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A study of the readiness of post-pandemic computer-based four-tier diagnostic test (CBFTDT): A review of economic level, school grades, and device accessibility

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ABSTRACT

Student readiness for using computer-based assessment was affected by economic level, school grade, and device accessibility. This study analyzed student readiness using a computer-based assessment, the four-tier diagnostic test (CBFTDT). The data in this study were students' responses to a questionnaire consisting of 16 statements about three aspects: mental access, skill access, and usage. The questionnaire consists of 16 statements with three aspects: items, media, and effectivity. The questionnaire was proved valid by experts and its estimated reliability score was 0.99. This study proved that the Student is still not ready to use the computer-based assessment, with an average readiness of 60%. In addition, there is no effect of economic level, school grade, and device accessibility on the readiness for using the computer-based assessment. Hence, the treatment of all stockholders is needed to prepare students to use the computer-based assessment.

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INTRODUCTION

The implementation of the computer-based test (CBT) to assess the examinee's ability has been proven with many conveniences (Dolan et al., 2005; Lim et al., 2006). The CBT has several advantages, i.e., accuracy, efficiency, effectiveness, and more straightforward test implementation (Ferdiansyah, 2016; van Lent & Global, 2009; Yu & Iwashita, 2021). In addition, the assessment using CBT is also proven to decrease fraud because students face the system without tolerance (Jamaluddin et al., 2015; Kikusawa et al., 2006; Nwoke et al., 2017). Moreover, some systems of CBT give punishment to students who try cheating.

The invention of CBT is growing along with the popularity of digital learning. Nowadays, there are so many types of CBT with functions such as, i.e., diagnostic tests (Ahmad et al., 2010; Alderson & Huhta, 2005; Berner et al., 1994; Maulidiansyah et al., 2021), formative tests (Peat & Franklin, 2002; Rudland et al., 2011; Tomasik et al., 2018; van Groen & Eggen, 2019), summative tests (Johan & Supardi, 2015; Pramadya & Indriati, 2019; Syathroh et al., 2018), and selec-

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tion test (Martinussen et al., 2004; Potosky & Bobko, 1997; Wiechmann & Ryan, 2003) that are developed using sophisticated technology.

Computer-based four-tier diagnostic test (CBFTDT) is a type of CBT developed to diagnose student ability using the four-tier test. CBFTDT has been developed to facilitate teachers and students to conduct the four-tier test more easily, effectively, and efficiently. In CBFTDT, teachers can initially input the items and analysis guidelines. After that, the system will analyze all students' answers according to the guideline and calculate the student's abilities.

In terms of measurement, CBT is helpful. However, most researchers have not considered the factor of student readiness to use CBT. The student should be prepared to use a computer before they use computer-based tests (Arcelay et al., 2021; Infante-Moro et al., 2019; Kaarakainen, 2019; Massoud, 1991). Hence, apart from focusing on technology development, aspects of student readiness also need consideration.

The study of student readiness to use CBT the most assumption that Gen Z and post-gen Z are literate with technology. However, studies show that students are proficient only in using gadgets, especially smartphones, for entertainment, games, and social network services (Cha & Seo, 2018; Dhiman, 2021; Kumar & Sherkhane, 2018; Pratama et al., 2020; Singh & Samah, 2018; Wardhani, 2018; Widodo & Wartoyo, 2020). In addition, another study also proved that students, even though they come from Gen Z and post-gen Z, are still not fluent in using computers (Auxier & Anderson, 2020). The student dominates using the smartphone, while the broader scope of computer use is more massive, especially in assessment.

Student readiness to use CBT determines the success of the measurement process. Furthermore, once the system is unfamiliar, the students will be confused and upset about the assessment process (Emine & Kalelioglu, 2019; Reyes et al., 2021; Tang et al., 2021). Especially in the assessment context, student readiness to use the device, the hardware, and the software can be determined by the measurement accuracy. Since the student is not ready to use the system, the measurement process could be biased, primarily when trouble occurs.

The analysis of student readiness is functional for stockholders to consider when making a policy. Knowing the students' readiness, the stockholders can design the next step to optimize the facility and school programs (Chorrojprasert, 2020; Stockwell, 2008). The readiness analysis focuses not on school facilities but the student's ability and mental (Chan, 2001; Lestari et al., 2016). Generally, three factors contribute to student readiness to use CBT, i.e., economic level, school grade, and device accessibility.

The economic level contributes to the quality of life. Students from a high economic level will have better access to education. In other conditions, students with a high economic background will get a better support system (Amanor-Mfoafo et al., 2020; George-Jackson & Gast, 2015). Hence, hypothetically, it can be stated that the higher the student's economic background, the more prepared students are to adapt to using CBT.

The next factor is school grades. It cannot be denied that every student wants to enter a high-school grade to get a better education. The empirical studies also show that high-school grades are more innovative in implementing learning, especially in the optimal use of facilities. In contrast, in schools with low grades, many studies have shown that the weaknesses of learning are the lack of optimizing learning facilities (Martin et al., 2020; Rafique et al., 2021).

Finally, device accessibility is the technical aspect affecting student readiness for computer-based assessment. Access to digital devices follows the economic aspects, where a student with a higher economic aspect tends to find it easier to access electronic devices, i.e., smartphones, laptops, computers, and computer tablets. Conversely, students without digital devices have trouble using computer-based assessments (Händel et al., 2020; van Rooij & Zirkle, 2016). Hence, the readiness to use computer-based assessment is also affected by digital device accessibility. Therefore, the research questions that are the subject of this study are as follows.

RQ1: How does the economic background affect student readiness for using the computer-based assessment?

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RQ2: How does the school grade (school contribution) affect the student's readiness to use the computer-based assessment?
RQ3: How does the device accessibility affect student readiness to use the computer-based assessment?

RESEARCH METHOD

Instruments

This study analyzed student readiness for using CBFTDT as the computer-based assessment. The data were collected using a questionnaire from students from five districts in the Special Region of Yogyakarta. The items have been developed by Zakwandi (2022) and Dray et al. (2011) with three aspects: item quality (mental access), media quality (skill access), and the effectiveness of measurement (usage). There are 16 items whose distribution is presented in Table 1.

Table 1. The Instruments

No.	Source	Item	Subscale within Factors
1.	Item Quality	1, 2, 3	Mental access
2.	CBT Media Quality	4, 5, 6, 7	Skill access
3.	Measurement Effectiveness	8, 9, 10, 11, 12, 13, 14, 15, 16	Usage

The experts analyzed and judged the instrument with a final score of CVI 0.96. In addition, the instrument was also analyzed empirically using the Rasch approach, with the result provided in Table 2.

Table 2. The Instrument Quality

No.	Aspects	Item
1.	Reliability of Estimates	0.99
2.	Infit Mean Square (SD)	0.99 (0.25)
3.	Outfit Mean Square (SD)	0.98 (0.30)
4.	Chi-Square (d.f. p)	13531.71 (0.0000)
5.	Global Root-Mean-Square Residual	0.5310
6.	Cronbach Alpha (Kr-20) Person Raw Score "Test" Reliability	0.86
7.	Separation (Strata-Separation)	2.31 (3.41)

Table 1 and Table 2 indicate the quality of the instrument both in content and empiric. Hence, it can be concluded that the instrument is good at examining student readiness. The instrument's reliability, with a score of 0.99, indicates that the instrument was consistent in measuring student liability with a high interpretation (Fisher, 2007). In addition, the FIT statistic model was shown by the Infit MnSq score of 0.99 ($0.77 \leq x \leq 1.33$), Outfit MnSq 0.94 ($0.50 \leq x \leq 1.50$), and Chi-Square (d.f.p) of 0.00 that proved the student response was fit with the Rasch model (Fisher, 2007; Linacre, 2006). Finally, the strata separation score showed the instruments' ability to group the student readiness with $3.41 \approx 4$ groups. Therefore, it can be concluded that the instrument was feasible to use in measuring student readiness.

Sample

This study was carried out in all districts in Yogyakarta Special Region. Ten public high schools participated in this study, representing three different grades: high grade (three schools), middle grade (four schools), and low grade (three schools). The classification was on the data from https://top-1000-sekolah.ltmpt.ac.id/. After that, the student as the sample was selected randomly, considering the sampling adequacy. The demography of the sample is presented in Table 3.

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Table 3. Sample Demography

No.	Aspects	Region														
		I			II			III			IV			V		
	School Grade	High	Middle	Low	High	Middle	Low	High	Middle	Low	High	Middle	Low	High	Middle	Low
1.	Gender															
	Boys	18	20	-	24	-	19	18	30	-	-	19	19	-	15	12
	Girls	32	23	-	42	-	40	54	55	-	-	41	26	-	72	21
2.	Ages (year)															
	< 15	4	1	-	4	-	-	5	5	-	-	-	2	-	1	-
	15 - 16	41	41	-	51	-	50	58	69	-	-	56	40	-	45	25
	16 - 17	5	1	-	11	-	9	9	11	-	-	4	3	-	5	8
3.	Location															
	Village	18	19	-	41	-	50	22	32	-	-	31	41	-	17	16
	City	32	24	-	25	-	9	44	53	-	-	29	4	-	34	17
4.	Economic Status															
	High Class	3	3	-	4	-	2	5	8	-	-	6	8	-	6	3
	Middle Class	46	40	-	62	-	56	64	77	-	-	53	37	-	45	30
	Low Class	1	-	-	-	-	1	3	-	-	-	1	-	-	-	-
5.	Device Accessibility															
	Phone	19	13	-	30	-	36	37	37	-	-	31	24	-	26	15
	Tablet	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Laptop/ Computer	3	1	-	-	-	-	-	-	-	-	1	-	-	2	-
	Phone & Computer Tablet	1	-	-	1	-	1	1	1	-	-	-	1	-	-	-
	Phone & Laptop/ Computer	24	25	-	35	-	19	33	42	-	-	26	19	-	21	18
	Computer Tablet & Laptop/ Computer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Have none	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Have all	2	4	-	-	-	3	1	5	-	-	2	1	-	2	-

Data Analysis

The data in this study are student responses of the readiness to use CBFTDT. The data were tabulated and analyzed using the Rasch model to obtain student liability. The student liability, presented by θ, was recalculated to provide a general scoring format on a 100-point scale. Furthermore, the score was analyzed using descriptive and inferential statistics to evaluate all factors that affect student readiness to use CBFTDT as the computer-based assessment. The statistical analysis used the non-parametric approach since the data was not normally distributed.

FINDINGS AND DISCUSSION

Findings

Student readiness to use the computer-based assessment, like CBFTDT, determines the success of the measurement process. Indeed, those who are not ready or not accustomed can make a mistake causing a bias in measurement. This study analyses three most decisive aspects affecting student readiness for computer-based assessment and digital learning transformation.

The Effect of Economic Level

The socio-economic level has proven to have an impact on educational quality. In general, there are three groups of socio-economic levels in society: high, middle, and low levels. This study provides unusual results where students at all economic levels are ready to use the computer-based assessment at the same level. Figure 1 shows the summary of student responses.

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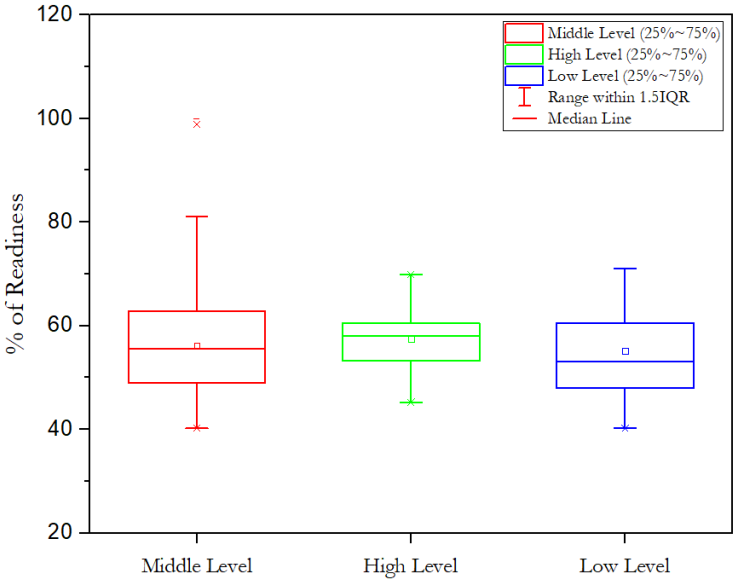

Figure 1. Box Plot for Student Readiness Based on Economic Level

Figure 1 shows the % of readiness on the same scale. Students from high economic level % of readiness of 57.47 with a std. error of 3.33. Then, in the middle level of 56.22 with a std. error of 0.48 and a low level of 55.20 with a std. error of 1.66. These scores show that there is no significant difference in % of readiness.

Another result is finding about student confidence to use the computer-based assessment. The students with the middle economic level are more enthusiastic than those with the other level, with the highest % of readiness reaching 80%. This result is outside the expectation because the high-level economic student is more likely to be ready to use the computer-based assessment.

Differences in the average scores of students' readiness were also confirmed through inferential statistical analysis in Table 4. Table 4 shows that students' readiness did not significantly differ regarding economic status. This conclusion is based on a relatively large significance value of 0.092 > 0.05. Moreover, multiple comparisons also show that in each cluster, students' readiness does not show significantly different scores. These results are presented in Table 5.

Table 4. Analysis of Student Readiness Based on Economic Level

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.051	2	.025	.169	0.920
Within Groups	84.516	561	.151		

Table 5. LSD Multiple Comparison for Student Readiness Based on Economic Level

(I) Economic Status	(J) Economic Status	Mean Difference (I-J)	Std. Error	Sig.
High Level	Middle Level	1.2433	4.46946	0.781
Middle Level	Low Level	1.0212	1.64324	0.535
Low Level	High Level	-2.2646	4.71293	0.631

The Effect of School Grade

Besides economic factors, student readiness to use computer-based assessment is also affected by school readiness. A school that actively prepares students to learn using a computer with proper facilities will help students to use computer-based assessment. In this case, we try to analyze the readiness of students in the three levels groups based on the achievement of high SBMPTN scores. The initial result is shown in Figure 2.

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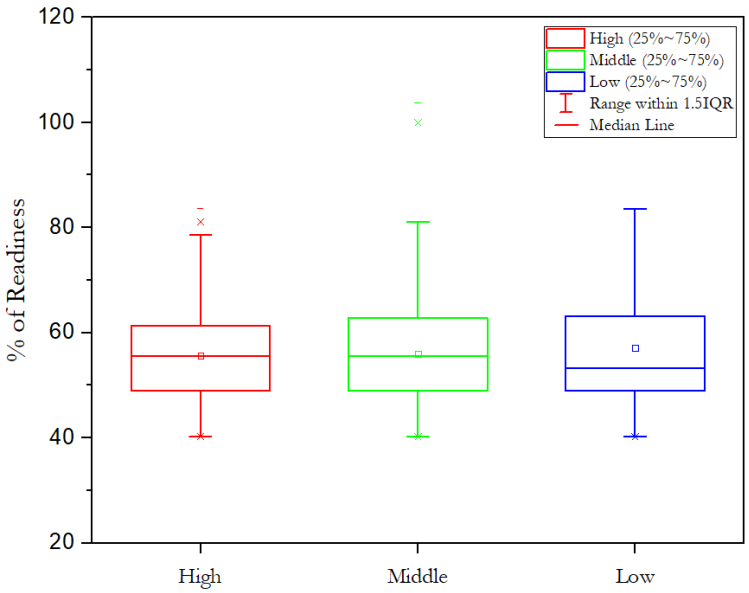

Figure 2. Box Plot for Student Readiness Based on School Grade

Figure 2 shows that students' readiness to take computer-based assessments is also low (below 60%). This finding shows that at the three school levels, % readiness has a relatively similar pattern in the 40% to 80% range. The academic qualifications of the three levels of this school are drastically different. This finding needs to be a joint thought that the development of learning in the digital realm is still not accompanied by the preparation of user qualifications, especially for students who will use these innovative products. The results of statistical tests with sig also prove % readiness, which is relatively the same, being 0.411, or there is no significant difference, as shown in Table 6.

Table 6. Student Readiness Based on School Grade

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	207.172	2	103.586	0.890	0.411
Within Groups	65304.018	561	116.406		

The significance value in Table 6 is confirmed by multiple comparison values for each school grade, as shown in Table 7. Based on Table 7, the difference in mean scores is only in the range of 0.41 to 1.58, indicating no difference. With sig., which is greater than 0.05, it can be concluded that there is no significant difference among the three classes.

Table 7. LSD Multiple Comparison for Student Readiness Based on School Grade

(I) School Grade	(J) School Grade	Mean Difference (I-J)	Std. Error	Sig.
High Level	Middle Level	-.41243	1.05063	0.695
Middle Level	Low Level	-1.16720	1.15795	0.314
Low Level	High Level	1.57963	1.20928	0.192

The Effect of Device Accessibility

Access to various digital devices has been proven to affect student readiness to participate in the online learning process, especially using CBT. The findings of this study show that all students have gained access to digital devices, at least in the form of smartphones. Some already have other devices, such as computers/laptops and tablets. Student demographics also show that some students have devices commonly used in online learning, including smartphones, tablets, and computers/laptops.

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The results of the device accessibility analysis on students' readiness to take computer-based assessments also vary. The highest readiness is shown by students who have smartphones and tablets. In terms of the assessment range, students with at least a smartphone have shown high readiness to participate in computer-based assessments. The % of readiness shown by students with only smartphones is higher than that shown by students with smartphones and computers. In more detail, these results are shown in Figure 3.

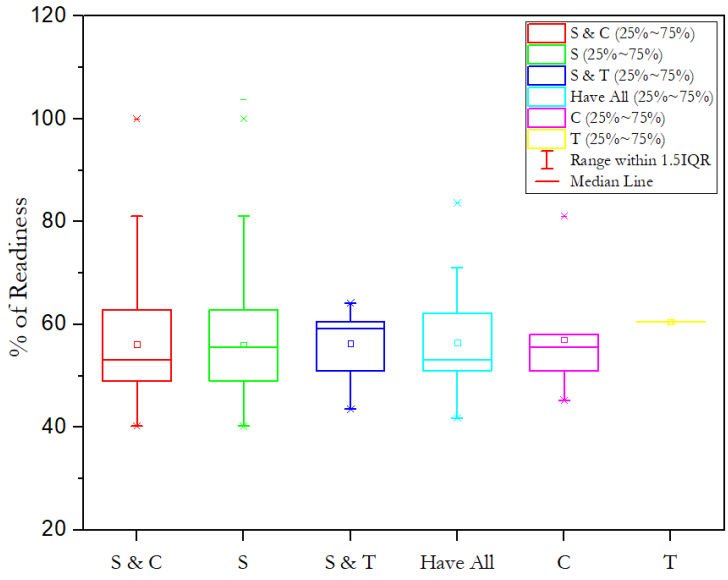

Figure 3. Box Plot for Student Readiness Based on Device Accessibility

Figure 3, besides showing the range of student readiness with various device accessibilities, also shows a relatively low average percentage, which is still below 60%. Students with access to all types of devices show the lowest average readiness compared to other groups of students. This finding refutes the assumption that the more students interact with electronic devices, the more ready they are to participate in online learning. Statistical findings are shown in Table 8 with a sig. 0.998> 0.05, meaning that there is no significant difference.

Table 8. Student Readiness Based on Device Accessibility

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	30.264	5	6.053	0.052	0.998
Within Groups	65480.926	558	117.349		
Total	**65511.190**	**583**			

Discussion

The readiness to carry out a computer-based assessment is based not only on the aspect of facilities but also on other essential aspects, namely the readiness of students to take part in the assessment process (Greiff et al., 2014; Irvin & Macklin, 2007). This study's results indicate that students' overall readiness to take part in computer-based assessments is still low, with an average of below 60%. Computer and internet facilities are sufficient in schools. This fact is an essential finding that students should be familiar with implementing assessments using electronic devices such as computers, laptops, tablets, or smartphones. Therefore, the recommended assessment system is a website compatible with many devices.

The low readiness of students to take part in computer-based assessments is inseparable from the low level of literacy and optimization of the facilities provided (Csapó et al., 2014; Maqableh et al., 2015; Terzis & Economides, 2011; Ukwueze & Uzoagba, 2021). Facts on the

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ground show that most of the learning process in schools still prioritizes the assessment process using paper-based tests. In fact, in tests on a national or international scale, the assessment has fully implemented CBT (Bardini, 2015; Yamamoto et al., 2019). The reason is that students have difficulty using CBT to learn and to use lots of mathematical symbols and pictures. This reason should not be used as a barrier to move because currently there are many conveniences to overcome this problem.

In addition, the results of this study also indicate that, currently, the quality of education in Indonesia is not good, especially in the transformation towards digital era learning. The assumption that initially dominated various circles that the better the economic conditions, the easier it would be for students to adapt was refuted by the fact that at almost every level of the economy, the % of readiness to carry out the electronic mode assessment process was still low. Not only are rural areas often labeled as lagging, but students in urban areas also show a response of unpreparedness. This finding is slightly different from previous studies, which state that the quality of education goes hand in hand with economic growth (Benos & Zotou, 2014; Hanushek & Woessmann, 2010; Tchamyou et al., 2019; Thurow, 1972). Tchamyou et al. (2019) explain that some factors affect the quality of learning when students are ready to participate.

Economic factors concerning students' access to electronic devices also do not increase students' readiness to participate in other assessments using computer-based assessments. Students with access to various electronic devices are believed to be able to increase digital literacy (Olsson et al., 2019; Park & Burford, 2013), which significantly affects the readiness to take part in the assessment using a computer-based assessment (Csapó et al., 2012; Greiff et al., 2014; Irvin & Macklin, 2007). This fact also shows that using electronic devices is not optimal among students and teachers during learning.

The results of this study also show schools' readiness to provide learning experiences to students, especially for carrying out assessments using computer-based tests. This finding indicates that, in general, not all schools have prepared students to be accustomed to using computer-based assessments.

CONCLUSION

The study of student readiness to use CBT should be considered before it is implemented because it relates to the measurement results' accuracy and validity. Students who are ready to take online assessments and learning will find it easier for them to participate. The same thing also applies to the implementation of computer-based assessments. The results of this study indicate that overall, the readiness to participate in computer-based assessments of students in Yogyakarta Special Region is still relatively low. Furthermore, the analysis of the three dominant aspects showed no significant differences in each of the groups analyzed. This result indicates that students in Yogyakarta Special Region need activities/activities/programs that can make them mentally, skillfully, and usage-ready to participate in computer-based learning and assessment. However, this research still requires further research to examine students' mental factors, skills, and usage in computer-based learning and assessment.

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