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Assessing Undergraduate Students' e-Learning Competencies: A Case Study of Higher Education Context in Indonesia

Ati Suci Dian Martha, Kasiyah Junus *, Harry Budi Santoso and Heru Suhartanto

Faculty of Computer Science, Universitas Indonesia, Depok 16424, Indonesia; aciantha@gmail.com (A.S.D.M.); harrybs@cs.ui.ac.id (H.B.S.); heru@cs.ui.ac.id (H.S.)
* Correspondence: kasiyah@cs.ui.ac.id

Abstract: The COVID-19 pandemic that occurred in early 2020 around the world has implications for Indonesia's education sector. This pandemic led to the Indonesian government policy to study from home at all academic levels using a distance learning approach. Studies on e-learning preparedness in Indonesia involving more comprehensive samples of universities during the pandemic are still limited. This study extended samples from several public and private universities in Indonesia to get a broader picture of e-learning readiness in various faculties with diverse university online learning cultures. This study used Rasch analysis to determine the validity and reliability of the instrument and differential item functioning (DIF) analysis to identify responses based on students' demographic profiles. The results show that most students were ready to study online, but a few were not ready. Moreover, the results show significant differences in students' e-learning readiness based on the academic year at university, the field of study, the level of organizational e-learning culture of the university, gender, and region. This work provides an insight into student readiness to study online, especially in higher education in Indonesia. The article presents the implications of online learning practices in universities and recommendations for future e-learning research.

Keywords: e-learning; students' e-learning preparedness; e-learning competency; Rasch analysis; online learning

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1. Introduction

The COVID-19 pandemic has provided momentum for the growth of online learning in Indonesia at all education levels, from kindergarten [1], primary school [2], junior high school [3], senior high school [4], to higher education [5,6]. In this pandemic, the application of online learning is inevitable. The Indonesian government supports these online learning activities by issuing policies to carry out learning activities from home [7]. In carrying out suitable online learning activities, students need to have the readiness to learn online [8–11]. The level of online learning readiness can affect students' interaction [12], level of emotional intelligence [13], satisfaction, and motivation [14–16] in the online learning environment. Students' preparedness for undertaking e-learning is essential to produce effective learning performance [17].

Before the COVID-19 pandemic, several universities in Indonesia had initiated learning innovations by implementing online learning (either fully online learning or blended learning). One of the universities that implements complete online learning in Indonesia is the Open University called Universitas Terbuka (UT). The learning process at this university is carried out through learning assistance services using Tuton (learning assistance through the Learning Management System asynchronously), TTM (face-to-face learning assistance), and Tuweb (learning assistance through online meetings/synchronously) [18]. UT students have a very high level of learning readiness compared to students who have never undertaken online learning [19]. The high level of UT students' online learning readiness is strongly influenced by self-regulation, self-directed learners, and the ability

to use various kinds of software [20]. One of the universities that applies blended learning is the Universitas Indonesia. Students in this tertiary institution have a high level of online learning readiness in terms of interaction in online communities [21]. Junus et al. [21] stated that students were ready to use technology to help the learning process. However, the ability to interact meaningfully in a discourse needs to be improved. Junus et al. [21] suggest that the institutions train students to communicate effectively with other learners and lecturers. The two universities mentioned above show that a high level of online learning readiness is possible because lecturers and students are familiar with the online learning environment. However, from 4741 universities in Indonesia, there are only 15–20 universities that have implemented e-learning [22–24]. This indicates that the online learning culture in Indonesian universities is still weak, and this situation undoubtedly affects students' readiness to participate in online learning.

At the end of 2019, the coronavirus outbreak (COVID-19) was first reported in Wuhan, China. This COVID-19 epidemic has spread and infected people throughout the world. Noting the alarming spread and severity rate, the World Health Organization (WHO), through Director-General Tedros Adhanom Ghebreyesus, established the situation as a pandemic as of 11 March 2020 [25,26]. The coronavirus pandemic has implications for various sectors of life in multiple countries, including Indonesia. The education sector in Indonesia is one of the areas affected by the coronavirus pandemic. Although the culture of online learning organizations in universities in Indonesia was still uneven at the onset of the pandemic, the Minister of Education and Culture of Indonesia, Nadiem Makarim, established a study from home (SFH) policy. Through circular number 36962/MPK.A/HK/2020, online learning and working from home were established to prevent the spread of the coronavirus disease) [7].

This pandemic situation led to the question of student readiness at tertiary institutions in conducting online learning activities. Several studies with regard to readiness to study online in higher education during the COVID-19 pandemic in Indonesia have been carried out. Widodo et al. [27] conducted a study on students at the University of Mataram. The results of his research [27] indicate that the level of student learning readiness is still lacking. This is due to a lack of mastery of online media, lack of training, limited costs, and poor internet connections [27]. Most students expect online learning to stop and for learning to return to face-to-face arrangements. Meladina and Zaswita [28] also found that the level of online learning readiness at Fort De Kock University was still lacking. Students felt they did not understand the material, were less focused on learning, and lacked interaction [28]. Meanwhile, Sulistyohati [29] found that students of the Faculty of Engineering, Cikarang University, were ready to study online, provided that universities prepared an e-learning system and socialized it.

In previous studies [19–21,27–29], a questionnaire was given to students in a subject area at a university in Indonesia. They also showed that technical constraints are the main factor for students' unpreparedness to learn online. It is essential to determine exactly how diverse factors, like the academic year at university, the field of study, the e-learning culture of a university, gender, and region, relate to student e-learning preparedness. This study expanded the sample to several public and private universities with various fields of study to get a broader picture of e-learning readiness in various faculties with diverse university online learning cultures. Research questions that guided the investigation of student readiness to study online at the university level were as follows:

1. What is the level of student preparedness to study online in the higher education context in Indonesia during a pandemic?
2. Are there any significant differences in student readiness to learn online during pandemics based on the year of study, the field of study, the level of e-learning culture at a university, student gender, and region?

To answer the research questions, we investigated student readiness for e-learning at tertiary institutions in Indonesia. This study used a cross-sectional quantitative survey method. We collected the data from a sample of 482 undergraduate students using the e-learning competencies (EC) questionnaire. Data analysis used the Rasch model measurement to determine the validity and reliability of the instrument and differential item functioning (DIF) analysis to identify responses based on student demographic profiles. The findings in this study are expected to improve the effectiveness of student performance in online learning environments in tertiary institutions. This article consists of several parts. Following the background section, the second section contains a literature review on e-learning, student preparedness, and factors affecting online learning implementation. The third section outlines the research questions to be answered in this study. The fourth section includes the methodology used in this study and discussion and recommendations are presented in the final section.

2. Literature Review

2.1. E-Learning Types and Implementation

E-learning is a learning method that uses information and communication technology to convey information/material for education [30]. Some other terms widely used for learning methods include virtual learning, online learning, online computer-based training (CBT), and internet-based training (IBT) [31,32]. There are two types of interactions in online learning, namely synchronous interactions and asynchronous interactions. Asynchronous communication, facilitated by media such as e-mail or discussion forums, allows student interaction even though participants cannot go online simultaneously. Synchronous interaction, supported by media such as video conferencing and chat and communication, is carried out by participants simultaneously online. During the COVID-19 pandemic, learning interactions were not undertaken face-to-face. Instead, both types of interaction in the online learning methods mentioned above were used with technology from various platforms. Likewise, in universities in Indonesia during the pandemic, the learning process was carried out through learning management system (LMS) devices such as Moodle or Google Classroom [33–35]. The material is given in interactive activities online through various online platforms such as Zoom, Google Meet, and Microsoft Teams [36–40]. The learning resources provided are varied, such as interactive videos, animations, interactive quizzes, and online discussions.

E-learning as a learning method has several advantages. According to Arkorful and Abaidoo [40], e-learning can facilitate communication/delivery of knowledge and motivate students to interact with each other, exchange information/ideas, and respect different perspectives in discussion activities. The e-learning method, associated with a clear and structured pedagogical approach, can also influence motivation, participation, autonomy, concepts, outcomes, and grades of students [41]. However, despite the benefits of e-learning, according to Omidinia, Masrom, and Selamat [42], there are still many challenges, especially in developing countries. The challenges of e-learning in developing countries include the lack of e-learning infrastructures such as computers, electricity, and skills. Also, the activeness of students participating in interactive learning is still low [42]. According to Bhuasiri et al. [43] in [32], barriers to e-learning in developing countries are due to the lack of investment in the necessary technology, such as hardware, software licensing, equipment maintenance, development of learning and training materials, and management support. From the students' perspective, some challenges affecting online learning include poor internet connectivity, inadequate computer laboratories, limited computers/laptops, inadequate computer skills, and lack of time to interact with lecturers and fellow students [44].

The implementation of e-learning in higher education in Indonesia, as a developing country, is currently facing many obstacles. According to Kusumo et al. [45], the challenges in implementing e-learning in Indonesia are low levels of learning independence, connection problems, and difficulties in producing teaching material. This statement is consistent

with the statement by Aboderin [46] in [47] that internet connectivity and the availability of tools (computers and software) are obstacles that affect the implementation of online learning in developing countries.

2.2. Student Preparedness

The determination of students' level of preparedness to learn online can be used as a basis for building a fair and effective e-learning system [14,48]. Studies on online learning readiness among students have been conducted over the last ten years. The studies show that the results of online learning readiness can vary with time, depending on the institution or instrument used for assessment [49].

Studies on student preparedness to learn online in Indonesia are still few. From 2015 to 2020, there were ten studies published regarding students' readiness in tertiary institutions and three studies for high schools in Indonesia. Seven of them found that students were at a suitably prepared level, and six studies found that students were not ready to learn online.

Suwarsono [50] conducted a student readiness study for level 2 and 3 students from a private university's engineering faculty. This study looked for significant differences based on academic level/year and gender. The measured dimensions consisted of self-directed learning readiness and technical readiness. The study found that the average student was at the ready level, with the technical readiness dimension having the highest level of preparedness and the lowest being self-directed learning readiness. There were no significant differences found based on academic year or gender. Junus et al. [21] conducted a study of the preparedness of freshmen students to study online. The results of this study indicated that students were ready to use technology to help the learning process. However, they still needed to develop self-discipline, learning skills, and an active role in the learning environment. The and Usagawa [51] compared online learning readiness between Indonesian and Myanmarese students. The study found significant differences based on the learning environment, lecturers' roles, university facilities, possible benefits of e-learning, and confidence in readiness. In these two groups of samples, there were no significant differences found in the learner's background. Overall, the results of this study indicated that both Indonesian and Myanmarese students were ready for e-learning. However, facilities at both universities were still inadequate to implement and support e-learning effectively. Sulistyohati [29] showed that students at the Faculty of Engineering of Cikarang University were ready to study online. Still, an e-learning system was required that could meet student needs for learning and assignments. A study by Firdaus et al. [52] concluded that students of the Faculty of Tarbiyah and Teacher Training at Wonosobo were ready to participate in online learning activities. However, it was necessary to manage good learning online and pay attention to network aspects because not all students had good internet access. An investigation by Ramadiani et al. [53] of junior and senior high school students in Samarinda showed that students were ready to learn online. Still, they hoped to add the use of games and music to online learning activities. A study by Dwiyanti et al. [8] for junior high school students in Denpasar showed that students were at the ready level overall. However, in the dimension of independent learning, students were judged to be not ready. Therefore, it is necessary to encourage students to communicate actively in online learning, especially shy students.

Several studies have also shown students' unpreparedness to learn online. Purwandani [54], in her study, found that students of one of the Informatics Study Programs in Jakarta were not ready because e-learning was considered problematic as they were not used to interacting with e-learning. Also, the presentation of interactive material content was not yet available. She recommended holding training sessions or workshops for e-learning users to build awareness of how to use e-learning to improve the quality of learning [54]. Mahardika and Ningtyas [55] measured online learning readiness in semester four and six students of the Teaching and Education Faculty in Malang. They found that students needed effective learning methods to maximize the delivery of material. Meladina [28] showed that students at Fort De Kock University found it challenging to undertake

online learning due to signal constraints, internet costs, lack of understanding of and focus on the material provided, and lack of interaction. Research conducted by Widodo et al. [27] showed that students' learning readiness at the University of Mataram was still lacking due to technical constraints, such as lack of mastery of online media, lack of training, limited costs, and difficulties in accessing the internet. Meanwhile, Saintika et al. [56] showed that students in the Central Java region found it difficult to learn independently. Furthermore, students' interest in learning online is still minimal. Ramadan et al. [57] found that high school students need more profound guidance about the benefits and easiness of using e-learning.

Previous studies show that technical constraints are the main factor for students' unpreparedness to learn online. Furthermore, adding interactive content, games, and music can increase students' readiness to learn online.

2.3. Factors Affecting Online Learning Implementation

Varying levels of student online learning readiness can affect the implementation of online learning activities. Factors such as gender, the student's year of study, the field of study, the level of organizational culture for e-learning, and the region can influence online learning activities.

In terms of the gender aspect, previous studies found that, in general, there were no significant differences in level, motivation, and satisfaction between men and women [58].

Nevertheless, the use of LMS resources showed a significant difference. In the wiki display and uploaded documents, the level of disturbance related to students' social lives perceived by men was higher than that perceived by women [58]. This finding is consistent with the results of Elango et al. [59]. They found significant differences between men and women concerning the relevance of the content and delivery of teaching materials, web use, online interactions, course compliance, and trust in the system [59]. Ünal et al. [49] found that women were more enthusiastic about using e-mail, learning management, and file management tools. Pingle [60] found that male students showed better readiness in collaborative activities than female students in terms of technological information skills, collaborative learning, independent learning, and reflective learning. This finding is the inverse of that of the research conducted by Johnson [61]. He found that women communicated more, had a more significant social presence, were more satisfied with the course, viewed the course as more valuable, and showed slightly better performance than men. Morante et al. [62] also found that female students were more involved in the learning community and achieved better learning outcomes.

Regarding the semester/academic year of the student, first-year students need more attention in the communication process, and they also need the provision of suitable teaching materials [63]. Second- and third-year students need further training in e-learning [49]. Fourth-year students are better able to adapt to e-learning and its components [49,64]. In one study, they showed greater independence and were more motivated to learn online [10]. Hung et al. [10] further found that the third- and fourth-year students had higher self-efficacy in online communication than the first- and second-year students on the same course. The students studied were taking courses on life chemistry, calculus, statistics, Taiwan ecology, and an introduction to environmental protection.

With regard to the field of study/knowledge students were part of, the author of [60] found that students in the University of Mumbai from the art department had better reflection abilities in learning compared to students majoring in commerce. Another study conducted by Adams et al. [47] in a public higher education institution in Malaysia found that students from the social sciences major had a higher preference for e-mail communication than medical students. Also, social science students were more confident when posting questions in online discussions [47].

The level of organizational culture in e-learning is one aspect that is still very rare in research on student readiness in online learning. Literature discussing learners' independent learning styles and habits and the evolution of learning styles and patterns is still limited [65]. When implementing e-learning strategies, organizational culture can act as a facilitator and preventive factor that influences the e-learning process [66]. In e-learning, organizational culture is related to the learning culture, changing learning habits, making students understand how to learn [67], and making both teachers and students accustomed to developing and using e-learning systems [68]. A culture for good/high online learning is not natural and does not just happen. Students need to go through a process of habituation that may continue for months or even years. Online study habits enrich the online learning experience, so that students are better prepared to study online. The lack of e-learning implementation in Indonesian tertiary institutions causes the online learning culture of Indonesian students to remain at a low level.

With regard to the influence of regions, Blankenship and Atkinson [48] found no significant differences in the self-management of learning and comfort with non-face-to-face communication between students who live in cities and rural areas. Likewise, in a study conducted by Thakkar and Joshi [69], the authors found no significant differences in e-learning attitudes between rural and urban students. However, a survey conducted by Elnakeeb and Khalifa [70] found that students who lived in urban areas had higher computer/internet self-efficacy and higher efficiency in online communication than those living in rural areas. Asfar and Zainuddin [71] also found that students from urban areas tended to be more independent in learning than those from rural areas.

This research is different from previous studies of student preparedness. In an earlier study, a survey was carried out on student respondents who had undergone online lectures for some time, both fully online and blended. In contrast to this earlier study, in our present study the questionnaire was given to students who had never undertaken online lectures, neither fully online nor blended. In connection with the emergence of the COVID-19 pandemic, each campus issued a policy on online learning. Our survey was conducted at the beginning of the pandemic. Many students were suddenly confronted with a distance learning environment and did not yet have much experience attending online lectures.

3. Method

3.1. Context of the Study

This study used a cross-sectional quantitative survey method. The questionnaires were distributed online and lecturers in West Java and Banten, Indonesia, were contacted to distribute the questionnaire links among their students. The provinces of West Java and Banten, Indonesia, were chosen as they have a higher number of tertiary institutions and students than other provinces [72]. Besides the tertiary institutions in the West Java and Banten provinces, they have diverse e-learning cultures, from high to low levels of e-learning culture [72]. The questionnaire was available for students online for two weeks, from 22 March 2020 to 5 April 2020, and was filled out by 482 students from 22 universities with various fields of study in West Java and Banten, Indonesia. Participation was voluntary and anonymous. The demographic profiles of the participants are illustrated in Table 1.

3.2. Instrumentation

The questionnaire used was the e-learning competencies scale developed by Parkes and Reading [17], which was adapted by Junus et al. [21]. There are 58 items in three dimensions as follows:

1. E-Learning management and e-learning environment, 24 items.
2. Interaction with teaching materials, 13 items.
3. Interaction with e-learning community, 21 items.

Table 1. Demographic characteristics of participants.

Category	Total	Percentage (%)
Gender		
Male	336	69.71
Female	146	30.29
Level of e-learning culture at the university		
High	117	24.27
Middle	57	11.83
Low	308	63.90
Field of study		
Economics	30	6.22
Sociology, politics, and humanities (SPH)	17	3.53
Education	10	2.07
Engineering	397	82.37
Health	28	5.81
Region		
Urban	286	59.34
Rural	196	40.66
Year of study		
First year	78	16.18
Second year	114	23.65
Third year	241	50.00
Four year	49	10.17
Age		
18 years and below	31	6.43
19 years	130	26.97
20 years	136	28.22
21 years	97	20.12
22 years	51	10.58
23 years	24	4.95
24 years and above	13	2.70

Responses to all items used a five-point Likert scale, from very poorly prepared (1) to very ready (5). Only one answer was allowed per item. We used the Rasch measurement model software WINSTEPS, version 3.90.2, to determine the instrument's validity and reliability. The Rasch model analysis was used because it is a powerful assessment tool for overcoming the circular dependence observed in classical test theory [73]. The Rasch model can provide objective measurements in a variety of settings [73,74]. Rasch analysis can calibrate item difficulty and person ability simultaneously through residual analysis [73]. In this study, we visualized the possibility of answering questions correctly or supporting statements through the item characteristic curve (ICC), the test information function (TIF), and the differential item functioning. WINSTEPS software transforms raw data (Likert-type data) of item difficulties and person abilities mathematically. The internal reliability scores shown in Table 2 refer to the fit statistics that determine the overall quality of the EC scale.

Table 2. Reliability of item and person.

	Mean Logit	Standard Deviation	Separation	Reliability	Cronbach's Alpha
Item	0.00	0.41	5.98	0.97	
Person	0.99	1.20	5.33	0.97	0.97

Based on Table 2, the item reliability index (0.97) was classified as "excellent" [75]. This index shows that the respondents responded well to the items given, or, in other words, the items were able to define the dimension variables very well. Item separation shows how important an item is in determining issues that are easy (very ready) and severe

(less ready). The value of item separation (5.98) indicates that the questionnaire items could group student readiness in learning online.

The person reliability index (0.97) indicated that the consistency of responses from respondents was "excellent" [75]. This index means that the EC scale could discriminate between respondents very well. The person separation value was (5.33), rounded up to 5. The strata person value was 7, reflecting mixed ability, which indicates the representation of the strength of students taking the test. The Cronbach's alpha index (0.97) was classified as "excellent". This index shows that the interaction between 482 respondents and 58 items was high. We can say that this measurement scale is an instrument with high reliability because it has perfect internal consistency [47]. We can also see the high interaction from the item fit curve in Figure 1. The curve shows that the level of item suitability for empirical data was appropriate, based on items that were fit to the model (red line). However, there were two items of misfit seen from point x that were not on the ideal line curve (red line). An item may "misfit" if there is an inconsistency in the respondent's answer [75]. This is because the item is very easy (very negative logit score) or complicated (logit score is too large) [75]. Therefore, these two items had to be reviewed.

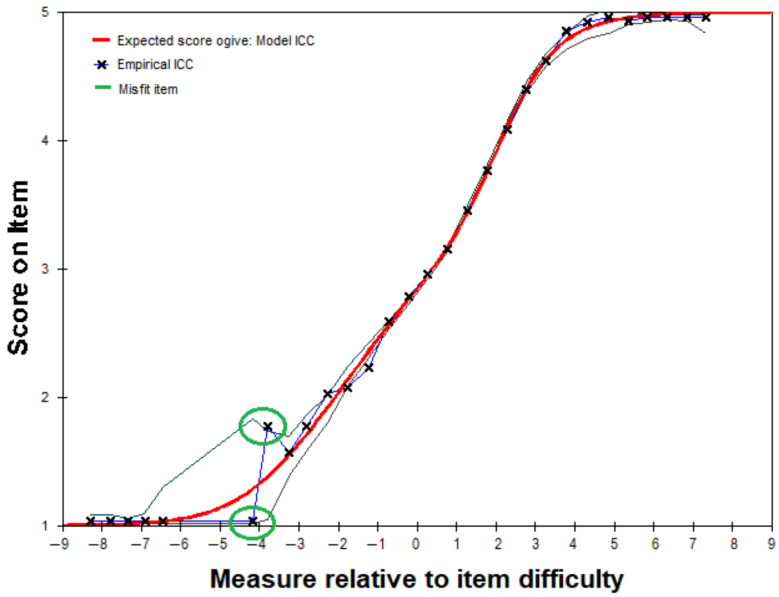

Figure 1. Expected score item characteristic curve (ICC). Every student has online learning readiness. Each online learning readiness is grouped into readiness ranges. Within each readiness range, one marker is plotted. The x-axis represents the average readiness of the students in that range. If there are no students, there is no marker. The y-axis represents the average of the responses scored by the students.

4. Results

This section presents the findings based on the Rasch analysis. First, student readiness for blended learning was analyzed. The overall findings indicate that students were ready to study online. Furthermore, we used DIF analysis to identify responses based on student demographic profiles (i.e., the academic year at university, fields of study, e-learning university culture, gender, and region). The DIF analysis informs various responses based on demographic groups' characteristics, the most appropriate analytical method for this study [47]. The findings presented in the next paragraph answer the research questions.

Based on Table 3, the mean value was above 0.00 logit and was in the range of 0.5 to 1.5, which means that the random size had excellent conditions, so the items were neither too easy nor too difficult. The standard deviation (SD) values were appropriate overall, and each dimension was in the range of −1.9 to 1.9, which means the data had a logical estimate (the data were ordered by model). We can conclude that, overall, students were ready to study online.

Table 3. Results for student online learning readiness.

	Mean	Standard Deviation
E-learning competencies (overall)	+0.99	1.20
E-learning management and e-learning environment	+0.96	1.36
Interaction with teaching materials	+0.98	1.43
Interaction with e-learning community	+1.29	1.56

The information function graph in Figure 2 shows two peaks of optimal information obtained for individuals with less preparedness and for more prepared individuals. Some individuals were less ready (negative peaks) to learn online, but more students were ready to undertake online learning (positive peaks).

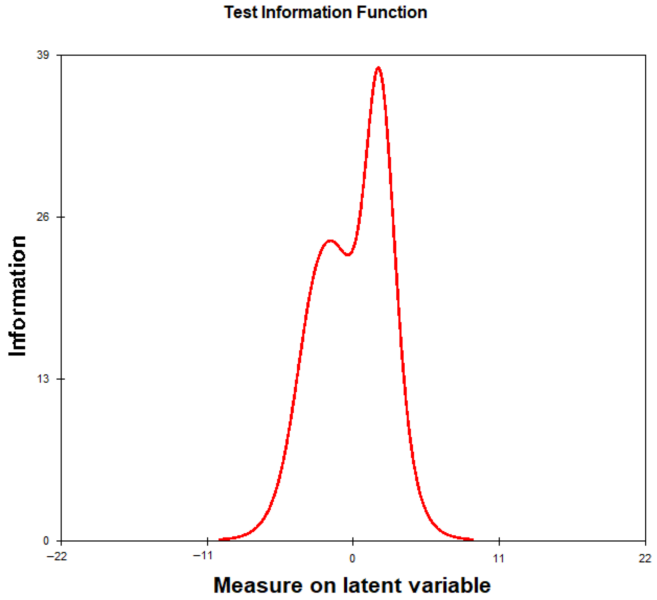

Figure 2. Test information function.

We also checked the suitability of items from this instrument. According to Boone et al. [76] in [75], there are three criteria that can be used to assess the suitability of an item:

- The outfit mean square (MNSQ) value is in the range $0.5 < \text{MNSQ} < 1.5$.
  Using this first requirement, two items were misfit, namely item A6 (learning/working in a disciplined and scheduled manner) and item B3 (presenting content in various formats (video, audio, etc.)). The outfit MNSQ values for the two items were 1.82 and 1.52.
- The outfit z-standard (ZSTD) value is in the range $-2.0 < \text{ZSTD} < +2.0$.
  The ZSTD value is greatly affected by sample size. In this study, the sample size was large enough that the ZSTD value was always above 3. Therefore, this condition was not used as a reference in this study.
- The point mean correlation (Pt Mean Corr) value is in the range $0.4 < \text{Pt Mean Corr} < 0.85$.
  The instrument met the third requirement, there being no items that had a Pt Mean Corr value under 0.4 or over 0.85. All items were eligible to be used for measurement.

The differences in readiness for learning online for students' academic year at university, the field of study, the level of e-learning culture at the university, gender, and region were analyzed using DIF analysis. The analysis for each demographic category mentioned above is described in the next paragraph.

Figure 3 illustrates the DIF plot based on student year of study. The DIF plot identified six items that have significant differences ($p > 0.05$). Items A1 (uploading/downloading

information and learning resources) and A7 (adapting to learning styles that fit the e-learning environment) show that the first-year students had better abilities than those in the second, third, and fourth years of study. Based on item A15 (making a priority scale in doing assignments that must be completed simultaneously), fourth-year students could prioritize tasks better compared to lower-level students. For items A4 (integrating various software applications to create a product) and B3 (presenting content in multiple formats (video, audio, etc.)), first-year and second-year students were better able to integrate various applications and present content in multiple formats. However, they were less able to manage their time to attend online classes regularly (item C17) compared to third-year and fourth-year students.

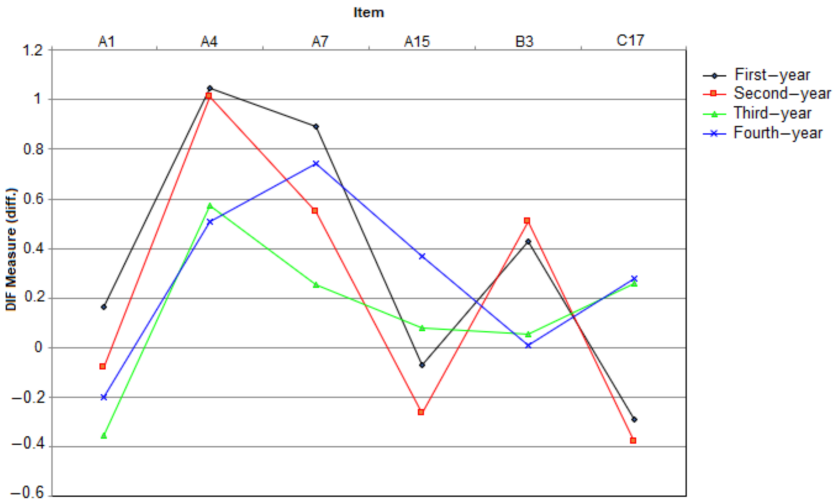

Figure 3. Person DIF plot according to student academic years of college.

The DIF plot based on the student field of study in Figure 4 identifies ten items with significant differences ($p > 0.05$). In item A2 (using search engines effectively), students in the health field can better use a capable search engine compared to students from other areas of study. In item A4, A5, and C17, students in economics were better able to integrate various software applications (item A4), use technology for understanding the formation of knowledge (item A5), and manage time (item C17) compared to students in other study fields. In item A13 (doing work independently), students in economics and engineering were more self-reliant than the students in other areas of study. In item A19 (doing appropriate strategic planning to complete the task), students in the SPH field were less able to make strategic plans than students in other study fields. However, students in the SPH fields can collaborate collaboratively to form knowledge (item C7). They do more willing to have their ideas discussed and criticized (item C8) than students in another field. In item A20 (evaluating yourself as a positive learner), the students in the education field think more positively in self-assessment than those in other study fields. However, students in the education field make less effort to initiate interaction with other members in the learning community (item C20) than other fields.

Figure 5 depicts the DIF plot for the university e-learning culture level. The DIF plot shows 11 items that had significant differences ($p > 0.05$). For item A1 (uploading/downloading information and learning resources), students with high and medium levels of university e-learning culture were more capable than students with low levels of university e-learning culture. However, students with a low-level e-learning culture could implement problem-solving strategies (item A14). They were better able to respond responsibly to other participants (item C1) and arrange a time to attend online classes regularly (item C17). Students with high levels of e-learning culture were more ready to study/work in a disciplined and scheduled manner (item A6) than students with medium and low university e-learning culture levels. This student group was also more autonomous in

doing their assignments (item A13), more prepared to present content in various formats (video, audio, etc.) (item B3), and more ready to collaborate to form knowledge (item C7). Students with a moderate level of university e-learning culture had a better ability to adapt to learning styles appropriate to the e-learning environment (item A7). They were better at showing/demonstrating knowledge through LMSs (item A12) and associating previous and new learned experiences (item B1).

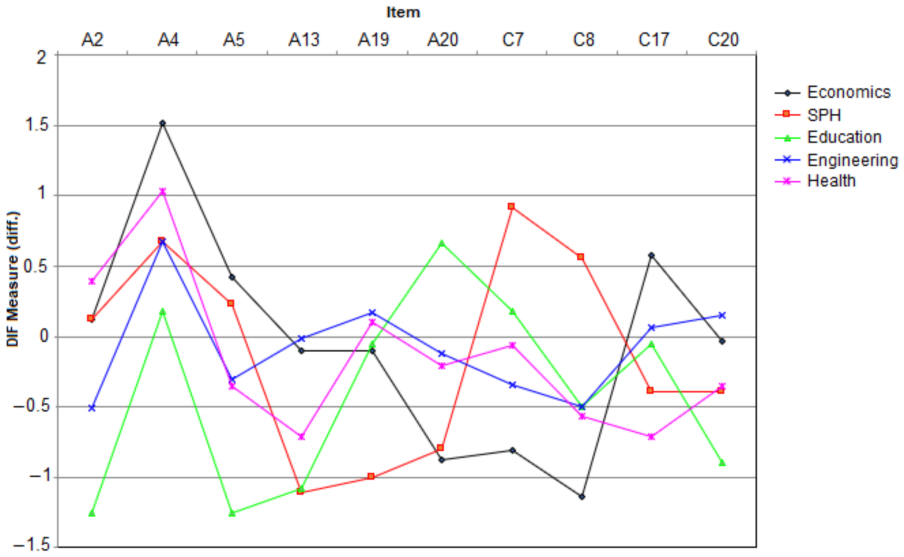

Figure 4. Person differential item functioning (DIF) plot according to student field of study.

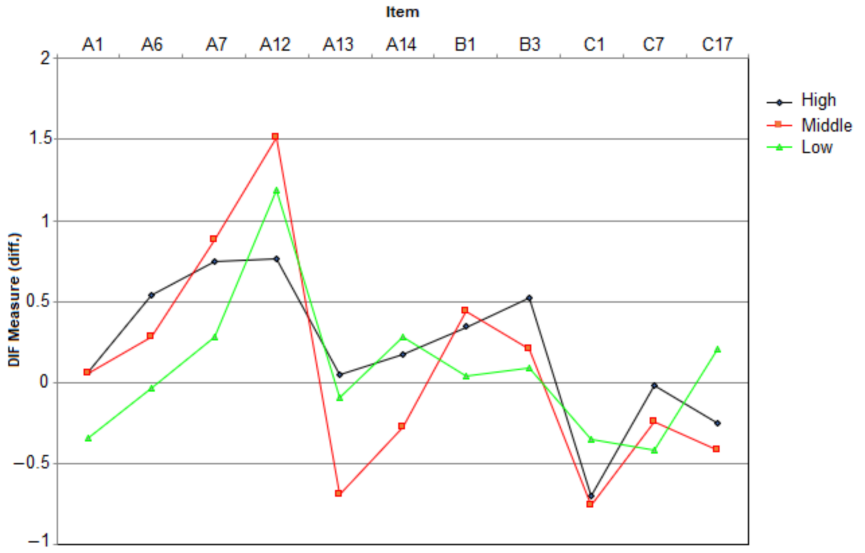

Figure 5. Person DIF plot according to university e-learning culture level.

In Figure 6, the DIF plot shows four items that had significant differences ($p > 0.05$) based on gender. For items A18 (applying logical steps to solve problems related to computer use), B12 (looking for information outside (not limited to online communities and available technology)), and C8 (willing to have their ideas challenged), female students had higher skills than male students. However, for item C17 (managing time to attend online classes regularly), male students could manage their time better than female students. Female students were more open-minded and organized, whereas male students had advantages in time management.

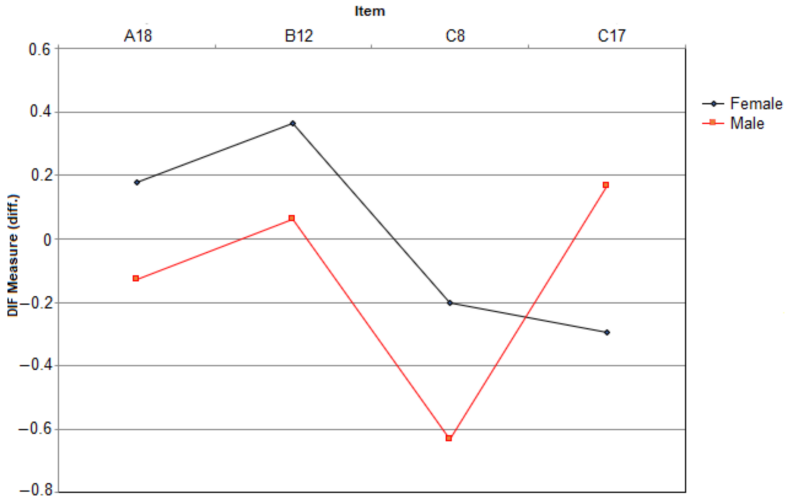

Figure 6. Person DIF plot according to student gender.

The DIF plot for the regions where students studied online is illustrated in Figure 7. The DIF plot identified four items as having significant differences ($p > 0.05$). Students who lived in rural areas were better at uploading/downloading information and learning resources (item A1) than students who lived in urban areas. This student group was also better able to work collaboratively to form knowledge (item C7) and contribute by proposing new ideas in discussions (item C10). Meanwhile, groups of students who lived in urban areas responded better to other participants (item C1) than those living in rural areas. The results reveal that living in rural areas did not dampen students' enthusiasm to learn online independently and collaboratively.

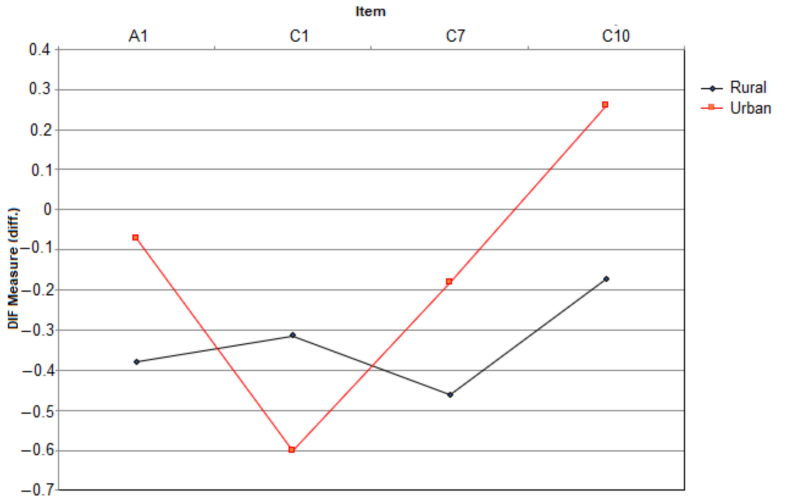

Figure 7. Person DIF plot according to student region.

5. Findings and Discussion

This study aimed to investigate the level of student readiness to learn online during a pandemic in Indonesia. Furthermore, this study assessed significant differences in student preparedness in online learning based on the academic year at university, the field of study, the level of e-learning culture at the university, gender, and region. The results show that some individuals were still less ready to learn online, even though more students were prepared to engage in online learning. Based on the questionnaire results, the obstacles students often experienced in learning online were the internet network, laziness, and discomfort following online meetings. Also, it took a while to understand the material described and there was interference from the surrounding environment. We recommend

that lecturers anticipate learning methods by increasing asynchronous activities over synchronous activities.

The DIF analysis shows significant differences for the demographic profiles of student online learning readiness. Demographic profiles were analyzed based on the year of study, field of study, the level of e-learning culture at the university, gender, and region. With regard to the students' academic year, the results of this study revealed that each group across the four years encountered obstacles in online learning readiness. First-year students had the advantage in accessing information and learning resources and adapting to learning styles in the e-learning environment. First- and second-year students could integrate various applications and present content in multiple formats. Third- and fourth-year students were more disciplined in managing their time to attend online classes. Fourth-year students were better able to make a priority scale for doing assignments that had to be completed simultaneously. Based on these findings, first- and second-year students' ability to access learning resources and adapt proves that they were passionate about learning new things. Therefore, we recommend that lecturers provide various learning resources and present interactive content [77] for the first- and second-year students to maintain students' enthusiasm. For students in years three and four, it is necessary to analyze whether students' discipline in managing time affects learning quality. Lecturers need to optimize their teaching time with learning activities to increase student creativity and understanding [78,79].

With regard to students' field of study, the study results revealed that students from all groups in education had no difficulty in interacting with teaching material. However, there were significant differences in management and the e-learning environment and interactions with the e-learning community. Students from the health sciences were better able to use search engines effectively. Students from the economics group could better use and integrate various applications and technologies and manage their time. Students from the economics and engineering fields were more independent in conducting online learning activities. Students from the sociology, politics, and humanities course could collaborate to shape new knowledge and were more willing to have their ideas challenged. However, this group of students could not make strategic plans related to completing assignments in learning. Students from the education sciences had positive thoughts in self-assessment but made less effort to initiate interactions with other members of the learning community. According to previous studies, metacognitive scaffolding can support planning, monitoring, and self-evaluation during the completion of learning tasks [80–82]. We recommend that lecturers provide metacognitive scaffolding assistance [83] to help students make strategic plans to complete their learning assignments. Additionally, we suggest that lecturers add collaborative learning activities to enhance interaction skills in the learning community. This recommendation is based on Laal and Ghodsi's [84] statement that collaborative learning can improve social competence.

With regard to organizational culture in e-learning, the study results revealed 11 items with significant differences. Students from universities with a high level of e-learning culture were more disciplined and had better schedules. This student group was also more independent in completing assignments while working collaboratively to form new knowledge. This student group was also better able to present content in various formats. Students from universities with high and medium levels of e-learning culture could better access information and learning resources. Students from universities with a moderate level of e-learning culture could better adapt to learning styles in an online learning environment. They could better interpret their knowledge through LMSs and were better able to associate their prior experience and the knowledge they had just learned. Students from universities with a low level of e-learning culture could respond responsibly to comments from other discussion participants and better manage their time to attend online classes. Based on these findings, a higher level of e-learning culture in a university provides the ability to adapt to learning styles in an online learning environment and be more independent in

learning. We recommend that virtual learning should be given greater attention than face-to-face learning or that blended learning should be used.

From the student gender perspective, there were significant differences between female and male students. Female students could better implement logical steps to solve problems, search for information without being limited to the online community, and were more willing to have their ideas challenged. Male students were better able to manage time to attend online classes. In accordance with these findings, we recommend that lecturers provide collaborative learning with heterogeneous groupings [85,86] of women and men. These groupings would allow students to help each other so that each member's shortcomings, both male and female, could be minimized.

From the perspective of student regions, there were significant differences between students who lived in urban areas and those living in rural areas. Students who lived in rural areas could access information and learning resources, collaborate to form knowledge, and contribute better by proposing new ideas in online discussions. On the other hand, students who lived in urban areas could respond responsibly to comments in online reviews. This reveals that the enthusiasm to study online, both independently and collaboratively, of rural students is not dampened by their location. The results follow Cjeda, Prieba et al., Philpott et al., and Renes and Strange in [87], who clarified that students from rural areas have a strong desire to learn and complete higher education. A previous study conducted by the authors of the current study [83] recommend that lecturers provide motivation scaffolding assistance to manage student motivation to study online until the end of the semester.

6. Conclusions

After 20 years, several Indonesian researchers in online learning are still struggling to advance Indonesian education by implementing distance education. The COVID-19 pandemic finally provided the momentum for the growth of online learning in Indonesia at all educational levels. In this pandemic, the application of online learning is inevitable. However, this has not been accompanied by student readiness to engage in online learning.

The results of this study reveal the level of students' e-learning readiness during the pandemic in Indonesia, showing the importance of familiarizing students with online learning activities—studying online needs to become a new organizational culture in higher education. Developing an e-learning culture is essential because, in the DIF analysis, this demographic factor showed the most prominent significant differences. In addition to the organizational culture of e-learning at the university, there were also substantial differences in other demographic factors—namely, the field of study, students' academic year at the university, region, and gender.

To improve students' online learning readiness, we recommend several improvements that should be prepared by lecturers: (1) preparing various learning resources, presenting interactive content, and optimizing teaching time with learning activities to increase creativity and understanding; (2) providing metacognitive scaffolding support to help students design strategic plans for task completion; (3) adding collaborative learning activities with heterogeneous groups; and (4) providing motivation scaffolding assistance to manage student motivation. With regard to theory, we suggest revisiting items and adjusting them to conditions in Indonesia to avoid confusion among students in responding to questions.

Apart from those findings, this study also has limitations. First, this research did not cover all universities in Indonesia. Out of the 4741 tertiary institutions in Indonesia, students from only 22 tertiary institutions in West Java and Banten, Indonesia, participated. Therefore, future studies need to cover all tertiary institutions in Indonesia to get a larger sample size so that the data can be grouped in more detail. Also, it is essential to note the readiness of online learning in terms of lecturers and campus management. Second, this research did not discuss the level of internet connectivity in each region. The regions considered in this study were only rural and urban. Future studies with a larger sample size could expand the region data. Furthermore, it is necessary to specify the level of

internet connectivity in terms of students' economic backgrounds and the infrastructure they must access.

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