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An Online Learning Approach For Individuals In Eastern Indonesia's Underdeveloped, Frontier, And Outermost Regions (3T) For Open And Distance Education

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ABSTRACT

This study examines the variables that affect adult learners' performance in online learning (OL) in open and distance learning in eastern Indonesia, focusing on the frontier, remote, and underprivileged areas. to apply a seven-construct structural equation model that integrates TPACK theory and the information system success (ISS) model. 150 participants' data were evaluated using PLS-SEM. The findings showed that teachers' TPACK skills, system quality, and service quality all positively affect OL success to differing degrees. This study's primary contribution is the novel integration of TPACK theory with the ISS Model, which other studies have not extensively investigated. Furthermore, this study highlights how critical it is to accommodate the unique needs and characteristics of students participating in online learning (OL). The results of this study can assist policymakers and educational practitioners in developing a more effective and efficient online learning environment that satisfies student demands and closes the theory-practice gap.

1. Introduction

Online education is now a flexible and accessible substitute for traditional classroom-based learning due to the quick growth of information and communication technology (ICT)(Lange & Costley, 2020; Trevisan et al., 2023). In eastern Indonesia, online learning has been increasingly popular in Open And Distance Education (ODE) institutions, giving learners the chance to further their education while juggling other obligations(Cavus et al., 2021). Online learning does, however, face difficulties and obstacles despite its potential advantages, especially for students in eastern Indonesia's frontier, remote, and underprivileged regions(Bovermann et al., 2018). The Open University was the driving force behind Indonesia's Open and Distance Education (ODE) system, which has greatly increased educational access and enabled individuals to advance their academic qualifications and expertise (Titus & Muttungal, 2023). Adult education at the Open University completely switched from offline to online learning as a result of the COVID-19 epidemic, which further drove the adoption of online learning(Hew et al., 2020). This approach to education has persisted even after the pandemic(Sahni, 2023). Adult learners find online learning appealing because it is flexible enough to accommodate their time and location, allowing them to select course materials and program designs that best suit their requirements and situations(Full et al., 2019). For part-time students who must juggle work obligations and academic obligations, this flexibility is quite beneficial(Blayone et al., 2017). Notwithstanding the advantages, non-full-time adult learners encounter several difficulties that have an impact on their educational journey(Gezani, 2024). Their capacity to participate completely in learning activities may be hampered by juggling work, family, and other obligations(Dwiyogo, 2018). Poor learning results may result from inadequate institutional support and instructional strategies that are not tailored to the unique needs of part-time adult learners (Kauffman, 2015). Determining the elements that affect online learning's efficacy is crucial to overcoming these

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obstacles and enhancing its success. The success of online learning has been extensively studied using the information system success (ISS) model, which looks at aspects including perceived benefits, student and instructor quality, technology system quality, information quality, service quality, and support system quality (Alismaiel et al., 2022; Ally, 2008) The majority of this research, however, concentrated on institutions in affluent nations.

By expanding the current Information System Success (ISS) model and combining it with other pertinent theories, scholars have advanced the field of online learning significantly in recent years(Dumford & Miller, 2018; Koh et al., 2023) These consist of the Expectation Confirmation Model (ECM) and the Technology Acceptance Model (TAM) (Yuebo et al., 2023). These studies have investigated the various elements that influence users' perceptions of e-learning's benefits, usage, and level of satisfaction (Chinnappan & Forrester, 2014). Furthermore, scholars have examined the impact of cultural elements and non-cognitive skills on the (Yu, 2021). A more extensive assessment of the efficacy of online learning systems is provided by the notable online learning success model that presented, which incorporates multiple variables(Lakhal et al., 2020). The potential of the (TPACK) paradigm, which highlights the convergence of technology, pedagogy, and content knowledge, for teachers, has not been thoroughly investigated despite these advancements(Yuebo et al., 2023). This framework provides a thorough method for comprehending and enhancing the abilities and caliber of teachers in the setting of online education(Hrastinski, 2019; Lu & Cutumisu, 2022). To completely comprehend the intricate dynamics of effective online learning and its implications for instructional design and implementation, more research into the TPACK framework is necessary(Tomei, 2007).

By creating a model of online learning success for adult non-full-time learners in open and remote education in eastern Indonesia, particularly in the frontier, outermost, and underprivileged regions (3T), this study seeks to close this research gap(Suhandiah et al., 2022). This study aims to determine the elements that favorably impact online learning success and offer suggestions for raising the standard of open and remote learning in Indonesia by fusing the TPACK framework with the ISS model(Galvis, 2018). To validate the suggested online learning success model, this study specifically examined students in eastern Indonesia, namely those in the border, outermost, and disadvantaged (3T) regions(Reedy, 2019). This study intends to investigate the effects of system quality, service quality, and teachers' TPACK skills on online learning success by gathering and analyzing data from 150 participants using Partial Least Squares Structural Equation Modelling (PLS-SEM)(Aklani & Liling, 2023). This study's primary contribution is the novel integration of the ISS model with the TPACK framework, which has not been extensively investigated in earlier studies(Purnomo et al., 2016). This study offers a more thorough understanding of the elements that affect online learning performance by integrating teachers' technological, pedagogical, and content knowledge into the model(Hokor, 2020). It also highlights how crucial it is to take into account the unique needs and traits of each student when learning online(Kumar et al., 2024). When creating and executing efficient online learning environments, educational practitioners and policymakers can benefit from the study's practical consequences(Cavus et al., 2021). Educational institutions can better meet the needs of students, close the theory-practice gap, and increase the overall success of online learning efforts by taking note of the characteristics that have been discovered(Caingcoy, 2023). This study examines the variables that affect adult learners' success in open and distance learning in eastern Indonesia, namely in the frontier, remote, and underprivileged areas (3T). Through the integration of the ISS model and the TPACK framework, this study adds to the body of literature by offering a more thorough comprehension of the factors that influence the success of online learning(Kolb, 2015; Kotzebue, 2023). The study's conclusions can guide the creation of tactics and interventions aimed at improving the effectiveness and efficiency of online learning environments while catering to the unique requirements of adult learners.

2. Conceptualization Research

With an emphasis on people's assessments of their "perceived satisfaction with using online learning systems" and their "intention to continue using online learning systems" following their involvement in online learning for academic or professional progress, this study explores the advantages of online learning. The theoretical models of adult online learning instruction that are employed in various programs within the Indonesian educational system serve as the foundation for this study. The ISS Model is integrated with TPACK Theory in this conceptual framework(Koehler et al., 2015). In Figure 1, the conceptual model is displayed. The theories assessed in this study are legitimate, trustworthy, and have a solid theoretical and pedagogical foundation, according to the literature survey. In Figure 1,the conceptual model is displayed. The theories assessed in this study are legitimate, trustworthy, and have a solid theoretical and pedagogical foundation, according to the literature survey. The study's discovered constructs Nine constructs are included in the study's model: information quality (IQ), system quality (SQ), service quality (SEQ), sustained usage (usage), user-perceived satisfaction (US), TPACK, and net benefits (NB). The degree of efficiency and support offered to users when they are using the platform determines how effective online learning (OL) systems are(Thyssen et al., 2023). In addition to making users feel more at ease on the network platform, higher-quality systems also protect users' privacy and speed up the retrieval of information online(Mario et al., 2023). According to service quality encapsulates the needs and expectations of consumers when they engage with OL platforms. According to the integrity, timeliness, accuracy, relevance, and stability of the information supplied are all considered aspects of information quality(Acar-şeşen, 2023).

Figure 1: Suggested model for online learning success

Furthermore, the idea of USE aligns with learners' willingness to consistently interact with the OL platform, whereas US refers to their cognitive judgment in determining whether the effort and advantages of the system are appropriate(Muslimin, 2023). NB has to do with students' post-learning academic, professional, and personal growth. It is expected of teachers to learn TPACK, which is the fundamental knowledge needed to successfully integrate information technology, instructional methods, and content (Hidayati et al., 2023) When technology is used to offer instruction, it is more of a pedagogical approach taken by the instructor. Since educators bear the responsibility for implementing TPACK, attention must be specifically directed toward classroom teachers' active participation in the development and application of successful pedagogical practices in technology-enhanced learning environments(Thohir, 2023). Overseeing the necessary self-assessment of classroom instruction is a crucial responsibility for both administrators and instructors. As a vital part of a dynamic approach to developing and implementing specialized pedagogical approaches for adult learners, TPACK training in teacher education programs should emphasize the integration of technology in all of its forms. Three core knowledge areas are included in TPACK: technology, instructional methods, and subject matter. TPACK requires a thorough comprehension of knowledge transfer in a high-tech learning environment, going beyond the simple aggregation of these components(Trevisan et al., 2023). In addition to using technology in educational practices, the teacher's job is to develop a thorough understanding of how educators transfer knowledge to adult learners(Pujawan et al., 2022). The study and use of TPACK must transcend a narrow focus on technology, integrating pedagogical practices and theories of teaching and learning into the creation and execution of online programs(Thyssen et al., 2023).

3. Research hypothesis

Digital technologies are essential to online learning (OL), and students' attitudes and motivation to actively participate in OL can be greatly influenced by the usability and functionality of these systems(Toker, 2022) Implementing suitable learning systems can enhance learning results, claims (Toker, 2022). Additionally, they emphasize how information technology and multimedia may enhance the online learning environment. Furthermore, proposed that student-led learning can be facilitated through the use of smart gadgets and virtual communities(Sapri et al., 2019). Consequently, the following theories have been proposed for this research.

H1a: The intention to stick with the OL system is positively impacted by system quality.

H1b: Perceived satisfaction is significantly impacted by system quality.

Defined empathy, trust, capability, product mix, ease of use, and security as the five essential criteria to gauge the quality of online services after being examined from the standpoint of the customer's perceived value [(Sugilar, 2021). The ability of an online platform to meet users' demands without in-person connection is a critical component in determining its ability to draw in and keep consumers(Abuhassna et al., 2022). According to this paper, the ability to offer users individualized services and prompt resolutions for users experiencing issues with the platform are both indicators of good service quality, and they have an impact on users' assessments of how helpful and user-friendly the online platform is (Abuhassna et al., 2020). As a result, the following theories have been put out for this investigation.

H2a: The quality of the services has a significant positive impact on the use of the OL system in a broader sense.

H2b: The quality of the service has a positive and significant impact on the identified problems.

Use the five characteristics of accuracy, timeliness, completeness, relevance, and consistency to gauge the quality of information(Pardamean et al., 2022). Their selection of dimensions has been widely cited by researchers

looking into the quality of content on websites. Prior studies have demonstrated the importance of information quality as a criterion for online platform quality. In his investigation of website quality in the mobile environment, discovered that all three aspects of website quality significantly affect the usability and convenience of mobile devices(Lok & Hamzah, 2021). When customers use online learning services, if they believe the platform's content is abundant and of good quality, they will see the course material as more valuable and their expectations will be more confirmed(Herwin et al., 2022). Their degree of satisfaction with the course material also rises. Investigated the ongoing usage patterns of MOOC participants(Chen et al., 2021). He assessed MOOC sites' content quality in terms of lecture quality and supplementary learning as part of his research(Blayone et al., 2017). He discovered that the quality of the content significantly positively impacted the perceived usefulness and projected confirmation rate. In light of the results of both studies, the quality of course content on online learning platforms will be referred to in this study as "Quality of Content" (QoC)(Yu, 2021). This covers the depth of the course material, the caliber of the video recordings, the structure of the course material, and the variety of resources included in the course. The degree of confirmation users expect from using online education platforms and their opinions of the platforms' usefulness are influenced by the quality of the course material they believe is available(Broadbent & Lodge, 2021).

H3a: Perceived satisfaction is positively impacted by the quality of the information.

H3b: Sustainable use benefits from high-quality information.

It was discovered that teachers' technical and pedagogical abilities improved, which somewhat enhanced the efficacy of their online instruction. Results correlate positively with online teachers' TPACK level, which is directly tied to their intrinsic motivation. Additionally, instructors' drive to use technology is an innate motivator to integrate technology with teaching and learning to achieve more effective teaching and learning, and technology is a significant instrument for online teaching and learning [36–39]. The following theories have been put out in light of these findings. *H4a: Perceived satisfaction is positively impacted by TPACK.*

H4 b: TPACK contributes to the sustained use of OL systems.

H4c: Net profit is positively impacted by the user satisfaction assessment, which changes the most according to prior study findings, was contextualized and modified to create the most generally used scale(Putra & Murwani, 2022). Further studies have demonstrated that user happiness is a crucial factor influencing their intention to keep using. The expectancy confirmation model (ECM) has this information (Yuebo et al., 2023). As a result, the following theory is put forth: When users are more satisfied with their experience evaluation and platform usage, they are more likely to intend to stick with the online learning platform they are now using. In light of this, the following theory is developed.

H5: The sustained usage of OL systems is positively impacted by user satisfaction.

Online participation pleasure is the attitude of online participation. The breadth and depth of online involvement, on the other hand, are behavioral performance, and students' ongoing use is learning behavioral performance(Castro & Tumibay, 2021). Cognitive performance, or learning impact, is the measure of the validity of online involvement(Gezani, 2024). There cannot be prolonged participation behavior or sustained behavioral efficacy without an attitude of participation satisfaction(Stephen & Rockinson-Szapkiw, 2021). Online education is a learner-centered, self-directed approach that uses the Internet and other information technologies, in contrast to traditional classroom instruction(Wijaya & Arismunandar, 2018). Consequently, OL satisfaction has a major impact on the advantages of OL. In light of this, the following theories are put forth.

H6: Net advantages are greatly increased when users are satisfied.

H7: Net benefits are positively impacted by continued use.

4. Methodology

The statistical analysis method employed in this study was Partial Least Squares Structural Equation Modeling (PLS-SEM)(Afrillia et al., 2022). PLS-SEM was selected for several reasons. First of all, PLS-SEM makes it possible to evaluate the measurement model and structural model at the same time, which is essential for investigating the connections between latent variables and how they affect the success of online learners(Tran & Huang, 2022). Second, PLS-SEM is suitable for the 150-person study sample because it supports smaller sample sizes and is well-suited for exploratory research(Aklani & Liling, 2023). Furthermore, PLS-SEM is capable of handling formative and reflective measurement models, which capture the multifaceted nature of the research model's constructs (Tran & Huang, 2022). Furthermore, PLS-SEM offers resilience to problems that are frequently encountered in survey-based research, such as non-normality and the existence of outliers (Yuebo et al., 2023). In the context of non-full-time adult students in open and distance education in Eastern Indonesia, particularly the frontier, outermost, and disadvantaged (3T) regions, the use of PLS-SEM allows for an efficient analysis of the relationships between system quality, service quality, teachers' TPACK skills, and online learning success(Cavus et al., 2021).The measurement model and structural model are among the elements of the data analysis section that are described in (Kwok & Yang, 2017). The validity and reliability of the variables employed in this study are assessed by the measurement model. Reliability was evaluated to guarantee variable consistency, as determined by Cronbach's alpha and CR values. At the same time, validity checks concentrated on the adopted variables' convergent and discriminative features. Three techniques—Fornell-Larcker, HTMT, and cross-loading—were used to evaluate discriminant validity to guarantee variable distinctiveness. The Average Variance Extracted (AVE) value is the primary determinant of convergent validity. The bootstrap approach is used in the structural model's hypothesis testing to verify the suggested theories. A random sample of 150 participants was selected for the study from five study centers connected to the eastern Indonesian branch campus of the Open University Municipality. An online and an in-person paper questionnaire were both used in the March 2024 survey. The validity criteria were satisfied by 150 responses in total, and participants gave their written informed consent before beginning the study.

5. Instrument

To gather pertinent research, a thorough assessment and classification of the literature on attitudes toward online learning (OL), factors influencing the quality of OL, and Technological Pedagogical Content Knowledge (TPACK) was carried out over the last 10 years. Gathering pre-existing research scales was the first step in the scale creation process. This scale was then completed and further refined through expert interviews. gathering and analyzing data. Five study centers connected to the municipal branch campuses of the Open University of Eastern Indonesia participated in a questionnaire survey that was carried out in March 2024. There were 163 initial responses to the poll, which used a combination of online and in-person paper surveys. A total of 145 replies were found to be legitimate after thorough verification, and these were then included in the analysis. Table 1 displays the respondents' sociodemographic profile, which includes their gender, age, major, occupation, income, current semester of study, and continuing education. This data provides important information about the sample's characteristics. Furthermore, it was decided that 145 people would be a suitable sample size for this investigation. There are enough observations in this sample size to support reliable statistical analyses and insightful findings. Considering the purpose of the study, this sample size also provides a fair representation of the target population. This study's sample size and sampling strategy are justified because they both support the validity and dependability of the results. This approach option attempts to make the research findings more broadly applicable to a larger group of adult tuition learners participating in open and distance learning in eastern Indonesia, especially in the underprivileged, frontier, and outermost districts. Structural Equation Modeling (SEM) is a multivariate statistical technique used in data analysis(Sugilar, 2021). SEM is a multivariate statistical method that uses the covariance matrix of variables to examine and analyze complex data. This approach incorporates both independent and dependent variables into a path diagram while accounting for measurement error. A more thorough analysis of the connections between observable variables that might not be directly measured is made possible by this method. Partial Least Squares Structural Equation Modeling (PLS-SEM), one of the approaches in latent variable analysis, makes use of partial least squares to investigate the relationship between independent and dependent variables. PLS-SEM is a useful analytical technique, especially when there are strong connections between components (Tran & Huang, 2022). PLS-SEM3.0 was the data analysis method used in this study to evaluate the suggested conceptual framework for effective adult online learning.

6. Evaluation Of Measurement Models

As first- and second-order factors in the net benefits (NB) and TPACK constructs, the factor loadings of IQ, SQ, SEQ, US, and USE demonstrated values over 0.7 for Cronbach's α, rho_A, and CR, showing strong reliability in these constructs. Additionally, they showed very little multicollinearity, as shown by Variance Inflation Factor (VIF) values below 5. By having only one

factor with loadings more than 0.5 for each item in its respective construct, each construct demonstrated loadings higher than 0.5 for the identical items, guaranteeing good construct validity. Standardized loadings for every variable and Average Variance Extracted (AVE) were investigated to improve scale validation. Since factor loadings shouldn't be less than 0.5, all of the items assessed in this study had factor loadings more than 0.750, all of which were statistically significant. Furthermore, each latent variable's AVE was greater than 0.5, confirming the scale's good convergent validity. The outcomes are displayed in Table 2. To ascertain which was more significant, the correlation coefficient matrix between the two possible variables and the square root of the AVE were compared. According to the criteria set forth by [48], strong discriminant validity between latent variables is indicated when the squared value of the Average Variance Extracted (AVE) for a latent variable is greater than the correlation coefficient between that variable and the other variables. Strong discriminant validity is indicated by the fact that each diagonal AVE value in this investigation is greater than the correlation coefficient between the corresponding latent variables. As shown in Table 3, the squared AVE for IQ, for instance, is 0.852, which is higher than its correlations with the other variables (0.088, 0.467), indicating that these variables are sufficiently valid. The discriminant validity between the variables was then further evaluated using the HTMT and cross-loading techniques. Tables 4 and 5 present the results, which demonstrate strong discriminant validity among them.Evaluation of structural models The Bootstrapping method is used to estimate parameters for structural model assessment, yielding 5000 analog samples for examination. T values for path coefficients were computed by academics' suggestions [49]. The findings of this investigation confirmed the other nine hypotheses, while H2a, H3a, and H3b were not supported, as shown in Table 6. Hypotheses H2a, H3a, and H3b were not supported by the results, as shown in Table 6, however, the other nine hypotheses were.

7. Result

Common Method Variance (CMV) The variance described by the first component before re-rotation was 12.87%, which is lower than 50% as recommended by other research, according to exploratory factor analysis of the latent variables in this study. This outcome minimizes the possible influence on further empirical research by indicating that common method bias is not a serious issue in this paper.

Table 1. Socio-demographic responden

		Frequency	Valid Percen
Gender	1	65	44,83%
	2	80	55,17%
total		145	100,00%
age	1	10	6,90%
	2	45	31,03%
	3	34	23,45%
	4	33	22,76%
	5	23	15,86%
total		145	100,00%
Education Progress	1	73	50,34%
	2	72	49,66%
total		145	100,00%
Major	1	34	23,45%
	2	23	15,86%
	3	31	21,38%
	4	12	8,28%
	5	22	15,17%
	6	11	32,35%
	7	12	8,28%
total		145	100,00%
Now semester studi	1	34	23,45%
	2	21	14,48%
	3	35	24,14%
	4	26	17,93%
	5	12	8,28%
	6	17	11,72%
total		145	100,00%
Occupation	1	34	23,45%
	2	21	14,48%
	3	23	15,86%
	4	19	13,10%
	5	12	8,28%

8. Discussion

These findings are consistent with hypotheses H1a and H1b, which suggest that learners' satisfaction and retention are positively impacted by the quality of the online learning (OL) system. This implies that students' pleasure and motivation to stick with the OL system are greatly influenced by its structure, which includes its fairness, use, and flexibility. Additionally, the results support hypothesis H2b, which demonstrates how service quality positively affects perceived pleasure. This emphasizes how important service quality is in determining how satisfied students feel. The brand and competitiveness of education are significantly improved by online learning support services, which are becoming more and more common in the cutthroat education industry. The impact of service quality on continuing use, however, was shown to be negligible, defying expectations and hypothesis H2a.

Table 2. Reliability and validity convergence

Construct	item	loading	VIF	Cronbach Alpha	CR	Ave
NB	AD	0.88	2.12	0.5	0.93	0.80
	CD	0.91	2.67	-	-	-
	PD	0.89	2.40	-	-	-
IQ	IQ1	0.87	2.84	0.87	0.94	0.76
	IQ2	0.87	2.98	-	-	-
	IQ3	0.89	2.69	-	-	-
	IQ4	0.75	1.49	-	-	-
TPACK	PCK	0.86	2.27	0.87	0.95	0.78
	TCK	0.85	1.97	-	-	-
	TK	0.87	2.28	-	-	-
	TPACK	0.85	2.20	-	-	-
SEQ	SEQ1	0.92	3.90	0.93	0.95	0.87
	SEQ2	0.96	3.98	-	-	-
	SEQ3	0.91	3.33	-	-	-
	SEQ4	0.90	3.35	-	-	-
SQ	SQ1	0.90	3.08	0.92	0.95	0.83
	SQ2	0.89	3.02	-	-	-
	SQ3	0.85	3.15	-	-	-
	SQ4	0.83	3.12	-	-	-
US	US1	0.90	3.36	0.94	0.95	0.85
	US2	0.93	4.23	-	-	-
	US3	0.992	4.08	-	-	-
	US4	0.98	4.20	-	-	-
USE	USE1	0.89	3.20	0.91	0.93	0.75
	USE2	0.85	2.36	-	-	-
	USE3	0.83	2.15	-	-	-
	USE4	0.83	2.39	-	-	-
	USE5	0.96	3.57			

This implies that although service quality has an indirect impact on perceived satisfaction, it does not directly affect sustained use. Students' degree of satisfaction, which is determined by service quality, affects their likelihood of sticking with the online learning system. According to hypotheses H3a and H3b, learners' perceived happiness and continuing use were not significantly correlated with the quality of the information. This outcome deviates from the conclusions of earlier researchers, including [13:21], who proposed that information quality had a favorable effect on reported satisfaction and ongoing use. The traits of open and remote learning

students, who frequently rely heavily on their teachers and may not exhibit active learning behaviors, can be blamed for this disparity. Additionally, learners' active comprehension of information and the fit between their needs and expectations and the resources at their disposal affect how satisfied they feel themselves to be. The assumption that multiple comparisons between learners and information resources are necessary to develop perceived satisfaction is supported by the study's lack of a significant link between perceived satisfaction and information quality.

Table 3. Discriminant validity according to the Fornell-Larcker standard.

	IQ	NB	SEQ	SQ	TPACK	US	USE
IQ	0.85	-	-	-	-	-	-
NB	0.06	0.89	-	-	-	-	-
SEQ	0.41	0.16	0.91	-	-	-	-
SQ	0.46	0.23	0.52	0.90	-	-	-
TPACK	0.39	0.32	0.39	0.52	0.85	-	-
US	0.23	0.60	0.34	0.39	0.32	0.93	-
USE	0.12	0.58	0.26	0.34	0.33	0.63	0.87

Table 4. HTMT

	IQ	NB	SEQ	SQ	TPACK	US	USE
IQ	-	-	-	-	-	-	-
NB	0.09	-	-	-	-	-	-
SEQ	0.45	0.17	-	-	-	-	-
SQ	0.51	0.25	0.73	-	-	-	-
TPACK	0.45	0.36	0.49	0.58	-	-	-
US	0.22	0.62	0.37	0.14	0.35	-	-
USE	0.13	0.65	0.28	0.37	0.37	0.64	-

Table 5. Cross Loading

	IQ	NB	SEQ	SQ	TPACK	US	USE
IQ1	0.87	0.83	0.39	0.41	0.37	0.18	0.09
IQ2	0.87	0.05	0.33	0.39	0.36	0.14	0.08
IQ3	0.89	0.08	0.40	0.44	0.38	0.19	0.11
IQ4	0.75	0.07	0.29	0.32	0.23	0.17	0.11
AD	0.07	0.88	0.13	0.20	0.29	0.53	0.52
CD	0.08	0.91	0.14	0.22	0.29	0.55	0.51
PD	0.07	0.89	0.14	0.19	0.26	0.52	0.53
SEQ1	0.39	0.16	0.92	0.64	0.43	0.33	0.26
SEQ2	0.38	0.15	0.90	0.60.	0.41	0.32	0.22
SEQ3	0.34	0.13	0.91	0.61	0.39	0.29	0.22
SEQ4	0.38	0.13	0.90	0.62	0.39	0.32	0.24
SQ1	0.45	0.24	0.63	0.90	0.49	0.38	0.35
SQ2	0.42	0.17	0.60	0.89	0.48	0.33	0.27
SQ3	0.39	0.17	0.60	0.89	0.46	0.32	0.30
SQ4	0.41	0.13	0.63	0.90	0.46	0.35	0.29
PCK	0.35	0.27	0.39	0.45	0.86	0.29	0.29
TCK	0.38	0.28	0.31	0.41	0.83	0.25	0.29
TK	0.35	0.28	0.41	0.46	0.86	0.29	0.29
TPACK	0.33	0.24	0.39	0.47	0.85	0.27	0.25
US1	0.15	0.52	0.41	0.41	0.28	0.90	0.57

Table 6. PLS-SEM path

H1a: SQ->USE	0.12	0.05	2.66	0.008	SUPPORT
H1b: SQ->US	0.22	0.04	4.37	***	SUPPORT
H2a: SEQ->USE	-0.04	0.42	0.98	0.32	NON SUPPORT
H2b: SEQ->US	0.13	0.42	3.17	0.00	SUPPORT
H3a: IQ-> US	-0.01	0.47	0.37	0.71	NON SUPPORT
H3b: IQ->USE	-0.09	0.04	1.93	0.05	NON SUPPORT
H4a: TPACK->US	0.15	0.03	3.61	***	SUPPORT
H4b: TPACK->USE	0.14	0.03	3.83	***	SUPPORT
H4c: TPACK->NB	0.08	0.04	2.36	0.02	SUPPORT
H5: US->USE	0.53	0.06	12.21	***	SUPPORT
H6: US->NB	0.37	0.05	5.99	***	SUPPORT
H7: USE->NB	0.33	0.05	5.81	***	SUPPORT

Likewise, there was no evidence to support hypothesis H3b, suggesting that the quality of the information had no beneficial effect on continuing use. This conclusion can be explained by the fact that students mostly utilize the online learning platform for required activities, including watching lectures from teachers, turning in assignments, or taking tests, rather than actively using the platform to further their education. The results, on the other hand, support hypotheses H4a, H4b, and H4c, which contend that teachers' Technological Pedagogical Content Knowledge (TPACK) has a direct impact on student's satisfaction with the learning system, their likelihood of sticking with it, and their educational gains. They also highlight the advantages of integrating TPACK knowledge into instructional design and practical teaching. By offering quantitative proof of the relationship between teachers' TPACK proficiency and students' learning satisfaction, intention to continue learning, and learning benefits, this study adds to the body of current knowledge. Note that there hasn't been any quantitative research done on this relationship before. Furthermore, some empirical research has demonstrated the beneficial effects of teachers' TPACK proficiency on students' academic progress and willingness to continue learning (Stephen & Rockinson-Szapkiw, 2021) and on continuous usage intention (Trevisan et al., 2023). The significance of teachers' TPACK expertise in enhancing students' learning outcomes and engagement with online learning platforms is further supported by these studies.

The results also provide credence to hypothesis H5, which contends that sustained use of online learning is significantly positively impacted by user satisfaction (US). This suggests that students' perceptions of their level of satisfaction have a big impact on how long they stay involved with the online learning environment. Finally, this study supports hypothesis H6 by emphasizing that greater reported satisfaction is linked to greater learning gains for students, which is consistent with other studies. On the other hand, less satisfied students are less interested in the advantages of studying. These results highlight how crucial it is to promote student happiness to maximize learning outcomes. Furthermore, this research backs up hypothesis H7, which emphasizes the benefits of ongoing use of online learning platforms. There is a greater chance of sustained use when these systems successfully meet the demands of students, which encourages productive and fruitful learning experiences. In conclusion, this study advances our knowledge of the variables affecting student satisfaction, retention, and learning advantages in the setting of online education. The results of this investigation show both similarities and contrasts with those of earlier studies. To maximize students' learning experiences, educational institutions and online learning providers can use these findings to improve the design and delivery of online learning systems, increase service quality, and highlight teachers' TPACK knowledge.

9. Discussion

In conclusion, this study combines the ISS Model and TPACK to provide a thorough model for effective adult online learning. The results highlight the vital role that teachers' TPACK teaching proficiency plays in enhancing the advantages that adult learners gain from online learning. This study emphasizes how crucial teachers' TPACK competencies are in determining how well online learning goes. The findings indicate that learners' reported satisfaction and sustained engagement are positively impacted by high TPACK abilities. Furthermore, this study emphasizes how TPACK improves student learning outcomes in online learning contexts. Enhancing TPACK abilities has the

potential to enhance teaching methods, promote consistent usage of online learning environments, and raise student satisfaction, especially for the study's adult participants. Nonetheless, it's critical to acknowledge certain limitations. First of all, even though teachers and administrators play a big role in the OL process, their opinions were not taken into account in this survey, which only included students as respondents. Therefore, to analyze the elements that influence adult online learners' success, future studies should look into the viewpoints of administrators and instructors. Second, care should be taken when extrapolating the findings because the study's sample is restricted to students in a certain area. To identify the success determinants of adult OL in various countries, more study is required because different regions have distinct learning contexts and resources.

10. Implications

First, by merging the ISS and TPACK theories, this model presents a thorough multifaceted model for the success of adult online learning (OL) in Indonesia, particularly in the frontier, outermost, and underprivileged regions. The approach broadens the range of influencing factors by highlighting system quality, service quality, and teachers' TPACK capabilities. It builds on earlier study material. The link between these parameters and subjective pleasure, ongoing use, and overall benefits in adult OL is confirmed by empirical validation in this model. Second, prior research has mostly ignored the critical role that teachers' TPACK skills play in OL success in favor of focusing on the relationship between characteristics that influence sustained usage and reported pleasure. This study found that TPACK significantly improved learners' reported happiness, OL benefits, and ongoing system use. Higher degrees of pleasure and greater OL system utilization are correlated with stronger TPACK, which eventually results in greater learning advantages. The second important contribution is this explanation of how TPACK directly affects OL benefits. Subsequently, whereas the majority of prior empirical research has focused on full-time students, this study turns its attention to adult learners, family, and societal responsibilities. By showing that there is no positive correlation between learner quality and reported satisfaction among adult learners, this study contradicts earlier findings. This disparity most likely results from the various research participants. This study takes into account persistent and cultural elements that affect OL success in the setting of adult learners. Persistence and perceived satisfaction, sustained usage, and a moderating effect of long/short-term orientation on the link between sustained use and benefits were all found to be positively correlated in the study. A third important addition is this tailored strategy, which provides more pertinent and concentrated findings. Last but not least, this study will move the focus of OL success research from developed to underdeveloped nations, particularly in Indonesia's east. Even though OL is used worldwide, students' achievement may be impacted by several factors, including the OL environment, cultural background, educational system, and economic conditions in diverse regions. Research on the effectiveness of OL in underdeveloped nations is therefore required. Researching the elements that affect open distance learning success can aid in the development of more practical and scientific methods for OL success in online learning in Indonesia and other developing nations. This study offers a reference for the advancement and development of remote open education instruction in this area since it not only comprehensively examines the theoretical elements influencing OL performance but also offers concrete recommendations and solutions at the practical level.

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References

Abuhassna, H., Al-Rahmi, W. M., Yahya, N., Zakaria, M. A. Z. M., Kosnin, A. B. M., & Darwish, M. (2020). Development of a new model on utilizing online learning platforms to improve students' academic achievements and satisfaction. International Journal of Educational Technology in Higher Education, 17(1). https://doi.org/10.1186/s41239-020-00216-z

Abuhassna, H., Awae, F., Bayoumi, K., Alzitawi, D. U., Alsharif, A. H., & Yahaya, N. (2022). Understanding Online Learning Readiness among University Students: A Bibliometric Analysis. International Journal of Interactive Mobile Technologies, 16(13), 81–94. https://doi.org/10.3991/ijim.v16i13.30605

Acar-şeşen, C. K. A. C. B. (2023). Predicting Preservice Science Teachers ' TPACK through ICT. 11269–11289.

Afrillia, Y. M., Putra, Z. H., Noviana, E., Hidayat, R., & Dahnilsyah, D. (2022). The connection between prospective teachers' procedural and conceptual knowledge with problem-posing skills of fractions. International Journal of Evaluation and Research in Education, 11(2), 763–772. https://doi.org/10.11591/ijere.v11i2.22202

Aklani, S. A., & Liling, J. R. (2023). Analysis of ChatGPT Usage to Support Student Lecture Assignments. 13(3), 599–604.

Alismaiel, O. A., Cifuentes-Faura, J., & Al-Rahmi, W. M. (2022). Online Learning, Mobile Learning, and Social Media Technologies: An Empirical Study on Constructivism Theory during the COVID-19 Pandemic. Sustainability (Switzerland), 14(18). https://doi.org/10.3390/su141811134

Ally, M. (2008). Foundations of educational theory for online learning. In The theory and practice of online learning.

Blayone, T. J. B., vanOostveen, R., Barber, W., DiGiuseppe, M., & Childs, E. (2017). Democratizing digital learning: theorizing the fully online learning community model. International Journal of Educational Technology in Higher Education, 14(1). https://doi.org/10.1186/s41239-017-0051-4

Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed methods case study. International Journal of Educational Technology in Higher Education, 15(1). https://doi.org/10.1186/s41239-018-0107-0

Broadbent, J., & Lodge, J. (2021). Use of live chat in higher education to support self-regulated help seeking behaviours: a comparison of online and blended learner perspectives. International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-021-00253-2

Caingcoy, M. E. (2023). Journal of World Englishes and Educational Practices (JWEEP) Research Capability of Teachers: Its Correlates, Determinants and Implications for Continuing Professional Development. 2018, 70–81. https://doi.org/10.32996/jweep

Castro, M. D. B., & Tumibay, G. M. (2021). The Leadre. Education and Information Technologies, 26(2), 1367–1385.

Cavus, M., Kan Kilinc, B., Yazici, B., Tekeli, S., Gunsoy, G., GunsoY, B., & Karaduman, C. (2021). Modeling The Contribution Of Distance Education To Students' Preparation For The Professions. Turkish Online Journal of Distance Education, 22(1), 106–119. https://doi.org/10.17718/TOJDE.849890

Chen, X., Zou, D., Xie, H., & Wang, F. L. (2021). Past, present, and future of smart learning: a topic-based bibliometric analysis. International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-020-00239-6

Chinnappan, M., & Forrester, T. (2014). Generating procedural and conceptual knowledge of fractions by pre-service teachers. Mathematics Education Research Journal, 26(4), 871–896. https://doi.org/10.1007/s13394-014-0131-x

Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: exploring advantages and disadvantages for engagement. Journal of Computing in Higher Education, 30(3), 452–465. https://doi.org/10.1007/s12528-018-9179-z

Dwiyogo, W. D. (2018). Developing a blended learning-based method for problem-solving in capability learning. The Turkish Online Journal of Educational Technology, 17(1–10), 51–61. https://eric.ed.gov/?id=EJ1165753

Full, K. M., Malhotra, A., Crist, K., Moran, K., & Kerr, J. (2019). Assessing psychometric properties of the PROMIS Sleep Disturbance Scale in older adults in independent-living and continuing care retirement communities. Sleep Health: Journal of the National Sleep Foundation, 5(1), 18–22. https://doi.org/10.1016/j.sleh.2018.09.003

Galvis, Á. H. (2018). Supporting decision-making processes on blended learning in higher education: literature and good practices review. International Journal of Educational Technology in Higher Education, 15(1), 1–38. https://doi.org/10.1186/s41239-018-0106-1

Gezani, B. (2024). Challenges of Online Learning in the Comprehensive Open Distance and Elearning Context – A Case Study of the University of South Africa. E-Journal of Humanities, Arts and Social Sciences, 5(7), 1265–1274. https://doi.org/10.38159/ehass.20245716

Herwin, H., Fathurrohman, F., Wuryandani, W., Dahalan, S. C., Suparlan, S., Firmansyah, F., & Kurniawati, K. (2022). Evaluation of structural and measurement models of student satisfaction in online learning. International Journal of Evaluation and Research in Education, 11(1), 152–160. https://doi.org/10.11591/ijere.v11i1.22115

Hew, K. F., Jia, C., Gonda, D. E., & Bai, S. (2020). Transitioning to the "new normal" of learning in unpredictable times: pedagogical practices and learning performance in fully online flipped classrooms. International Journal of Educational Technology in Higher Education, 17(1). https://doi.org/10.1186/s41239-020-00234-x

Hidayati, N., Zubaidah, S., & Amnah, S. (2023). Effective learning model bases problem based learning and digital mind maps to improve student ' s collaboration skills. International Journal of Evaluation and Research in Education (IJERE), 12(3), 1307–1314. https://doi.org/10.11591/ijere.v12i3.22654

Hokor, E. K. (2020). Pre-service Teachers' Probabilistic Reasoning in Constructivist Classroom. Pedagogical Research, 5(2). https://doi.org/10.29333/pr/7838

Hrastinski, S. (2019). What Do We Mean by Blended Learning? TechTrends, 63(5), 564–569. https://doi.org/10.1007/s11528-019-00375-5

Kauffman, H. (2015). A review of predictive factors of student success in and satisfaction with online learning. Research in Learning Technology, 23(1063519), 1–13. https://doi.org/10.3402/rlt.v23.26507

Koehler, M. J., Mishra, P., Michigan, E. De, & Unidos, E. (2015). ¿ Qué son los Saberes Tecnológicos y Pedagógicos del Contenido (TPACK)? What Is Technological Pedagogical Content Knowledge (TPACK)? 10, 9–23.

Koh, J. H. L., Daniel, B. K., & Greenman, A. C. (2023). Adaptiveness for Online Learning: Conceptualising 'Online Learning Dexterity' from Higher Education Students' Experiences. New Zealand Journal of Educational Studies, 58(2), 379–397. https://doi.org/10.1007/s40841-023-00287-2

Kolb, D. A. (2015). Lifelong Learning and Integrative Development. In Experiential learning : experience as the source of learning and development.

Kotzebue, L. Von. (2023). Two is better than one — Examining biology- specific TPACK and its T-dimensions from two angles. Journal of Research on Technology in Education, 55(5), 765–782. https://doi.org/10.1080/15391523.2022.2030268

Kumar, C., Rangappa, K. B., Suchitra, S., & Gowda, H. (2024). Digital distractions during blended learning and its negative repercussions : an empirical analysis. 19(1), 1–18. https://doi.org/10.1108/AAOUJ-02-2023-0024

Kwok, D., & Yang, S. (2017). Evaluating the intention to use ICT collaborative tools in a social constructivist environment. International Journal of Educational Technology in Higher Education, 14(1), 1–14. https://doi.org/10.1186/s41239-017-0070-1

Lakhal, S., Mukamurera, J., Bédard, M. E., Heilporn, G., & Chauret, M. (2020). Features fostering academic and social integration in blended synchronous courses in graduate programs. International Journal of Educational Technology in Higher Education, 17(1). https://doi.org/10.1186/s41239-020-0180-z

Lange, C., & Costley, J. (2020). Improving online video lectures: learning challenges created by media. International Journal of Educational Technology in Higher Education, 17(1). https://doi.org/10.1186/s41239-020-00190-6

Lok, W. F., & Hamzah, M. (2021). Student experience of using mobile devices for learning chemistry. International Journal of Evaluation and Research in Education, 10(3), 893–900. https://doi.org/10.11591/ijere.v10i3.21420

Lu, C., & Cutumisu, M. (2022). Online engagement and performance on formative assessments mediate the relationship between attendance and course performance. International Journal of Educational Technology in Higher Education, 19(1). https://doi.org/10.1186/s41239-021-00307-5

Mario, J., Iglesias, O., Cabero-almenara, J., & Palacios-rodríguez, A. (2023). Development of the teacher ' s technological pedagogical content knowledge (TPACK) from the Lesson Study : A systematic review. February. https://doi.org/10.3389/feduc.2023.1078913

Muslimin, A. I. (2023). TPACK-SAMR digital literacy competence , technostress , and teaching performance : Correlational study among EFL lecturers. 15(2).

Pardamean, B., Suparyanto, T., Cenggoro, T. W., Sudigyo, D., & Anugrahana, A. (2022). AI-Based Learning Style Prediction in Online Learning for Primary Education. IEEE Access, 10, 35725–35735. https://doi.org/10.1109/ACCESS.2022.3160177

Pujawan, I. G. N., Rediani, N. N., Antara, I. G. W. S., Putri, N. N. C. A., & Bayu, G. W. (2022). Revised Bloom Taxonomy-Oriented Learning Activities To Develop Scientific Literacy and Creative Thinking Skills. Jurnal Pendidikan IPA Indonesia, 11(1), 47–60. https://doi.org/10.15294/jpii.v11i1.34628

Purnomo, A., Ratnawati, N., & Aristin, N. F. (2016). Pengembangan Pembelajaran Blended Learning Pada Generasi Z. Jurnal Teori Dan Praksis Pembelajaran IPS, 1(1), 70–76. https://doi.org/10.17977/um022v1i12016p070

Putra, E. I., & Murwani, I. A. (2022). The Implementation of S-O-R Framework (Stimulus , Organism , and Response) in User Behavior Analysis of Instagram Shop Features on Purchase. 9523(4), 42–53. https://doi.org/10.36347/sjet.2022.v10i04.003

Reedy, A. (2019). Rethinking online learning design to enhance the experiences of Indigenous higher education students. Australasian Journal of Educational Technology, 35(6), 132–149. https://doi.org/10.14742/ajet.5561

Sahni, J. (2023). Is Learning Analytics the Future of Online Education? International Journal of Emerging Technologies in Learning (IJET), 18(02), 33–49. https://doi.org/10.3991/ijet.v18i02.32167

Sapri, J., Agustriana, N., & Kusumah, R. G. T. (2019). The Application of Dick and Carey Learning Design toward Student's Independence and Learning Outcome. 295(ICETeP 2018), 218–222. https://doi.org/10.2991/icetep-18.2019.53

Stephen, J. S., & Rockinson-Szapkiw, A. J. (2021). A high-impact practice for online students. Smart Learning Environments, 8(1), 2–18.

Sugilar. (2021). Students' Barriers To Online Tutorial. Turkish Online Journal of Distance Education, 22(1), 170–178. https://doi.org/10.17718/TOJDE.849901

Suhandiah, S., Suhariadi, F., Yulianti, P., Wardani, R., & Muliatie, Y. E. (2022). Online learning satisfaction in higher education: what are the determining factors? Cakrawala Pendidikan, 41(2), 351–364. https://doi.org/10.21831/cp.v41i2.35724

Thohir, M. A. (2023). The effects of TPACK and facility condition on preservice teachers ' acceptance of virtual reality in science education course. 15(2).

Thyssen, C., Huwer, J., Irion, T., & Schaal, S. (2023). education sciences From TPACK to DPACK : The " Digitality-Related Pedagogical and Content Knowledge " -Model in STEM-Education.

Titus, A., & Muttungal, P. V. (2023). Empowered learning in school: A scoping review. International Journal of Evaluation and Research in Education, 12(2), 729–738. https://doi.org/10.11591/ijere.v12i2.24429

Toker, S. (2022). The progress of 21st-century skills throughout instructional design projects: a quasi-experimental comparison of rapid prototyping and dick and carey models. In Education and Information Technologies (Vol. 27, Issue 2). Springer US. https://doi.org/10.1007/s10639-021-10673-2

Tomei, L. A. (2007). A theoretical model for designing online education in support of lifelong learning. In Online Education for Lifelong Learning. https://doi.org/10.4018/978-1-59904-319-7.ch006

Tran, Q., & Huang, D. (2022). Using PLS-SEM to analyze challenges hindering success of green building projects in Vietnam. 24(1), 47–64. https://doi.org/10.1108/JED-04-2020-0033

Trevisan, O., De Rossi, M., Christensen, R., Knezek, G., & Smits, A. (2023). Factors shaping faculty online teaching competencies during the Covid-19 pandemic. Educational Technology Research and Development, 71(1), 79–98. https://doi.org/10.1007/s11423-023-10197-1

Wijaya, H., & Arismunandar, A. (2018). Pengembangan Model Pembelajaran Kooperatif Tipe STAD Berbasis Media Sosial. Jurnal Jaffray, 16(2), 175. https://doi.org/10.25278/jj71.v16i2.302

Yu, Z. (2021). The effects of gender, educational level, and personality on online learning outcomes during the COVID-19 pandemic. International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-021-00252-3

Yuebo, L., Halili, S. H., & Razak, R. A. (2023). Factors Influencing the Online Learning Success of Adults in Open and Distance Education in Southwest China. International Journal of Information and Education Technology, 13(10), 1615–1624. https://doi.org/10.18178/ijiet.2023.13.10.1670