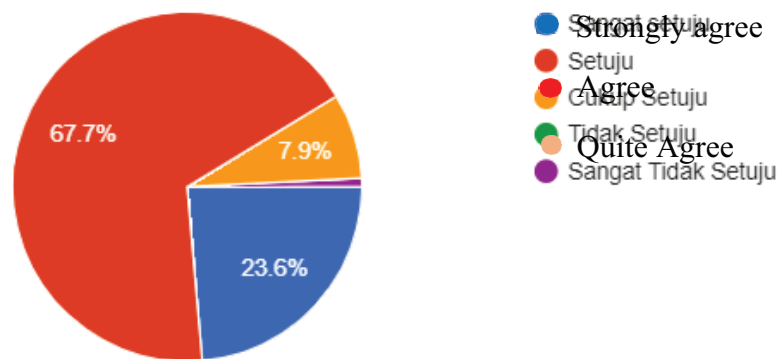
Interactive media in learning
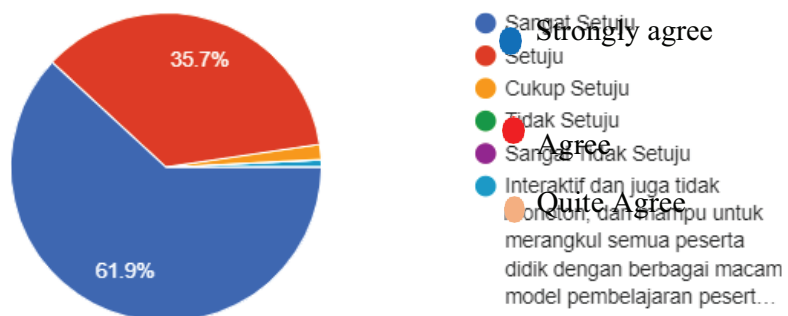
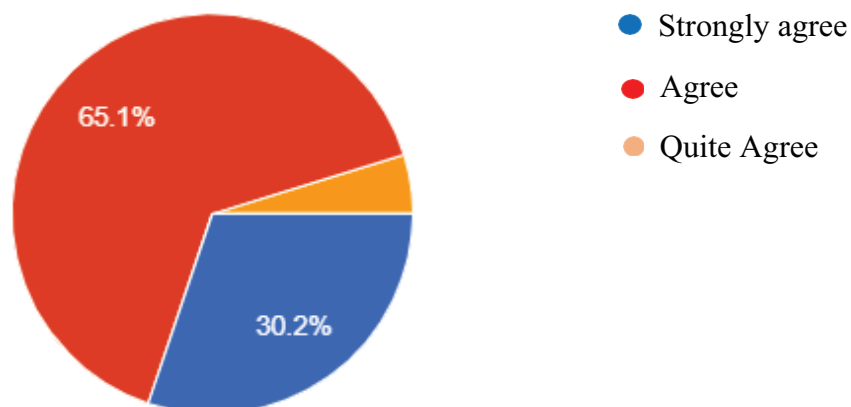### Characteristics of the STEM learning model

a. The STEM model is suitable in economic subjects
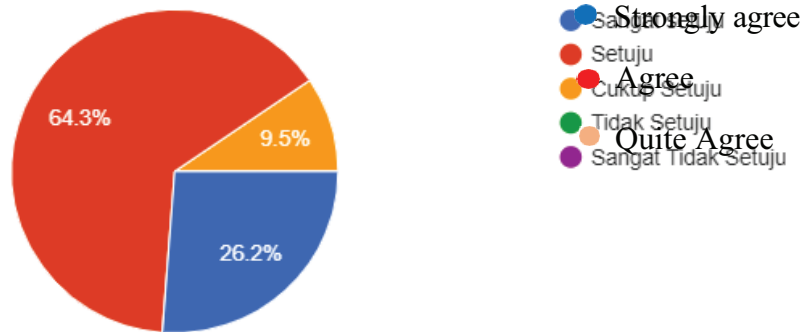

b. One aspect of STEM Learning is asking science questions that are integrated in economic topics
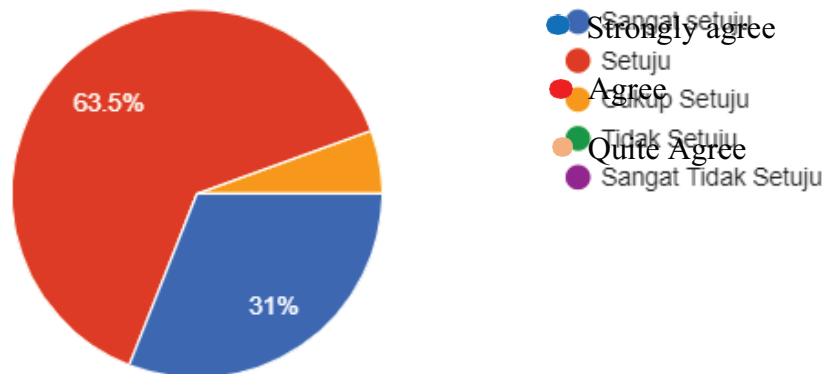

c. STEM learning needs to emphasize aspects for developing and using models
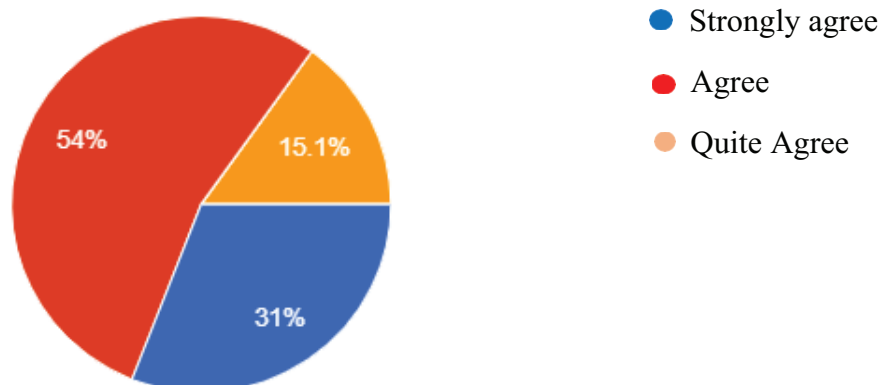
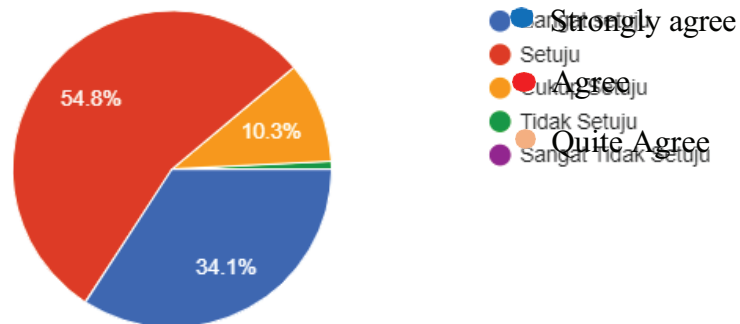**d. Planning and investing can be done in STEM-based learning innovations**

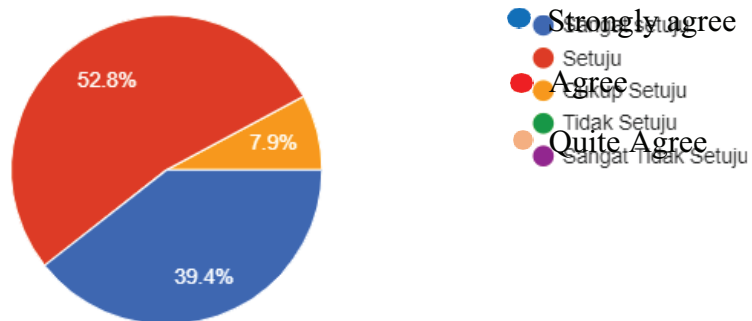**e. Analyzing and interpreting data related to economic topics is an aspect of STEM-based learning**

f. The discussion method becomes the most dominant learning style in STEM based learning

g. Inquiry model that is integrated with technology is one way to implement STEM learning

Suitability of STEM with the Industrial Revolution Era 4.0

Whereas for STEM learning respondents gave their perceptions that STEM was suitable to be implemented in learning in the Industrial Revolution 4.0 era. This is because STEM has the following characteristics: 1) Involving students in inquiry; 2) Involving students in productive cooperation; 3) Requires students to apply STEM understanding; 4) Give opportunities to students to answer; 5) Involving students to apply the skills of the process; 6) Requires multiple answers; 7) Increase student sensitivity.

3.2. Efforts to integrate Information Technology and STEM-based Learning Models in the face of the Industrial Revolution Era 4.0

Based on interviews conducted on respondents from 3 universities, namely: 1) Malang State University (UM); 2) Surabaya State University (UNESA) and 3) Jember State University (UNEJ) obtained various results. Respondents used as informants are respondents who are taking pedagogical courses in an effort to prepare to become a teacher. The result is that respondent 1 (UM) did it using a special information technology platform like Kahoot! And Quizizz in doing STEM based learning. As for respondents 2 and 3

(UNESA and UNEJ) the form of integration is to use learning videos that are already available on You Tube and used to illustrate the topics of learning being carried out.

4. Conclusion

The conclusions in this article include:

1. Information Technology and STEM Learning Perception for prospective economics teachers is Good Both of the 128 respondents answered Very Agree that Information Technology is a skill that must be mastered in the era of the industrial revolution 4.0. While the majority of 128 respondents answered Agree that STEM-based learning is suitable to be applied in this era.

2. Efforts to integrate Information Technology and STEM-based Learning Models in the face of the Industrial Revolution Era 4.0. from 3 universities namely with certain platform applications and by using technology-based learning resources in the application of the learning process.

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