Investigating the relationship between students' reading performance, attitudes toward ICT, and economic ability

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ARTICLE INFO

Keywords:
Reading performance
Attitudes toward ICT
Student economic ability
PLS-SEM
Mediation analysis

ABSTRACT

This study explores the relationship between attitudes toward ICT and reading performance in the educational context. The mediating role of attitudes toward ICT on student economic ability and reading performance was also examined. Data was collected using stratified random sampling from 240 students in senior high school and 330 undergraduate students in teacher training and education program using an online platform (eDia) and paper-based. Partial least square structural equation modeling (PLS-SEM) was used for data analysis. The joint-two stage approach was applied to perform the second-order construct in path analysis. The measurement model confirms that all the instruments used in this study are valid and reliable. The structural model showed that three out of four hypotheses were empirically supported. Attitudes toward ICT have a significant effect on Reading performance. The direct effect from student economic ability to attitudes toward ICT was positively significant. We found that attitudes toward ICT positively mediate the relationship between student economic ability and reading performance for mediation analysis. The student economic ability does not affect the student reading performance. Limitations and future directions were also discussed as well.

1. Introduction

Indonesian students placed the 9th lowest ranking on reading skills according to the PISA 2018 report. Based on this report, the average score of reading literacy of Indonesian students was 371 in 2018, which showed that there were 21 points decrease compared to 2015, which put Indonesia far from the average score of other countries (Organization for Economic Cooperation and Development, 2007) whereby reading skill has a vital role in student learning achievement. In addition, reading is an essential skill and develops the student’s mind as the foundation to being a great learner (Walczyk and Griffith-Ross, 2007). Previous studies also showed that improvement and a diverse range of research on children’s attitudes toward reading as both cognitive and affective factors related to children’s reading skills and their development (Becker et al., 2010; Clark, 2014; Clark and De Zoysa, 2011; Logan et al., 2011; McGeown et al., 2012; Medford and McGeown, 2011).

On the other hand, the development of technology and computer equipment provides opportunities to transfer data, knowledge and reading ability in the digital age. This development has an impact on student development in learning that tends to access information on computers because of the accessibility of information, the ability to find the desired information, the ease of archiving information, and the budget savings used to increase knowledge to achieve learning goals (Rose, 2011; Spencer, 2006). Furthermore, the use of the internet on computer devices to obtain information also influenced the development of libraries that turned into e-books and e-magazines whereby the availability of reading material easily accessible in the school environment or a similar learning environment will affect students reading abilities (Hanson et al., 2008; Woody et al., 2010).

The integration of information and communications technology (ICT) and education application has become a fundamental ideology in teaching and learning sought over the past two decades because it brings new opportunities, resources, and methods that benefit students and teachers. Attitudes toward ICT and student reading performance have a strong relationship where the use of ICT has proven to be effective in enriching language learning experiences, and it provides opportunities for students to explore language knowledge and improve student reading ability (Chen and Flowerdew, 2018; Fujitani et al., 2003; Larsen-Walker, 2017; López-Pérez et al., 2011). Incorporating primary and secondary school technology plays a vital role for teachers...
and students (Han et al., 2017; Park et al., 2016). When ICT continues to affect education, teachers are also growing their standards of using technology for education. Lim and Jung (2019) have consistently predicted the ability of the students to read—their approach to technology, but how the model system applies to the use of technology and reading performance is still unclear. Various frameworks have analyzed student perceptions of ICT and reading performance (Lim and Jung, 2019; Pardede, 2019). However, in China and Western countries except in Indonesia, this type of research has been limited. This fact indicates a shortage of empirical research in Indonesian culture regarding student reading and interaction with attitudes toward ICT.

The Minister of Education and Culture of Indonesia (MOEC) and the Indonesian Ministry of Religious Affairs (MORA) targeted recognizing and improving reading skills (Stern et al., 2018). However, the results of the 2016 World's Most Literate Nations (WMLN) study showed that the Indonesian reading rank is 60th out of 61 countries studied (Miller and McKenna, 2016). Based on the results of an international survey related to the ability to read for Indonesian students, this study aims to look for other factors that have a relationship with reading performance instead of improving student reading abilities. The research instrument adapted items on attitudes toward ICT for teaching and learning context by Li et al. (2019), and for reading performance using adapted items from PIRLS (2006). Because the technology application is related to the economic ability of students (Farooq et al., 2011), we also added student economic ability items adapted from the PISA SES questionnaire from Organization for Economic Cooperation and Development (OECD) (2016) to make better framework research. Therefore, this study aimed to propose, examine, and develop a framework based on attitudes toward ICT to explain and predict student reading performance in Indonesia. To present the robust finding, the present study use an advanced statistical approach to assess the two-stage model, namely the measurement and structural model in PLS-SEM, and explore the theory on the relationship between student attitudes toward ICT, reading performance, and economic ability. The results of this study attempt to explain the role of technology in reading skills and student economic ability based on a trusted research framework.

2. Conceptual framework and hypotheses

A Conceptual framework is needed to support testing the model and discussing the results. The study draws relationships between student economic ability, attitudes toward ICT, and reading performance as a conceptual framework shown in Figure 1.

The attitudes toward ICT specify the use of information, communication, and technology application in teaching and learning (Li et al., 2019). The original construct of attitudes toward ICT is measured using six factors correlated in the framework model. However, this study just adapted five out of six factors that are relevant to the Indonesian context except for the national policy of educational technology. These factors are the use of technology, perceived usefulness, perceived ease of use, subjective norms, and facilitation conditions. The use of technology refers to how the student has positive feelings about using technology (Davis, 1989; Teo et al., 2018). The perceived usefulness refers to how a person believes it would boost his job performance through a particular program (Teo et al., 2018). Perceived ease of use is how convenient a person believes it would be to use the program easily (Cheung and Vogel,
For the reading performance, we combine some constructs in the questionnaire from PIRLS (2006). The wording of all questions in the reading performance was adapted into the Indonesian language. The final version of the reading performance aspect contains 17-item questionnaires. Reading performance consists of the main elements of reading, namely attitudes to reading, reading confidence, and reading enjoyment. Reading enjoyment describes how much a reader can feel from reading a book or other reading materials (Rogiers, Van Keer and Merchie, 2020).

3. Methodology

3.1. Research approach, design, and software

This study used a quantitative research approach with a cross-sectional survey design (Creswell, 2002). The target population was senior high school and undergraduate students in teacher training and education major at the university level. Partial least square structural equation modeling (PLS-SEM) was the method used for data analysis, although the ability of PLS and its suitability for use in various research areas had become an important topic in debates related to research methodology (Bentler and Huang, 2014; Dijkstra, 2014; Hair et al., 2019; Henseler et al., 2014; Sarstedt et al., 2019). The choice of the PLS-SEM method in this study is based on guidelines proposed by Henseler (2018). More specifically, this research focuses on a predictive-explanatory study, predictive relevance of each variable, R square of endogenous variables, path coefficients using statistical inference, and effect sizes using Cohen $f^2$ for multiple regression. In addition, there are three main reasons why this study uses PLS-SEM, namely testing the proposed theoretical framework, the complexity of the model used, the use of composites and latent factors as measured by observation items in all constructs (Cepeda-Carrion et al., 2019; Hair et al., 2019).

Finally, this study employed the SmartPLS 3.2.8 software package (C M Ringle et al., 2015) for data analysis. SmartPLS 3.2.8 is rarely done in educational studies, so this study wants to initiate the use of PLS-SEM with SmartPLS 3.2.8 in the educational field.

3.2. Participants

Participants for this current study were taken using stratified random sampling. The ethical approval for conducting the research was granted by Pakuan University. We also asked the participant to fill the consent statement with complete information to join in the research. This study was conducted in three provinces in Indonesia, Yogyakarta, Bogor, and West Kalimantan. 240 students in senior high school from 10th to 12th grade from ten different schools and 330 undergraduate students from three universities in teacher training and education program, 570 students with 40.4% Male and 59.6% Female. The participants were students aged from 15 to 24 years old. All participants were asked to complete the questionnaire using paper-based or online-based using eDia Platform. The paper-based data collection was used to cover some schools with a lack of computer laboratory or internet connection problems, so students can also participate in this study. eDia is the online system for diagnostic assessment. For several areas, including pre-school to higher education. The eDia system was used for evaluations (B Csapó and Molnár, 2019). The eDia was used to help the researcher elaborate based on the digital assessment by computerizing the paper-based test. The eDia also used the user identification code to enter the system, so we can confirm the student participation precisely.

3.3. Instruments

Attitudes toward ICT were measured using 29 items adapted from Li et al. (2019). Attitudes toward ICT factors consist of the use of technology (six items), perceived usefulness (six items), perceived ease of use (five items), subjective norms (six items), and facilitation conditions (six items). To measure attitudes toward ICT as a single construct, we use the second-order construct with the joint two-stage approach using reflective indicators (Christian M. Ringle et al., 2012; Sarstedt et al., 2019).

Reading performance items were measured and constructed into a reading performance questionnaire adapted from PIRLS (2006), the reading performance consists of reading attitudes (nine items), reading confidence (four items), and reading enjoyment (six items) were measured using six items adapted from the PISA SES questionnaire from OECD (2016). Reading performance items are related to questions that depict student perceptions of the reading activity, as represented in Table 2. Student reading performance and student economic ability factors were constructed using the first-order construct with reflective indicators. All of the items on reading performance, attitudes toward ICT, and student economic ability were categorized on a four-point Likert scale ranging from 1 (strongly disagree) and 4 (strongly agree).

3.4. Data collection and screening

In this study, the target population was senior high school and undergraduate students in teacher training and education major. Data were collected using stratified random sampling via a paper-based and online data collection platform, eDia. Overall, 570 responses from the survey were collected for further data analysis. Firstly, we handle missing values that yield similar outcomes if only a few points ($\leq5\%$) in a large dataset.
3.5. Assessment of the measurement model (validity and reliability)

Based on the latest guidelines proposed by Hair et al. (2019), the assessment of reflective measurement models encompasses the evaluation of factor loading, convergent validity, discriminant validity, and internal consistency reliability. All constructs were estimated in Mode A (reflective indicators). Figure 2 illustrates the measurement model using a Consistent PLS algorithm in SmartPLS 3.2.8.

The first step is to evaluate latent factors’ reliability and examine factors loading of items in reflective constructs. If the construct is composed using a formative construct, loading weights are measured instead of the loading factor. The essential points are the correlation between each construct and items in one construct (Hair et al., 2021). To convince all constructs (latent factors) can explain more than 50 percent of the variance of items, the loading value should be above 0.5 (Hair et al., 2009; Kock, 2014). Therefore, non-contributing items in reflective indicators with loadings that were below 0.5 have to be excluded from the measurement model. 10 out of 19 items from the reading performance construct were deleted because low loading values (<0.5) of measurements are non-contributing indicators with a negligible effect. The result of low loading in reading performance might occur because reading performance is a construct combined from three reading aspects.

Next, internal consistency reliability statistics were evaluated using Cronbach’s alpha, Composite Reliability (CR), and Rho_A. Indicators’ reliability explains the proportion of variances from latent factors that range from 0 to 1 (Dijkstra and Henseler, 2015). The indicator’s value on internal consistency reliability should be above 0.7 (Hair et al., 2019). The reliability indicators of constructs in this study ranged from 0.854 to 0.986 (see Table 1) for internal consistency reliability indicators. Table 2 summarizes the result of values from reliability, loading, and validity indicators for the measurement model. However, for the second-order construct, Attitudes toward ICT were calculated separately to find the loading, composite reliability and the Average Variance Extracted (AVE) according to the recommendation by Barker and Ong (2016) for the higher-order construct. Table 3 informs the calculation results for loading, CR, and AVE components for the second-order construct. For attitudes toward ICT AVE (0.919), the square root of AVE (0.958), and CR (0.965), which mean that the second-order construct meets the threshold criteria for loading and reliability indicators. The overall reliability values of the constructs used in this study are highly reliable.

In evaluating the validity, this study used convergent validity and discriminant validity criteria. The first is convergent validity which is useful for measuring the level of correlation of multiple variables in the same construct. The Average Variance Extracted (AVE) values are evaluated to assess convergent validity, which should be above 0.5 for each composite construct in the measurement model (Hair et al., 2019). The results from the analysis showed that the AVE values ranged from 0.496 to 0.932, and the CR value ranged from 0.887 to 0.988 (see Table 1), which means the constructs used in this study meet the thresholds of convergent validity. There is a low value of AVE in reading performance (0.496), but we still can establish convergent when AVE is often too strict if the CR value is higher than 0.6 (Malhotra and Dash, 2011).

Discriminant validity is used to determine the extent to which constructs differ empirically from other constructs (Hair et al., 2019; Sarstedt et al., 2019). In this study, there are seven constructs in the form of the first-order construct and one second-order construct. Discriminant validity in this study was evaluated using two criteria, Fornell and Larcker criterion (Fornell and Larcker, 1981) and HeteroTraitMonoTrait (HTMT) criterion (Henseler et al., 2015). Fornell and Larcker (1981) recommend that discriminant validity is achieved when the square root of the AVE is higher than the AVE shared correlation on a particular latent factor. The square root of the AVE should be above 0.5 and higher than the inter-correlation of latent factors in the model (Hair et al., 2009). Table 4 shows the validity measurement based on the Fornell and Larcker criterion. HeteroTraitMonoTrait (HTMT) criterion was used as the second criterion to assess discriminant validity, but the calculation was conducted after converting the full model using the joint two-stage approach using reflective indicators (see Figure 3) (Christian M. Christian M Ringle et al., 2012; Sarstedt et al., 2019). The score factors or composite factors from first-order constructs were used on the second-order construct, attitudes toward ICT. The HTMT values should be less than 0.9 and 0.85, respectively, to establish the discriminant validity (Henseler et al., 2015). Table 5 reflected the establishment of discriminant validity established based on the HTMTo.85 criterion. To conclude, according to all standards used in this study, all constructs meet discriminant validity indicators.

Table 4 shows no discriminant validity concern because the values of the square root of AVE in the diagonals are higher than the correlations between constructs below. It means that the respondents were able to comprehend and distinguish the different constructs in this study.

4. Results

In PLS-SEM, the model was analyzed and interpreted in two stages. The first is assessing the outer model (measurement model) to confirm the loading, reliability, and validity. The second is assessing inner models (structural models) such as the path coefficient for direct and indirect effects, regression coefficients, and other quality criteria.

### 4.1. Common method bias

To ensure this study is free from Common Method Bias (CMB), this study employed two approaches, Harman’s single factor test and Variance Inflation Factor (VIF) in PLS-SEM. Harman’s single factor test is performed to determine whether a single variable appears for the greater
part of the covariance between the measures using principal axis
factoring with a single factor to extract (Podsakoff et al., 2003). The
result indicated a single factor solution accounted for only 40.036% of
the cumulative variance. This value is less than 50%. The variance
inflation factor (VIF) was used based on the approach proposed by Kock
(2015) to assess and confirm CMB using PLS-SEM. The full collinearity
factor was used in this study. When the VIF of each latent factor has a
value greater than 3.3, it is categorized that the latent factor has patho-
logical collinearity that shows the model is affected by bias. Table 6
shows that all latent factors in this model have a VIF value of less than 3.3
so that CMB is not a pervasive issue in the proposed model.

4.2. Assessment of the structural model

To assess structural mode, we transformed the initial model in
Figure 2 to the structural model with a second-order construct using the
joint two-stage approach in Figure 3. Figure 3 shows the analyzed model
according to the joint-two stage approach through a consistent PLS al-
gorithm. The use of a joint-two approach was chosen to overcome
problems related to the use of the second-order construct, such as R2 in
the second-order construct is typically almost equal to one, and the
challenge for endogenous can be influenced by other variables and
overlapping variables in the full proposed model. Firstly, to examine
the structural model, the VIF values of exogenous constructs were evalu-
ated. The VIF values of constructs should be less than 3 (Hair et al.,
2019). The initial evaluation of VIF values showed that all VIF values of
constructs were less than 3, indicating no issue for collinearity. If
collinearity is not a problem, the next step is to examine the R2 in
endogenous constructs using consistent PLS algorithm calculation to get
the result. The R2 measures the total variance explained at each
endogenous construct shown in the center of endogenous variables in
Figure 2. The R2 also measures the explanatory power and the sample
predictive power of constructs in the model (Rigdon, 2014; Shmueli and
Koppius, 2011). The R2 value is ranging from 0 to 1. The cut-off criteria
for R2 are 0.75 (substantial), 0.50 (moderate), and 0.25 (weak) (Hair
et al., 2019; Henseler et al., 2009). In this study, there are two endoge-

uous constructs: attitudes toward ICT (R2 = 0.692) categorized as
substantial, but reading performance (R2 = 0.170). R2 value as low as
0.10 can be considered satisfactory based on a particular context (Rai-
thel et al., 2012). In the educational field, reading performance can be
predicted with many constructs, but reading performance is merely
predicted using two predictors in this study. The high R2 values in at-

titudes toward using ICT might achieve because this construct is a
second-order construct from five predictors in the first-order constructs.

R2 has a function as the number of predictors in constructs, which means
that the greater the number of predictor constructs, the higher the R2
value (Hair et al., 2019). The calculation of $f^2$ effect size from exogenous
to endogenous variables showed that student economic ability has a
large effect size ($f^2 = 1.592$) to attitudes toward ICT as a target
construct, and attitudes toward ICT have a medium effect size ($f^2 = 0.163$) to reading performance as target construct. The values of $f^2$ effect
size are categorized based on a rule of thumb by Cohen (1988), 0.02
(small), 0.15 (medium), and 0.35 (large).

The subsequent analysis for predicting model accuracy (Rigdon,
2012) in the assessment model was calculated from the result of Q2
values (Geisser, 1974; Stone, 1976). we ran a blindfolding analysis with
the default setting to examine Q2. In blindfolding analysis, a single point
in the data matrix is removed, and the removed data replaces the mean to
estimate the model parameter (Rigdon, 2014). The Q2 values combine
aspects of out-of-sample prediction and in-explanatory power (Sarstedt
et al., 2019; Shmueli et al., 2016). The Q2 values should be above 0 for a
specific dependent construct to identify the predictive accuracy of the

Figure 2. Full measurement of the proposed model using a consistent PLS Algorithm.

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structural model. $Q^2$ values above 0, 0.25, and 0.50 represent small, medium, and large predictive relevance (Hair et al., 2019). The results from the analysis show that the predictive relevance of reading performance and attitudes toward ICT as target constructs in a sequence are small ($Q^2 = 0.061$) and medium ($Q^2 = 0.485$).

Afterward, to confirm the hypothesis for direct and indirect effects, we ran the bootstrapping calculation with a 5% significant level and 10,000 bootstrapping subsamples to assess significance with path coefficients based on percentile confidence intervals, particularly to assess the mediation effect of attitudes toward ICT on student economic ability and student reading performance. This calculation procedure follows recommendations by Aguirre-Urreta and Rönkkö (2018).

The direct effect from student economic ability to attitudes toward ICT was positively significant. Attitudes toward ICT also have a significant positive effect on reading performance, which explained the findings from Dundar and Akçayır (2012) and Moran et al. (2008) on the relationship of ICT positively affecting student learning skills. However, the direct effect of student economic ability on reading performance was not significant. For mediation analysis, we found that student attitudes toward ICT positively mediate the relationship between student

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**Table 2. The loadings, reliability, and validity indicators for first-order constructs.**

| Item code | Item Description (Constructs) | Loading | Alpha | Rho_A | CR | AVE |
|-----------|--------------------------------|---------|-------|-------|----|-----|
| RAA6      | I answer questions in a workbook or on a worksheet about what I have read | 0.738   |       |       |    |     |
| RAA7      | I talk with other students about what I have read | 0.748   |       |       |    |     |
| RAA9      | I read only if I have to | 0.673   |       |       |    |     |
| REE2      | I need to read well for my future | 0.714   |       |       |    |     |
| REE3      | I enjoy reading | 0.624   |       |       |    |     |
| RCC1      | Reading is very easy for me | 0.730   |       |       |    |     |
| RCC3      | When I am reading by myself, I understand almost everything I read | 0.681   |       |       |    |     |
| SEA1      | I have my personal computer in my home | 0.772   |       |       |    |     |
| SEA2      | I have a laptop for learning activity | 0.880   |       |       |    |     |
| SEA3      | I have internet connection in my home | 0.864   |       |       |    |     |
| SEA4      | I have television cable/internet in my home | 0.828   |       |       |    |     |
| SEA5      | I have a new model for some technology devices. | 0.885   |       |       |    |     |
| SEA6      | I have a smartphone with an internet connection. | 0.838   |       |       |    |     |
| AUT_TTT1  | I look forward to some aspects of my work that needs the use of technology | 0.940   |       |       |    |     |
| AUT_TTT2  | I like working using a computer or tablet. | 0.934   |       |       |    |     |
| AUT_TTT3  | When I am using technology tools, it realizes that it will be difficult to stop | 0.933   |       |       |    |     |
| AUT_TTT4  | Technology gives me a better insight | 0.946   |       |       |    |     |
| AUT_TTT5  | I using Whatapps and email to communicate with my colleagues. | 0.934   |       |       |    |     |
| AUT_TTT6  | I am addicted to using technology | 0.842   |       |       |    |     |
| AUT_U1    | Using technology improves my work performance | 0.975   |       |       |    |     |
| AUT_U2    | Using technology makes me more effective in using time | 0.939   |       |       |    |     |
| AUT_U3    | Using technology helps me to finish my work quickly | 0.972   |       |       |    |     |
| AUT_U4    | Using technology gives me new knowledge | 0.967   |       |       |    |     |
| AUT_U5    | Using technology helps me to solve my problem | 0.972   |       |       |    |     |
| AUT_U6    | Using technology can help me to answer some questions. | 0.967   |       |       |    |     |
| AUT_F1    | Learning how to technology is easy for me | 0.897   |       |       |    |     |
| AUT_F2    | When I am using technology, I do not need much effort | 0.912   |       |       |    |     |
| AUT_F3    | I am ingenious in using technology | 0.929   |       |       |    |     |
| AUT_F4    | I can use technology without helps from other people | 0.916   |       |       |    |     |
| AUT_F5    | I adapt very well when I have new technology devices | 0.916   |       |       |    |     |
| AUT_SI1   | People encourage me to use technology | 0.965   |       |       |    |     |
| AUT_SI2   | People tell that important to me know about technology | 0.976   |       |       |    |     |
| AUT_SI3   | People support me when I use technology | 0.960   |       |       |    |     |
| AUT_SI4   | People give me help when I use technology | 0.964   |       |       |    |     |
| AUT_SI5   | People influence my behaviour to use technology | 0.939   |       |       |    |     |
| AUT_SI6   | People discuss to me how I can use technology | 0.960   |       |       |    |     |
| AUT_LF1   | My school has a wireless network or internet connection | 0.895   |       |       |    |     |
| AUT_LF2   | My school supports me with some technology devices in teaching at the classroom | 0.908   |       |       |    |     |
| AUT_LF3   | When I have a problem using technology, I get help from assistance. | 0.917   |       |       |    |     |
| AUT_LF4   | My school has a personal computer and laptop to use for regular teaching activity | 0.868   |       |       |    |     |
| AUT_LF5   | When a technology device does not work or broken, I immediately get a replacement from school | 0.848   |       |       |    |     |
| AUT_LF6   | My school provides a room with some technology devices. | 0.907   |       |       |    |     |
Table 3. The loadings, reliability, validity indicators for the second-order construct.

The calculation for attitudes toward ICT

| First order construct | STD loading | STD loading squared | Error Variance – 1-loadings squared |
|-----------------------|-------------|---------------------|-------------------------------------|
| The use of technology | 0.954       | 0.910116            | 0.089884                            |
| Feeling of ease to use| 0.901       | 0.811801            | 0.188199                            |
| Learning facility     | 0.864       | 0.746496            | 0.253504                            |
| Subjective influence  | 0.935       | 0.874225            | 0.125775                            |
| Usefulness            | 0.945       | 0.893025            | 0.016975                            |
| Total loadings        | 4.599       | 4.235663            | 0.764337                            |
| Total loadings squared| 21.150801   | 21.915138           |                                     |

AVE: 0.9198
CR: 0.965122875

Table 4. Discriminant validity based on the Fornell-Larcker criterion.

| AUT_TTT    | ATUT     | AUT_F | AUT_LF | RP  | SEA   | AUT_SI | AUT_U |
|------------|----------|-------|--------|-----|-------|--------|-------|
| 0.922      | 0.905    | 0.831 | 0.781  | 0.337| 0.735 | 0.860  | 0.904 |
| AUT_TTT    | 0.905    | 0.831 | 0.860  | 0.337| 0.735 | 0.860  | 0.904 |
| AUT_F      | 0.831    | 0.901 | 0.831  | 0.735| 0.735 | 0.735  | 0.904 |
| AUT_LF     | 0.781    | 0.864 | 0.781  | 0.335| 0.735 | 0.735  | 0.904 |
| RP         | 0.337    | 0.371 | 0.335  | 0.735| 0.735 | 0.735  | 0.904 |
| SEA        | 0.735    | 0.780 | 0.799  | 0.337| 0.735 | 0.735  | 0.904 |
| AUT_SI     | 0.860    | 0.935 | 0.824  | 0.353| 0.735 | 0.735  | 0.904 |
| AUT_U      | 0.904    | 0.945 | 0.799  | 0.337| 0.735 | 0.735  | 0.904 |

Note: Diagonals in bold represent the square root of AVE while diagonals off represent the correlations. AUT_TTT, The use of technology; ATUT, Attitudes toward ICT; AUT_F, Feeling of ease to use; AUT_LF, Learning facility; RP, Reading performance; SEA, Student economic ability; AUT_SI; Subjective influence; AUT_U, Usefulness.

Figure 3. The structural model using the joint two-stage approach transformed from the proposed model.
economic ability and student reading performance with full mediation. We found support for three out of four hypotheses. In more detail, Table 7 summarizes the results of the hypotheses according to path coefficient, T statistics, and p values.

5. Discussion and conclusion

This predictive-explanatory study was conducted to investigate the impact of student economic ability and student attitudes toward using ICT on reading performance in the educational field, especially for Indonesian students in higher school and university. This study also examines the mediating role of attitudes toward ICT on the relationship between student economic ability and reading performance. The result revealed evidence empirically that three out of four hypotheses within the proposed model. As expected, student economic ability directly increases attitudes toward ICT, but it does not directly improve student reading performance. Student attitudes toward using ICT mediate this relation with full mediation. This finding explains that although students have high economic abilities, this aspect does not enhance students' ability to read. The attitudes in using appropriate and correct ICT for the benefit of education play an essential role in improving student reading performance. The use of attitudes toward ICT as a second-order construct in this study provides high predictive relevance almost 0.5 (Q2 = 0.485), which explains that the attitudes toward ICT in-sample predictive power were above a moderate level. However, the proposed model in this study merely uses two predictors of reading performance (Q2 = 0.061). In reality, there are so many aspects that can affect students' reading abilities and habits. Our model tries to depict a specific application of PLS-SEM in the education field with limited constructs.

In general, the results of this study are in line with much of the previous research that had been conducted in predicting student reading abilities or performance in different research settings and domains (Chen and Flowerdew, 2018; Clark, 2014; Clark and De Zoysa, 2011; Jang and Henretty, 2019; Larsen-Walker, 2017; Lim and Jung, 2019; Pardede, 2019). This study provides essential support for the application of ICT in improving student reading performance in an educational context with the proposed model. For instance, in context, the positive relations of technology applications that affect student reading skills (Dundar and Akcayir, 2012) found that smartphone use increases the students' reading abilities in learning. In another study, Moran et al. (Moran et al., 2008) found positive relationships through meta-analysis on technology use and reading performance in line with this study. Our findings were also similar to the conclusion founded by Dini et al. (2019) in the context of the higher student economic ability, the better student reading ability. However, in our study, this relationship is mediated by attitudes toward ICT. Ghorbani and Golparvar (2020) also found a connection between socioeconomic status with ICT-enhanced language learning and language outcomes in the educational context. In this study, we investigated the relationships between reading performance, attitudes toward ICT and student economic ability based on the proposed model in Figure 1 whereby no studies performed this structural model in advance.

The findings of this study can be an initial alert for The Minister of Education and Culture of Indonesia (MOEC) and the Indonesian Ministry of Religious Affairs (MORA) to improve student reading performance through technology applications as the leading supporter of infrastructure at high school and university. Wekke and Hamid (2013) also suggested the need for the implementation of technology in the application of education in schools to improve student language learning and reading ability. Reading performance is an essential aspect in developing students' knowledge, considering that the report from the World’s Most Literate Nations (WMLN), which placed Indonesia in ranks 60th out of 61 countries in student reading performance.

Finally, it should be noted that our findings in this study seem to be essential and relevant to Indonesian education systems in other improving student reading performance through attitudes toward ICT and technology application in educational contexts. The proposed model has been proven valid and robust based on the quantitative approach using PLS-SEM. This study have showed that attitudes toward ICT affect the reading performance whereby the student economic ability fully mediates the reading performance via attitudes toward ICT. This study also had explained the application of PLS-SEM to the educational context, which can be useful for researchers and educators to find relationships between various target constructs.

6. Limitations and direction for further research

Although this study explained how to use PLS-SEM for measurement and structural model for the educational field properly, the results have some limitations. The first limitation is that this study is a cross-sectional study so there are some disadvantages, such as difficulty to analyze behaviours over the period and the challenge to put samples together based on a variable on the studied population. Second, because of school facility limitations whereby there is a lack of computer laboratory, we applied two data collection methods for this survey. Even though the previous research by Csapó et al. (2009) had confirmed there is no bias effect between paper and online-based tests, there are possibilities where the different assessment types can lead to different attitudes among students when it comes to self-assessing their own qualities, characteristics, experiences, or behaviours. Third, the bias may happen, but researchers had taken some procedures such as detecting outliers using Mahalanobis distances, common method bias, data screening, and

| Table 5. Discriminant validity based on HTMT0.85. |
|-----------------------------------------------|
| Latent factors | Attitudes toward ICT | Reading performance | Student economic ability |
|----------------|----------------------|----------------------|-------------------------|
| Attitudes toward ICT | 0.408            |                      |                         |
| Reading performance | 0.821             | 0.343                |                         |
| Student economic ability | 0.343         | 0.000                |                         |
| Note: ** Second-order construct. |

| Table 6. Full collinearity VIF Values. |
|---------------------------------------|
| Latent factors | Reading performance | Student economic ability | Attitudes toward ICT |
|----------------|---------------------|--------------------------|----------------------|
| Full collinearity VIF | 1.944             | 1.181                     | 1.046                |

| Table 7. Summary of finding according to path coefficient, direct and indirect effect. |
|---------------------------------------------------------------------------------------|
| Hypothesis | Path coefficient | T Statistics | p Values | Bias, 95% Confidence interval | Conclusion |
|----------------|------------------|--------------|----------|-----------------------------|------------|
| Attitudes toward ICT - > Reading performance (H1) | 0.344 | 4.365 | 0.000 | [-0.002, 0.461] | Supported |
| Student economic ability - > Attitudes toward ICT (H2) | 0.783 | 37.688 | 0.000 | [0, 0.815] | Supported |
| Student economic ability - > Reading performance (H3) | 0.038 | 0.667 | 0.505 | [-0.004, 0.128] | Not supported |
| Student economic ability - > Attitudes toward ICT - > Reading performance (H4) | 0.270 | 4.145 | 0.000 | [-0.001, 0.366] | Supported, with Full mediation |
necessary precautions. Researchers hope this study will be an initial step to proving that there are interactions between reading performance, attitudes toward ICT, and student economic ability. In future studies, the researcher will conduct other path modeling using constructs in this study with the Metacognitive Awareness of Reading Strategies Inventory (MARS) Mokhtari and Reichard (2002) for the complex model to explore student reading performance. Employing FIMIX-PLS and PLS Predict analysis will be exciting methods to assess constructs in a structural model for further study.

Declarations

Author contribution statement

Eri Sarimahah: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.
Soeharto Soeharto: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.
Figiati Indra Dewi: Performed the experiments; Contributed reagents, materials, analysis tools or data.
Roy Efendi: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

The data that has been used is confidential.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

The authors would like to appreciate a forum discussion of the doctoral school of education at The University of Szeged and Pakuan University for some recommendations to improve the quality of this study.

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