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Students e-learning readiness towards education 4.0: Instrument development and validation

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ABSTRACT

One of the characteristics of Education 4.0, which is a response to the demands of Industry 4.0, is the use of adaptive and artificial intelligence technologies in online education. In relation to e-learning preparedness, many researchers have conducted studies. But in Education 4.0, the teaching and learning processes' peculiarities were not considered. Therefore, this study aims to develop and validate an instrument for assessing the e-learning readiness of students toward Education 4.0. There were 126 undergraduate students participated in this study. The respondents were asked to fill out the online-based questionnaire voluntarily. The data obtained were then statistically analyzed using the Pearson product-moment correlation test to measure the instrument's validity. The validity test showed that all items on the questionnaire are considerably valid at a significance level of 0.01. Meanwhile, the instrument reliability was measured through Cronbach's alpha score. The reliability test confirmed that six aspects out of seven of the instrument are categorized as high reliability (flexibility, learning preferences, project-based learning, data interpretation, improving curriculum, and self-directedness). One aspect (field experience) showed a moderate level of reliability. The study's findings confirmed that the questionnaire developed is valid and reliable for collecting data concerning the students' e-learning readiness toward Education 4.0.

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INTRODUCTION

Today's technological development has a significant impact on how education has developed. Online tests, tailored learning, and digital classrooms are a few examples that frequently appear and are simple to locate in today's current educational period. Some distinctive features of Education 4.0 include using adaptive and artificial intelligence technology in the classroom (Fisk, 2017; Hariyanto & Köhler, 2020). Education theorists refer to how cyber technologies, whether physical or not, are incorporated into learning and educational processes as "education 4.0." Education 4.0 is a phenomenon that satisfies the demands of Industry 4.0, where humans and robots collaborate to find answers, resolve issues, and create new possibilities for innovation.

The ability to learn at any time, anywhere, and without students present is a given in the modern world. E-learning is the term used to describe this sort of education. When referring to e-

learning, the "e" means a process is digitally altered, saved, and transmitted electronically (Clark & Mayer, 2016). E-learning is a well-liked option among students due to the rapid development of Internet users and networking technologies. According to Rosenberg and Foshay (2002), e-learning is typically an online version of traditional learning and depends on the Internet.

It is well recognized that traditional "static" e-learning essentially offers identical instructional resources and setting to every learner (Brusilovsky, 2000). This conventional e-learning recreates conventional face-to-face instruction in a brand-new technology-based learning format. Personalized "dynamic" e-learning is one of the newest e-learning technologies. This results from the widespread acceptance that every pupil is unique. As a result, it is impossible to compare one pupil to another. In this sense, numerous researchers have created individualized e-learning that can be customized to meet the needs of individual students based on their learning preferences, knowledge levels, cognitive styles, and behavior.

By allowing students to employ customized e-learning and choose their learning style and pace, "dynamic" e-learning has achieved several Education 4.0 criteria that Fisk proposed (Fisk, 2017). Concerning e-learning preparedness, other researchers have conducted many studies. To evaluate the readiness for e-learning, Alshaher (2013) employed the McKinsey 7S model. Structure, strategy, system, skill, style, staff, and shared values/goals are the seven variables this model considers. Five components to gauge preparation for e-learning were suggested by Alem et al. (2016). These components include motivation, self-competence, self-directed learning, financial resources, and usefulness. To assess the level of e-learning preparedness in a developing nation, Aydin and Tasci (2005) created the e-Learning Readiness Survey (e-LRS), which included questions about people, technology, innovation, and self-development.

Vicki Williams of Penn State University created the online learning readiness questionnaire, which is frequently used in universities and colleges. It includes questions on self-directedness, learning preferences, study habits, technical skills, and computer equipment capabilities. However, the studies mentioned above are not considered when determining what makes up the teaching and learning process in Education 4.0. Therefore, it's crucial to look into the e-learning readiness among learners toward Education 4.0. The student's willingness to face the learning environment fitting with the digital-based characteristics of Education 4.0 is crucial to absorb the knowledge smoothly. Therefore, this study aims to develop and validate the instrument that could be used to gauge the level of readiness of students toward Education 4.0 characteristics.

RESEARCH METHOD

The research design of this study divides into two stages, as seen in Figure 1. The first stage deals with the development of the instrument, and the second focuses on piloting the instrument to the students to evaluate its validity and reliability. The first stage looks into detail and considers the research purposes (Crocker & Algina, 1986). As already mentioned, the main purpose of this study is to investigate the e-learning readiness of students in higher education to face the education 4.0 paradigm. As such, the authors searched for the already established instrument for measuring students' e-learning readiness. The authors also did review some education 4.0-related literature. The work continued by identifying the aspects that represent the characteristics of education 4.0. Then, developing the questionnaire items for each element specified in this study was done by considering the previous research on e-learning readiness and education 4.0.

The second stage of the research design starts by setting the instrument up based on the online survey. Then, ask the voluntary-based students to fill it up. From the data collected, the process continued by analyzing the validity and reliability of the instrument.

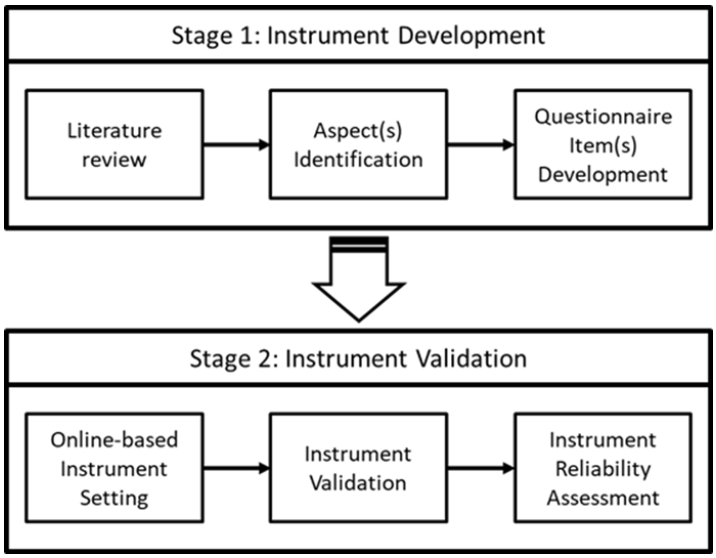

Figure 1. Steps in Developing and Validating the Instrument

RESULT AND DISCUSSION

Reviewing the Existing Instrument

A literature review was performed by first looking at the definitions of e-learning readiness, including the factors that may influence the assessment of e-learning readiness. One commonly used purpose is readiness can be seen as a factor that must be achieved before an e-learning implementation is successful. This can be defined as several factors that can positively impact the successful implementation of e-learning (Odunaike et al., 2013). Concerning that definition, Alshaher (2013) conducted a study to assess e-learning readiness through McKinsey 7S Model. This model was developed by Peters et al. (1983). This model deals with seven variables, and all the variables begin with the letter "S," including structure, strategy, systems, skills, style, staff, and shared values/superordinate goals (Franta, 2012; Liutu, 2010).

Another researcher proposed a multidimensional construct consisting of five factors: self-competence, self-directed learning, motivation, finances, and usefulness (Alem et al., 2016). Srichanyachon (2010) has identified critical components of e-learning readiness and concluded that there were three major factors: technology, human resources, and culture. Meanwhile, Aydin and Tasci (2005) developed the e-Learning Readiness Survey (e-LRS). It includes elements such as technology, innovation, people, and self-development. In addition to these factors, each may have three different components: resources, skills, and attitudes.

One commonly used and adopted by many universities and colleges to evaluate the e-learning readiness of students is the online learning readiness questionnaire Vicki Williams initially made from Penn State University. This questionnaire comprised dimensions of self-directedness, learning preferences, study habits, technology skills, and computer equipment capabilities with three options of response: agree, somewhat agree, and disagree. The list of the existing instruments already used by researchers to measure e-learning readiness can be seen in Table 1. Previous studies have developed the instrument to evaluate e-learning readiness in an organization, school, college, and company context. Nevertheless, it is found that the existing instruments have little contribution to accommodating education 4.0 characteristics.

Table 1. The Existing Instruments for Measuring E-learning Readiness

Name	Description
E-learning System Readiness Assessment (ELSRA) (Alshaher, 2013)	The instrument assesses the readiness of an organization to implement an e-learning system based on the McKinsey 7S model. This model deals with seven variables: structure, strategy, system, skill, style, staff, and shared values/superordinate goals.
E-learning Readiness (ELR) (Alem et al., 2016)	The instrument measures the concept of e-readiness in the online learning environment. It consists of a five-dimensional structure of self-competence, self-directed learning, motivation, finance, and usefulness.
E-learning Readiness (Srichanyachon, 2010)	The instrument evaluates e-learning readiness in Thailand, divided into three factors: technology, human resources, and culture.
e-Learning Readiness Survey (e-LRS) (Aydin & Tasci, 2005)	The instrument assesses the e-learning readiness of companies in Turkey which comprises of factors: technology, innovation, people, and self-development.
Online Learning Readiness Questionnaire (Williams & Pennsylvania State University, n.d.)	The instrument evaluates the e-learning readiness of students, which comprises dimensions of self-directedness, learning preferences, study habits, technology skills, and computer equipment capabilities.
E-learning Readiness (Ünal et al., 2014)	The instrument investigates the e-learning readiness level of students at Haceteppe University, which has five main components: availability of technology, use of technology, self-confidence, acceptance, and training.
Online Learning Readiness Scale (OLRS) (Hung et al., 2010)	The instrument validates the college student's readiness to learn online in five dimensions: self-directed learning, motivation for learning, computer/internet self-efficacy, learner control, and online communication self-efficacy.
McVay's Readiness for Online Learning Questionnaire (Smith et al., 2003)	The instrument evaluates a student orientation course towards online learning which comprises 13 items.

Identifying the Instrument's Aspects

Identifying the instrument's aspects in this study was based on the characteristics of education 4.0. The evolution of education 4.0 cannot be separated from the effect of the revolution of industry 4.0. Diwan (2017) exemplified that industrial revolution 4.0 involved big data, the internet of things, and adaptive and artificial intelligence techniques in the industrial mechanism. Therefore, the characteristics of education 4.0 are considerably influenced by the usage of those industry 4.0-related technologies. Postulated nine characteristics of education 4.0, namely:

> *(1) learning processes can be performed anytime, anywhere, (2) learning can be personalized to individual students, (3) students can determine their own learning path, (4) students will be exposed to more project-based learning, (5) learning focuses on field experiences such as internships, project consulting and collaboration, (6) students are exposed to data interpretation, (7) students are being examined in different ways, (8) students may help to improve the curriculum that can assist in renewal, and (9) students learn independently and the role of the teacher as a moderator changes (Fisk, 2017).*

The process continued by identifying the main aspects of education 4.0. These aspects may become the initial construction of the instrument to measure the e-learning readiness that represents Education 4.0. After reviewing each characteristic of education 4.0, the authors identified seven aspects as the representation of education 4.0, as seen in Table 2.

Table 2. Instrument's Aspects Identification

No.	Education 4.0 Characteristics	Aspects
1	learning processes can be performed anytime, anywhere	Learning Flexibility
2	learning can be personalized to individual students students can determine their own learning path	Learning Preferences
3	students will be exposed to more project-based learning students are being examined in different ways	Project-based Learning
4	learning focuses on field experiences such as internships, project consulting and collaboration	Field Experience
5	students are exposed to data interpretation	Data Interpretation
6	students may help to improve the curriculum that can assist in renewal	Curriculum Improvement
7	students learn independently and the role of the teacher as a moderator changes	Self-directedness

Developing the Instrument

After the aspects of the instrument were identified, the work continued by constructing and developing the instrument. Since there are some similar aspects with the existing instrument, thus the questionnaire items of the instruments were adopted from those related instruments. The other questionnaire items were newly created by considering some related literature. The questionnaire outline of the student e-learning readiness evaluation can be seen in Table 3.

Table 3. The Questionnaire Outline

Aspects	Items Number	References
Learning Flexibility	1, 2, 3, 4	(Alshaher, 2013; Aydin & Tasci, 2005; Smith et al., 2003; Srichanyachon, 2010; Ünal et al., 2014; Williams & Pennsylvania State University, n.d.)
Learning Preferences	5, 6, 7, 8	(Hung et al., 2010; Williams & Pennsylvania State University, n.d.)
Project-based Learning	9, 10, 11, 12	(Fisk, 2017; Lou & MacGregor, 2004)
Field Experience	13, 14, 15	(Fisk, 2017; Lou & MacGregor, 2004)
Data Interpretation	16, 17	(Fisk, 2017)
Curriculum Improvement	18, 19, 20	(Fisk, 2017)
Self-directedness	21, 22, 23, 24, 25	(Alem et al., 2016; Aydin & Tasci, 2005; Smith et al., 2003)

Evaluating the Instrument Validity

In order to measure the validity and reliability of the instrument, the questionnaire was distributed to 126 undergraduate students of Universitas Negeri Yogyakarta. The participants in this study were asked to fill out the online-based questionnaire voluntarily. The questionnaire consisted of 25 items on a 5-point Likert scale, from 'strongly disagree' (point 1) to 'strongly agree' (point 5). The data obtained were then statistically analyzed using the Pearson product-moment correlation test. The result, as seen in Table 4, showed that all items on the questionnaire are considerably valid at a significance level of 0.01.

Table 4. The Instrument Validity

No.	Statement	Validity
1	I can learn from e-learning anytime	Valid (0.575**)
2	I can learn from e-learning anywhere	Valid (0.472**)
3	I have an internet access whenever I need to study	Valid (0.493**)
4	I have an internet access wherever I need to study	Valid (0.477**)
5	I learn pretty easily	Valid (0.562**)
6	I am able to develop a good way to solve problems I run into	Valid (0.684**)
7	I prefer to learn with my own learning style	Valid (0.513**)
8	I like to learn with my own learning pace	Valid (0.436**)
9	I know the meaning of project-based learning	Valid (0.621**)
10	I prefer to learn by working on a project	Valid (0.555**)
11	I am ready to be evaluated through field project	Valid (0.494**)
12	I am ready to be evaluated through assignments	Valid (0.677**)
13	I like doing an internship	Valid (0.552**)
14	I like doing a mentoring project	Valid (0.455**)
15	I like doing a collaboration project	Valid (0.421**)
16	I know about a big data	Valid (0.604**)
17	I know how to interpret data	Valid (0.678**)
18	I know my university's curriculum	Valid (0.610**)
19	I may provide suggestion for updating the curriculum	Valid (0.554**)
20	I may provide suggestion for improving the improvement	Valid (0.531**)
21	I effectively take responsibility for my own learning	Valid (0.655**)
22	I am confident in my ability to independently prioritize my learning goals	Valid (0.752**)
23	I am good at setting goals and deadlines for myself	Valid (0.622**)
24	I am autonomous/independent	Valid (0.631**)
25	I can keep myself on track and on time	Valid (0.599**)

** : Correlation is significant at the 0.01 level (2-tailed)
* : Correlation is significant at the 0.05 level (2-tailed)

Evaluating the Instrument Reliability

This study measured the reliability test through Cronbach's Alpha score. Researchers agreed that one instrument could be considered reliable when the reliability score reached 0.7 or higher (Landauer, 1997; Nunnally, 1978; Robinson et al., 1991). In addition, Guilford in Durrheim and Tredoux (2004) provided a classification of reliability coefficients for interpreting reliability levels, as shown in Table 5.

Table 5. Reliability Coefficients Interpretation

Reliability Coefficient (r)	Interpretation
0,00 ≤ r < 0,20	Very low
0,20 ≤ r < 0,40	Low
0,40 ≤ r < 0,70	Moderate
0,70 ≤ r < 0,90	High
0,90 ≤ r ≤ 1,00	Very high

As seen in Table 6, six aspects of the instrument were categorized as high reliability ranging from 0.717 to 0.830. Those six aspects are learning flexibility (0.755), learning preferences (0.717), project-based learning (0.784), data interpretation (0.777), improving curriculum (0.761), and self-directedness (0.830). This evidence represented high internal consistency. Nevertheless, one aspect (field experience with Cronbach's Alpha 0.561) showed a moderate level of reliability which is still acceptable.

Table 6. The Instrument Reliability

Variables	Number of items	Cronbach's Alpha	Interpretation
Learning flexibility	4	0.755	High
Learning preferences	4	0.717	High
Project-based learning	4	0.784	High
Field experience	3	0.561	Moderate
Data interpretation	2	0.777	High
Improving curriculum	3	0.761	High
Self-directedness	5	0.830	High

CONCLUSION

There are seven aspects used in order to measure the students' e-learning readiness, namely (1) Learning flexibility; (2) Learning preferences; (3) Project-based learning; (4) Field experience; (5) Data interpretation; (6) Curriculum improvement; and (7) Self-directedness. The instruments developed were first validated by the experts and then got some adjustments according to the experts' feedback. The work continues by asking voluntary the students to fill out the questionnaire through the online-based application. One hundred twenty-six undergraduate students of Universitas Negeri Yogyakarta participated in the online survey. The questionnaire developed comprised 25 items with a 5-point Likert scale ranging from 'strongly disagree' (point 1) to 'strongly agree' (point 5). The data obtained were then statistically analyzed using the Pearson product-moment correlation test. The result showed that all items on the questionnaire are considerably valid at a significance level of 0.01. The work continues by assessing the reliability of each aspect of the questionnaire by using Cronbach's alpha approach. The results showed that six aspects of the instrument were categorized as high reliability ranging from 0.707 to 0.830. Those six aspects are learning flexibility (0.755), learning preferences (0.717), project-based learning (0.784), data interpretation (0.777), improving curriculum (0.761), and self-directedness (0.830). This evidence represented high internal consistency. Nevertheless, one aspect (Field Experience with Cronbach's Alpha (0.561) showed a moderate level of reliability which is still acceptable. It is concluded that the questionnaire developed has been tested and categorized as a valid and reliable instrument.

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