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Student Readiness on Online Learning in Higher Education: An Empirical Study

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Exposure to Covid-19 is a challenge for universities to implement an online learning system. The development of industrial technology, especially industry 4.0, requires every college graduate to have not only cognitive abilities but also problem-solving abilities. The research was in the mining engineering department, Faculty of Engineering, Universitas Negeri Padang, Indonesia. Therefore, identifying the elements that influence student readiness in online learning will enable universities to establish strategies to improve online learning quality. It is also the goal of this research. This study describes a model that measures student readiness in online learning in 3 dimensions: Self-management of Learning, lecturer quality, and access to technology. Besides, the impact of each construct on student readiness is estimated through the Partial Least Square Structural Equation Model (PLS-SEM). Then to identify the improvements in increasing student readiness, an Important-Performance Map Analysis (IPMA) is needed. From the 157 students, the R2 value was 0.582 (moderate), which affected online learning readiness. In addition, the quality of lectures was 0.351 (weak), and internet access needed to be improved. Thus, it is hoped that learning strategies can be applied to increase student activity in learning.

Keywords: students' readiness, online learning, PLS-SEM, IPMA, higher education

INTRODUCTION

Online learning due to the covid-19 virus outbreak caused various challenges for all education systems, especially universities (Davis & Hadwin, 2021; Hidayat et al., 2021; Husin et al., 2021). Like other educational institutions, universities are determined to continue educating their students and optimizing and maximizing the learning quality, as before covid-19 outbreak. However, routine habits during a pandemic, such as social interaction, face-to-face meetings, connectivity, and other issues, are restricted (Nguyen et al., 2021). This situation is influenced by: the rapid development of communication and information technology in universities, the emergence of demands for readiness and high satisfaction, the increasing level of job competition, and the higher level of

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privatization in universities (Dzimińska et al., 2018). Now, the question is how ready students are for online learning.

Therefore, universities must prepare qualified graduates and enable them to compete well when completing their education in higher education. This competition is also a result of the development of industry 4.0, which requires them not only to have hard but also soft skills, including the ability to solve every problem. Lecturers and students must commit to being open to each other and be able to communicate well in any situation encountered during online learning (Ferri et al., 2020).

In learning applied physics in the mining engineering department of *Universitas Negeri Padang*, students are required to fulfill all planned learning objectives for both theoretical and practical. Practical learning is a proof and test of understanding in theory (Al-Rahmi et al., 2021). During online learning, this face-to-face verification and testing activities cannot be done (Ramos-Morcillo et al., 2020; Souza et al., 2018). Students are led to be able to access other sources of information with today's technological sophistication. One way of obtaining information is by directly witnessing the lecturers conduct experiments in the laboratory through communication media such as YouTube or zoom (Boy et al., 2020). In this way, students can directly interact with lecturers when conducting experiments. Besides, they can immediately find out the activities during practice.

The use of technology platforms in universities, where students and lecturers carry out the teaching and learning process through online learning, must be able to interact and communicate effectively (Alawamleh et al., 2022). Students must be able to manage their learning management, be disciplined, and be actively involved in online learning (Changwong et al., 2018). Self-management and self-direction are keys for students to participate in online learning (Stephen & Rockinson-Szapkiw, 2021; van der Zanden et al., 2021; Zhu & Doo, 2021). Flexibility in online learning requires students to interact with learning resources and materials, independently seeking the information as needed (Rapanta et al., 2020; Shim & Lee, 2020). Self-management ability is expected to support online learning to the fullest. Thus, students will be ready for online learning. The student's initial problem during online learning is internet access. Then, the Indonesian government provides an internet quota for free every month for students to increase readiness for online learning.

Readiness is a condition of being able to react or alert in responding to something (Meeker et al., 2021). Facilities and knowledge of technology are significant in determining readiness for online learning. Online learning can properly run with easy access to information for lecturers and students. Thus, the determinants of student readiness when studying online are self-management on learning activities, lecturer quality, and technology access. In self-management on learning activity, students learn independently according to the plans that have been prepared by themselves (Mai, 2022). The lecturers need to improve their quality during online learning; the time management quality, communication, and learning design (Paliwal & Singh, 2021). Ease of information access will also influence the quality of lecturers in teaching and increase student readiness in online learning (Martin et al., 2020). The purpose of this empirical

study is to find out which variables and items have the most influence on student readiness and can provide improvements in online learning. The theoretical model to determine the constructs that affect students' readiness for online learning is the partial least squares structural equation model (PLS-SEM). In this model, there are five proposed hypotheses:

Hypothesis 1 (H1):Self-management on Learning activities has a positive effect on student readiness

Hypothesis 2 (H2): Quality lecturer has a positive effect on student readiness

Hypothesis 3 (H3): Technology access has a positive effect on student readiness

Hypothesis 4 (H4): Technology access has a positive effect on the quality of lecturers

Hypothesis 5 (H5): Technology access has a positive effect on student readiness through the mediation of lecturer quality

This study is expected positively influence online learning in universities after Covid-19 ends and can use online learning for some learning materials.

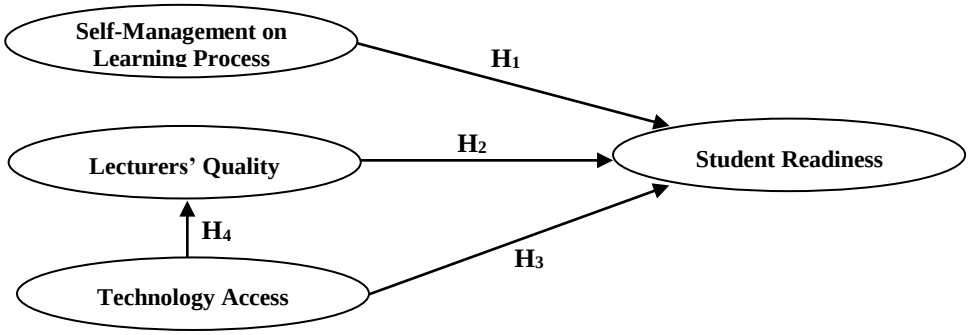

Figure 1
The proposed theoretical model. Source: self-elaboration

After getting the results of the hypothesis, the Important-Performance Map Analysis (IPMA) was carried out to see the possibility of improving indicators and constructs to improve student readiness in online learning. The results of this study can be used for further research to determine other variables that affect student readiness for online learning. Besides, stakeholders such as governments and universities can complete facilities that support online learning.

METHOD

Students' readiness for online learning is measured through a survey designed in January 2022. There are 13 indicators or items from the survey results using a 5-category Likert scale adapted in previous research (Al-Adwan & Khdour, 2000; Jiménez-Bucarey et al., 2021; Yasin & Ong, 2020). These items produce four constructs or dimensions; self-management in learning, lecturer quality, technology access, and student readiness (Table 1). This survey was designed by applied physics course lecturers majoring in mining engineering and learning method experts.

Table 1
Survey

Self-Management of Learning	
SML1	Have high expectations to succeed in learning
SML2	Set study plans and goals independently
SML3	Study according to a self-arranged plan
SML4	Complete tasks and gather information sources independently
Quality Lecturer	
LQ1	The online learning format applied by the lecturer can make students active
LQ2	The learning evaluation applied by the lecturer is sufficient
LQ3	The didactic method applied in online learning makes learning more effective
Technology Access	
TA1	The technology with the most advanced capabilities that I prefer to use
TA2	Can access the internet for a long time
TA3	Have access to a dedicated network connection
Student Readiness	
SR1	Online learning can be done well because you have free time
SR2	Flexibility required (inconvenience of attending conventional classes 2 or 3 times a week to campus)
SR3	Home or work, for a long time, can be used

Online learning is a new way of learning in universities, and its application is not the same as e-learning (Sarker et al., 2019). So the survey was designed and validated by the most relevant people from the application of online learning, such as lecturers as experts in learning methodologies and lecturers of applied physics courses. The sample in this study was all 183 students majoring in mining engineering at the Faculty of Engineering, Universitas Negeri Padang. The students attended Applied Physics lectures. The data obtained in this study are from questionnaires. The questionnaires are then distributed to the 183 students via google Forms and WhatsApp links. However, 157 students (86%) responded (Table 2).

Table 2
Respondent identification

Respondent Characteristics		Frequency	Percent
Gender	Female	31	19.7%
	Male	126	80.3%
	Total	157	100%
Age	<18 years old	27	17.2%
	>18 years old	130	82.8%
	Total	157	100%
Student ID Number	2021	145	92.4%
	>2021	12	7.6%
	Total	157	100%

Table 2 shows 126 respondents (80.3%) are males and 31 (19.7%) are females. This applied physics course is for first-year students. Thus, the number of students under 18 years is 27 people (17.2% and those above 18 years are 130 people (82.8%). The majority of respondents are first-year students. 145 students (92.4%) are students registered in 2021, and 12 students are repeating (under 2021) (7.6%). The data is processed using SmartPLS SEM because the sample size is relatively small, or ten times the number of indicators used (Hair et al., 2011; Hair et al., 2019; Hair et al., 2021).

The Partial Least Squares Structural Equation Model (PLS-SEM) was used to test the proposed hypothesis in the theoretical model. The PLS-SEM results predicted that the construction will have the most influence on students' online learning readiness.

PLS-SEM consists of 2 parts in the estimation process (Boubker & Douayri, 2020; Cepeda-Carrion et al., 2019; Hair et al., 2019; Hair et al., 2021; Suyatno et al., 2022; Ozkok et al., 2019):

Measurement Model Evaluation

1. Consistency reliability: Cronbach's Alpha (α) and consistency reliability (CR) of 0.7.
2. Convergent Validity: outer loading 0.7 and average variance extracted (AVE) 0.5.
3. Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT) < 0.9

Structural Model Evaluation

1. R square: model predictions are weak (0.25), moderate (0.5), and strong (0.75)
2. Path coefficient: if p-value < 0.05 the hypothesis is accepted and significant
3. Q square: has a predictive model relevance if Q square > 0, weak (0), moderate (0.25), and large (0.5)
4. Effect size (f^2): the effect of exogenous to endogenous constructs if f^2 0.02, 0.15, and 0.35 have small, medium, and large effects

FINDINGS AND DISCUSSION

Measurement Model Evaluation: Smart PLS-SEM

All constructs of the developed model meet the criteria of internal consistency, convergent validation (Table 3), and discriminant (Table 4). The final theoretical model is shown in Figure 2.

Table 3
Measurement model evaluation results

Constructs	Items	Consistency Reliability		Convergent Validity	
		Cronbach Alpha α ≥ 0.7	Composite Reliability CR ≥ 0.7	Outer Loadings ≥ 0.7	AVE ≥ 0.5
Self-Management of Learning (SML)	SML1	0.734	0.833	0.767	0.556
	SML2			0.776	
	SML3			0.725	
	SML4			0.712	
Lecturer Quality (LQ)	LQ1	0.706	0.832	0.766	0.624
	LQ2			0.741	
	LQ3			0.858	
Technology Access (TA)	TA1	0.750	0.857	0.870	0.666
	TA2			0.771	
	TA3			0.806	
Student Readiness (SR)	SR1	0.875	0.922	0.858	0.799
	SR2			0.894	
	SR3			0.928	

Table 4
Heterotrait-monotrait ratio (HTMT)

Constructs	Lecturer Quality	Self-Management of Learning	Student Readiness
Self-Management of Learning	0.783		
Student Readiness	0.837	0.757	
Technology Access	0.783	0.802	0.747

Heterotrait-Monotrait Ratio (HTMT) can be calculated using the following formula (Roemer et al., 2021):

$$HTMT_{ij} = \frac{1}{K_i K_j}\sum_{g=1}^{K_i}\sum_{h=1}^{K_j} r_{ig} r_{ih} : \left(\frac{2}{K_i-(K_i-1)}\cdot\sum_{g=1}^{K_i-1}\sum_{h=g+1}^{K_i} r_{ig} r_{ih} \cdot \frac{2}{K_j-(K_j-1)}\cdot\sum_{g=1}^{K_j-1}\sum_{h=g+1}^{K_j} r_{jg} r_{jh}\right)^{1/2}$$

Table 5
Goodness of fit model

	Saturated Model	Estimed Model
SRMR	0.086	0.088
Chi-Square	269.077	0268.733
NFI	0.729	0.730

Table 5 prove that the Standardized Root Mean Square Residual (SRMR) is less than 0.1 (Elastika et al., 2021; Hair et al., 2019; Hair et al., 2021;Sarmento & Costa, 2019). It means that the model has a good fit. Based on the Chi-Square value > 0.9 and the Normal Fit Index (NFI) ranges from 0-1 (NFI close to 1 indicates a high fit model) (Hair et al., 2019; Hair et al., 2021;Sarmento & Costa, 2019). Table 5 shows that the model is a good fit because it meets all the criteria. Thus, the applied model is suitable and accepted.

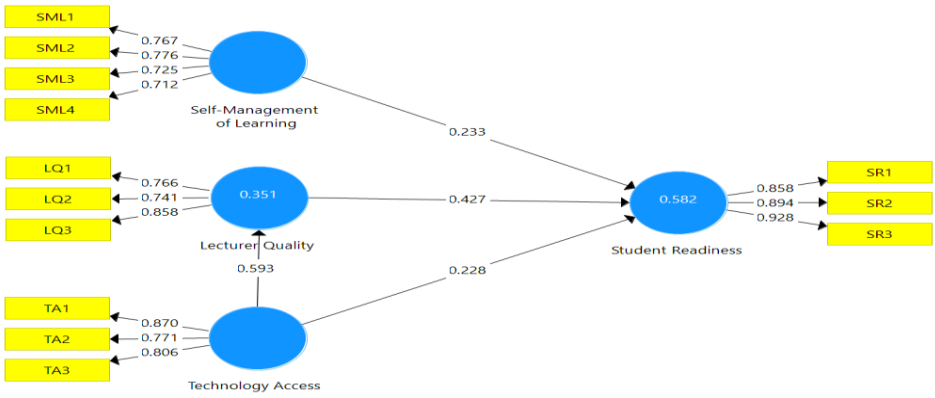

Figure 2
Structural model results

Structural Model Evaluation: Smart PLS-SEM

The results of the path coefficients are shown in Table 5 and presented in the appendix. It shows that the lecturer quality construct (LQ) has the most influence on student readiness (SR) in online learning (0.427). Besides, access to technology also significantly influences lecturers' quality (0.593). There is also an indirect impact of

access to technology (TA) on student readiness (SR) mediation of the lecturer quality (LQ) (0.253).

Table 5
Bootstrapped Results

Path Analysis	Path Coefficient	T Statistics	P-Values < 0.05	Hypothesis Result
SML ->SR	0.233	3.057	0.002	H1 accepted
LQ ->SR	0.427	5.484	0.000	H2 accepted
TA ->SR	0.228	3.189	0.002	H3 accepted
TA ->LQ	0.593	11.683	0.000	H4 accepted
TA ->LQ ->SR	0.253	5.407	0.000	H5 accepted

The model's predictive power from exogenous to endogenous constructs can be seen in Table 6. Student's readiness for online learning is influenced by self-management in learning activity (SML) constructs, lecturer's quality (LQ), and technology access. It has moderate predictive power (0.5820). It means self-management of learning, quality of lecturers, technology access, and technology access through lecturer quality mediators have an effect of 58.2% on student readiness, as well as access to technology on the quality of lecturers. It is observed that the predictive power of the model is weak (0.351). It states that technology access has a 35.1% effect on the quality of lecturers. The significance of the predictive model (Q2) for lecturer quality (0.203) is weak, and student readiness (0.448) is moderate. It can be concluded that the variable quality of lecturers and student readiness has a good observation value because $Q > 0$.

Table 6
R and Q square

Constructs	R Square	Category	Q Square	Category
Lecturer quality	0.351	Weak	0.203	Weak
Student Readiness	0.582	Moderate	0.448	Moderate

The effect size based on Table 7 on student readiness is 0.248 (moderate) for the lecturer quality (LQ). In addition, self-management of learning is 0.075, and technology access is 0.070. Each item has a small effect size. And the influence of the technology access constructs on the lecturer quality is big (0.541).

Table 7
Effect size (f^2)

Path Analysis	f^2	Category
SML ->SR	0.075	small
LQ ->SR	0.248	moderate
TA ->SR	0.070	small
TA ->LQ	0.541	large

The next step is to estimate the IPMA of constructs and items that are already valid to identify parts that need improvement.

IPMA Based on Construct

It can be seen from Figure 3 that the most important construct is technology access (0.675, presented in the appendix), but the students' readiness performance is somewhat less (70,810, see appendix). In improving student readiness in online learning, improving the performance of technology access(TA) constructs should be prioritized.

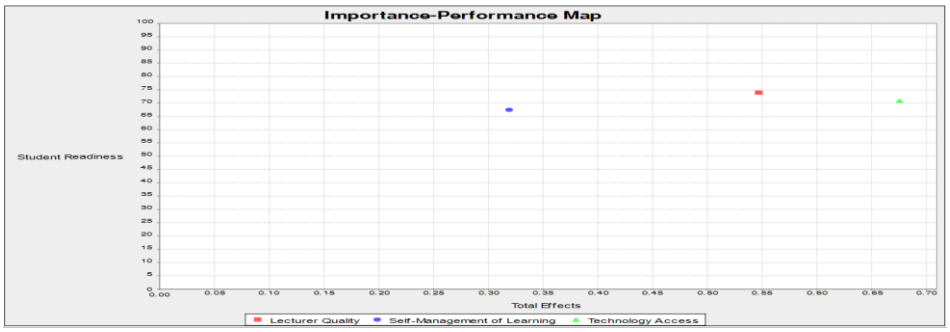

Figure 3
IPMA based on construct

IPMA Based on Item

Based on Figure 4, the indicators of technology access, especially for TA2 and TA3 items (presented in the appendix), are the most important. However, the performance of student readiness is still a bit low. In improving student readiness in online learning, you should prioritize the construct of technology access, especially on the indicators of TA2 (being able to access the internet for a long time) and TA3 (having access to a certain network connection).

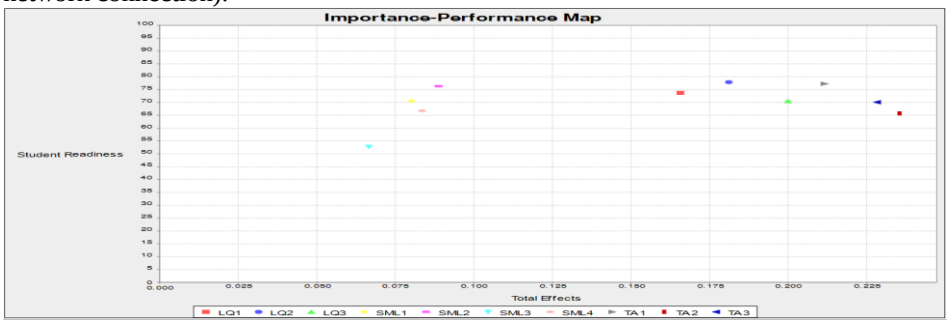

Figure 4
IPMA based on item

The results of the constructs and items found are not contradictory. Therefore, we can increase students' readiness for online learning by considering the results obtained on constructs and items of high importance. Thus, improving the performance of access technology (TA) is recommended.

DISCUSSION

In the last two years, the education system has faced obstacles in learning due to the Covid-19 virus outbreak. Education around the world is changing into the form of an online learning system that must emphasize the readiness of its students (Ebner et al., 2020; Tang et al., 2021).To measure student readiness and for research purposes on student readiness in online learning. The survey has four constructs or dimensions: self-management of learning, lecturer quality, technology access, and student readiness.

In the world of education, in addition to the quality of learning, a student needs to be ready, especially the students' readiness in learning (H. J. Kim et al., 2019). This readiness is very influential in helping students succeed in a learning activity (Küsel et al., 2020; Rafique et al., 2021). From the research, the five hypotheses were accepted, and the results from the re-investigation stated that technology access (TA) had a major influence on student readiness. In addition, access to technology also affects the quality of lecturers and indirectly affects student readiness. Students with a good readiness for learning will create a sense of relevance to the learning process (Geng et al., 2019; Handel et al., 2020). This interest will increase students' enthusiasm for learning and hopefully obtain maximum results.

The Effect of Self-Management of Learning

The self-management learning obtained a path coefficient of 0.233 and a significance of <5%. H1 is accepted. It means self-management learning has a positive effect on student readiness. This result is in line with previous research by Hamutoglu et al. (2021) and Martin et al. (2020). The ability to manage the learning process will increase readiness for online learning (Firat & Bozkurt, 2020), being a success in the learning process (S. Kim et al., 2021), making appropriate study plans (Hwang et al., 2021), and completing assignments well and on time (Adnan & Anwar, 2020).

The results of this study reveal that the better the self-management of learning, the higher the readiness of students. Self-management of the learning process increases the timeliness and maturity of learning planning. Then, it will improve the search for quality information to support learning materials.

The Effect of Lecturer Quality

The effect of the lecturers' quality obtained a path coefficient of 0.427 and a significance < 5%. H2 is accepted. The quality of lecturers has a positive effect on student readiness. It is in line with previous research conducted by Allam et al. (2020) and El Refae et al. (2021). During a pandemic or online learning, it is very significant to maintain and improve the quality of teaching and the quality of lectures. This improvement in teacher quality in teaching will guarantee improvements in the continuation of the higher education system in the future (Abad-Segura et al., 2020). In addition to the role of government and universities in supporting online learning, it also affects students' readiness. Quality is closely related to evaluation, and getting evaluation results process is carried out with several criteria. Thus, quality is obtained after an evaluation is carried out by establishing measurements and assessments on the object being studied or evaluated (Garau & Pavan, 2018).

The Effect of Technology Access

The effect of technology access obtained a path coefficient of 0.228 and a significance <5%. It means H3 is accepted, and technology access positively affects student readiness. In addition, the path coefficient is 0.593, and the significance is <5%. Therefore, H4 is accepted, and technology access positively influences the lecturers' quality. It is in line with previous research by Faisal & Kisman (2020), Joosten & Cusatis (2020), Martin et al. (2020), and Yudiawan et al. (2021).

In conventional learning systems, teacher-centered learning, the ultimate goal of the learning process is to transform knowledge (Chen & Yu, 2019). However, with the rapid development of technology and information, especially with the industrial revolution 4.0 (Lee et al., 2018), the learning system does not allow teacher-centered only. Students must be active in their learning (Hernández-de-Menéndez et al., 2019), students must be able to explore more knowledge (Syauqi et al., 2020) and seek additional information to support the material provided by the lecturer (Korhonen et al., 2019). Regarding the findings, the technology access construct needs to be improved because IPMA shows this construct is the most important. Besides, there is still an opportunity to improve the construct performance and its indicators. From the observation, we know that the quality of lecturers significantly affects the students' readiness. Lecturers must carry out good teaching strategies to increase student activity in learning.

The Effect of Technology Access on Student through Lecturer Mediation Quality

Through the mediation of the quality of the lecturers, the path coefficient is 0.253, and the significance is <5%. In conclusion, H5 is accepted. It means the quality of lecturers mediates the positive effect of technology access on student readiness. The quality of lecturers is partial because technology access directly affects students' readiness. Effective and efficient lecturers during online learning will increase the students' readiness with good access to technology. It is proved by the coefficient of the mediation path of lecturer quality in the influence of technology access on student readiness (0.593; p<5%; = 0.427, p<5%), which is greater than the path coefficient of the direct influence of technology access on student readiness (0.228, p <5%). Good access to technology will improve and maximize student readiness in online learning.

CONCLUSION

The industrial revolution development has affected education quality. Higher education must implement and design learning with complex scenarios. This study aims to see the universities' contribution to increasing student readiness in online learning. The quality of lecturers in the learning process for students majoring in mining engineering is fundamental to competing with technological developments in the era of industrial 4.0. In addition, technology access also has a significant effect on students' readiness to participate in online learning.

The findings from the Importance-Performance Map Analysis (IPMA) show that the educational success of the online learning model is the ease of technology access and student-centered learning. Thus students will be ready for online learning, can work together or collaborate, develop creative ideas, and be able to learn actively and interactively. The limitation of this research is that it is only conducted in the mining engineering department at one of the state universities in Indonesia. Therefore, it is not applicable to other majors. This study shows challenges, opportunities, limitations, and strengths in teaching mining students during online learning.

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Appendix

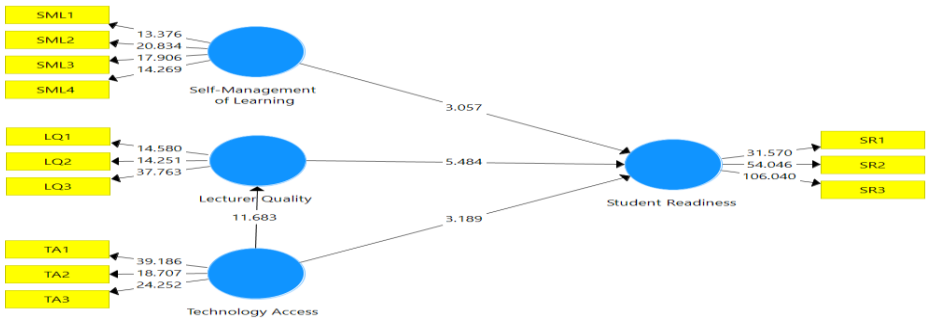

Figure X
Bootstrapped Results

Table X
Importance-Performance Map (Construct Total Effects for Student Readiness)

	Student Readiness
Lecturer Quality	0.547
Self-Management of Learning	0.319
Technology Access	0.675

Table Y
Importance-Performance Map (Construct Performances for Student Readiness)

	Performances
Lecturer Quality	73.933
Self-Management of Learning	67.413
Technology Access	70.810

Table Z
Importance-Performance Map (Indicator Total Effects for Student Readiness)

	Student Readiness
LQ1	0.166
LQ2	0.181
LQ3	0.200
SML1	0.080
SML2	0.089
SML3	0.067
SML4	0.084
TA1	0.212
TA2	0.235
TA3	0.228