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Determinants of Learning Satisfaction in Technology-Integrated Higher Education: The Role of Digital Competence and Self-Regulated Learning

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Abstract
The integration of digital technologies into higher education has transformed instructional practices and reshaped determinants of student learning satisfaction. This study investigates the influence of self-efficacy, academic service quality, digital competence, and self-regulated learning on student satisfaction within a technology-integrated biology education context. A quantitative survey design was employed involving 155 undergraduate students selected from a population of 360 students at a public university in Indonesia. Data were collected using a five-point Likert-scale questionnaire and analysed through PLS-SEM. The measurement model demonstrated satisfactory reliability and validity, with all constructs meeting the required thresholds for factor loadings, composite reliability, and average variance extracted. The structural model revealed that academic service quality ($\beta = 0.361$, $p < 0.05$) and self-regulated learning ($\beta = 0.516$, $p < 0.001$) significantly and positively predicted student satisfaction. In contrast, self-efficacy and digital competence did not exhibit significant direct effects. The model explained 85.7% of the variance in learning satisfaction ($R^2 = 0.857$), indicating strong predictive capacity. These findings suggest that within technology-integrated higher education environments, students' capacity to regulate their learning processes and the quality of institutional academic services play more decisive roles in shaping satisfaction than technical digital skills alone. The study contributes empirical evidence to the discourse on technology-enhanced pedagogy by emphasizing the strategic importance of self-regulation and institutional service systems in optimizing digitally mediated learning experiences.

Keywords: Academic Service Quality; Digital Competence; Learning Satisfaction; Self-Efficacy; Self-Regulated Learning

INTRODUCTION

The rapid development of digital technology has fundamentally transformed the landscape of higher education. Universities are no longer merely physical learning spaces but have evolved into technology-integrated learning environments supported by Learning Management Systems (LMS), online platforms, blended learning models, and digital communication tools. The integration of

technology into instructional processes has reshaped how knowledge is delivered, accessed, and constructed. In this context, learning effectiveness and student satisfaction are increasingly influenced by how well learners adapt to and engage with digitally mediated instructional systems.

Higher education institutions today function as complex technology-supported learning ecosystems in which pedagogical processes, academic services, and learner characteristics interact dynamically. Academic service systems are increasingly digitalized, ranging from online academic administration to virtual consultation and e-learning support services. Consequently, student satisfaction in higher education cannot be separated from the quality of technology-based academic services and the effectiveness of digitally facilitated learning experiences.

Within technology-integrated learning environments, digital competence and self-regulated learning (SRL) emerge as critical determinants of academic success. Digital competence enables students to effectively navigate LMS platforms, access online learning resources, evaluate digital information, and participate in virtual collaboration. Meanwhile, SRL plays a crucial role in helping learners manage their cognitive, motivational, and behavioral processes in flexible and autonomous digital learning contexts such as blended and online learning. Without adequate digital competence and self-regulation, students may struggle to fully benefit from technology-enhanced instructional designs. In such technology-mediated academic settings, psychological and behavioral factors such as self-efficacy, digital competence, service quality, and self-regulated learning may significantly influence students' learning satisfaction.

Self-efficacy is an individual's belief in their ability to perform tasks assigned to them, manage their learning activities, and achieve their academic goals, whether these goals originate from themselves or others (Mamesah & Kusumiati, 2019). Self-efficacy can also be defined as an individual's belief in their ability to overcome various situations and accomplish tasks using their existing abilities (Ghufron, 2017). Therefore, self-efficacy is one of the key factors that students must possess when planning their studies at a university to ensure they graduate on time. Self-efficacy is the confidence that an individual has in their ability to complete tasks effectively and efficiently so that the tasks produce the desired results. Self-efficacy refers to the belief that one is capable of doing what one desires (Sintya, 2019). According to Bandura (1977), the differences in self-efficacy among individuals lie in three components: Magnitude, Strength, and Generality. The researcher adopted self-efficacy indicators from these three components, which will be used to create a list of questionnaire statements for the research to be conducted.

Parasuraman et al. (1985) clearly define service quality as the comparison between the service expected by consumers (service users) and the service received. According to Rahmayanti (2013) in (Novriavani et al., 2022), academic service quality is a comparison between the academic services perceived by customers or stakeholders and the academic service quality expected by customers or stakeholders. If the perceived academic service quality is equal to or exceeds the expected service quality, then the service is considered to be of high quality. Higher education institutions are one form of service provider that involves a high level of interaction between service providers and service users (Bendriyanti, 2022). According to Tjiptono and Diana (2003), there are five criteria for determining service quality, namely reliability, responsiveness, assurance, empathy, and tangibles. The academic services referred to include services in the teaching and learning process, services in the use of facilities supporting the learning process provided by universities, and administrative services related to academics.

The digital era is a time when all humans can communicate with each other so closely even though they are far apart. We can easily obtain certain information quickly, even in real time. Students are academics who, in this era, enjoy accessing and using information technology. The use of digital media, whether for searching for information online, playing games or using online applications and other social media, facilitates students in communicating or building relationships or collaborations with others. Information technology is one of the necessities that cannot be separated from human life, including students (Lutvia, 2011). Where students utilize existing technology to carry out activities, whether daily activities, socializing, working, or learning. Technological advancements

have brought changes to the lifestyle, way of thinking, and behaviour of students today, and not only students but almost all sectors have been influenced by technological advancements (Widya et al., 2022).

The learning process in higher education requires students as learners to be creative, active, independent, innovative, understand the learning objectives to be achieved, and be able to determine the strategies to be implemented in order to achieve the desired learning outcomes. Self-regulated learning is related to students' ability to manage, control, and monitor themselves in terms of metacognition, motivation, and behaviour (Pamungkas, 2020). Self-regulated learning can improve students' abilities in terms of in the self-regulated learning (SRL) approach, students must regulate themselves to understand how and where to learn, how to get active help from peers or lecturers. Self-regulation in learning encompasses students' cognition, motivation, and behavior in performing learning activities and taking greater responsibility for knowing the efforts required to achieve learning objectives (Zimmerman & Martinez-Pons, 1990).

Students are required to adapt and regulate themselves effectively through their abilities and skills in controlling learning activities, setting goals, and seeking resources that facilitate the learning process. The characteristics of self-regulated learners are identified through three aspects, according to Zimmerman et al. (1989): metacognition, motivation, and behaviour. Someone with good metacognitive abilities will plan, organize, and instruct themselves and their behaviour both in learning and in learning efforts. Additionally, (Zimmerman et al., 1989) also noted that someone with good self-regulated learning will direct their behavior and optimize their activities toward desired goals.

The implementation of educational programs should not only focus on providing good physical facilities but should also be accompanied by a satisfactory academic service process to ensure student loyalty (Rinala & Yudana, 2013). Student satisfaction is one of the indicators of an institution's success in delivering higher education. Additionally, when students feel satisfied, there is a high likelihood of positive information emerging about the institution, which can attract many prospective students to choose that institution (Susetyo et al., 2022).

RESEARCH METHODS

This study uses a methodological approach utilizing Structural Equation Modelling (SEM) to determine the impact of self-efficacy, academic service quality, digital competence, and learning independence on student satisfaction in learning biology. This study combines self-efficacy, academic service quality, digital competence, and learning independence into an educational strategy to improve student satisfaction in learning biology at the state university level. Furthermore, future research should encourage the use of technology and innovative learning methods that promote academic and social development, ultimately leading to a more inclusive and adaptable education system in Indonesia.

The population is the entire subject of the research (Arikunto, 2006). The population in this study consists of all students in the Biology Education Program at the Faculty of Education and Teacher Training, University of Jambi, from the 2020-2023 cohort. The sample in this study was selected using quota sampling and chosen randomly. A sample is a portion or representative of the population that shares the same characteristics as the population (Hadi, 2009). According to Riduwan (2011), sampling technique is the method of selecting a representative sample from the population. The purpose of sampling in this study is to obtain observation objects that represent the population. In selecting the sample, the researcher followed Sugiyono (2011) regarding the determination of the sample size at a 10% error rate from the population. Based on the Table for determining the sample size from a specific population according to Sugiyono (2011), with a population size of 360 at a 10% error rate, the sample size for this study is 155 students. According to Sugiyono (2011), quota sampling is a technique for determining the sample size (quota) desired. This technique is carried out by selecting individuals based on certain characteristics that have been determined in advance. The

aim is to control who or what is included in the sample so that the distribution of characteristics is the same as the wider population. The advantage of quota sampling is that it is practical because the sample size is determined in advance.

The instrument used in this study is a questionnaire. According to Sutoyo (2012), a questionnaire is defined as a series of written questions or statements about factual data or opinions related to the respondent, which are considered facts or known truths and need to be answered by the respondent. The questionnaire used in this study is a closed-ended questionnaire. According to Riduwan (2011), a closed-ended questionnaire is a questionnaire presented in such a way that respondents are asked to choose one answer that matches their characteristics. According to U, Silalahi (2010), the Likert scale is a scale used to measure the attitudes, opinions, and perceptions of an individual or group of people regarding something. The closed-ended questionnaire used in this study employs a five-point Likert scale format, with response options including strongly agree, agree, neutral, disagree, and strongly disagree. The reason for using the Likert scale is that it is relatively easier to create and has a high level of reliability (consistency of the evaluation tool).

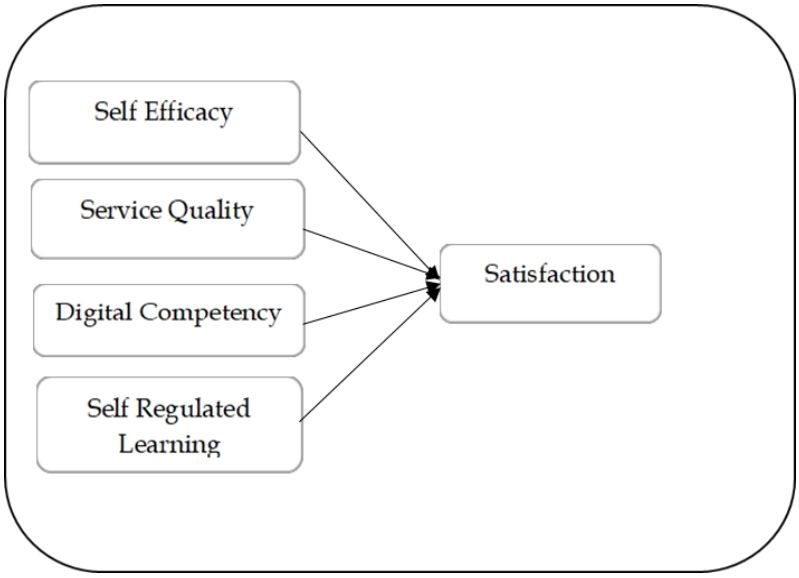

Figure 1. Research Hypothesis Framework

Where:

H1 : Self-efficacy as an independent variable
H2 : Service quality as an independent variable
H3 : Digital competence as an independent variable
H4 : Self-regulated learning as an independent variable
Y : Satisfaction as a dependent variable

Data collection was conducted through Google Forms, an application developed by Google Inc. At the time of the study, the researcher shared the questionnaire link via the social media platform WhatsApp to the 2020-2023 cohort after the academic activities were completed. The questionnaire instrument used in this study consists of two parts. In the first part, respondents were asked to provide demographic information, including gender and the year they enrolled at Jambi University. The second part contains 25 statements related to the variables being studied. The questionnaire used in this study was designed as a five-point Likert scale with response options of strongly agree, agree, neutral, disagree, and strongly disagree. All respondent answers were entered into Microsoft Excel and transferred into SmartPLS format. This is because the measurement and evaluation of the model were conducted through data computation in SmartPLS, which is based on the Partial Least Squares Structural Equation Modelling (PLS SEM) procedure.

The method used in this study was a survey, which aims to collect data about a population by asking questions to a sample from that population. Survey research is conducted on both large and small populations, but the data studied is from a sample taken from that population, thereby identifying relative occurrences, distributions, and relationships between sociological and psychological variables (Akdon and Hadi, 2005). Surveys were chosen for this research to fulfill the research objective of exploring the factors that influence student satisfaction in learning biology at the university level. The literature review provides guidance to researchers in discussing the definitions and analysis of theories and concepts related to the theoretical framework of the research (Prasojo et al., 2020). It also aims to determine an objective approach to research instrumentation.

The instruments were designed to answer the research objectives (Sukendro, et al., 2020). The research framework above (Figure 1) uses primary data as a data collection technique, namely by creating a research instrument in the form of a questionnaire. This study uses primary data because primary data is obtained directly from the source by the data collector, thus enabling direct interaction. Additionally, since the writing of the research proposal, the researcher has already determined the data to be obtained in accordance with the research objectives. Thus, during data collection, the researcher will not ask questions or provide questionnaires that are not necessary for the research. This aligns with the statement (Purwanto, 2018) In essence, the use of primary data in research can control researchers to only collect data that is relevant to the needs, and the collection of primary data using questionnaires is usually done by researchers who conduct research using quantitative methods, and the use of questionnaires is more efficient and suitable because it can reach a large number of respondents.

In the illustration in Figure 2, there are 5 latent variable groups and 25 manifest variables that follow the formative indicator model. The independent variables in this study consist of 4 variables, namely Self Efficacy (SE), Service Quality (SQ), Digital Competency (DC), and Self-Regulated (SR), while the dependent variable is Satisfaction (SF). The purpose of the measurement model analysis in the outer model section is to ensure that all indicators measuring latent variables demonstrate adequate convergent and discriminant validity. The path analysis model in this study uses a multiple regression model. A multiple regression model is a model with several independent variables (exogenous) and one dependent variable (endogenous).

The analysis was conducted using statistical techniques to test the hypotheses or assumptions that had been set temporarily and to describe the characteristics of the population. Data analysis in this study used Smart-PLS. Smart-PLS stands for Partial Least Squares Structural Equation Modeling (PLS-SEM), which is one of the data analysis methods used to test the relationship model between variables in research. PLS-SEM is a useful tool for measuring, testing, and understanding the relationships between variables in a conceptual model. Its purpose is to understand the extent to which these variables are interrelated and the extent to which they influence other variables in the model. The data collected from respondents is entered into a Table in Microsoft Excel according to the variable groups and indicators. After entering the raw data in Excel format, the data is saved in CSV (Comma delimited) format so that it can be detected by the SmartPLS program.

Data were calculated for Cronbach's alpha evaluation, which aims to report initial reliability before the main data collection. No construct had an alpha value below the threshold of 0.7. A Cronbach's alpha coefficient value of more than 0.7 indicates that the data to be studied has sufficient reliability. Conversely, a Cronbach's alpha coefficient value below 0.7 indicates that the data to be studied is unreliable. The statement items that have been it was created to demonstrate a high level of reliability and validity in providing comprehensive data, as evidenced by a Cronbach's alpha value exceeding 0.7, which reflects the perspective of students as learners at the university level.

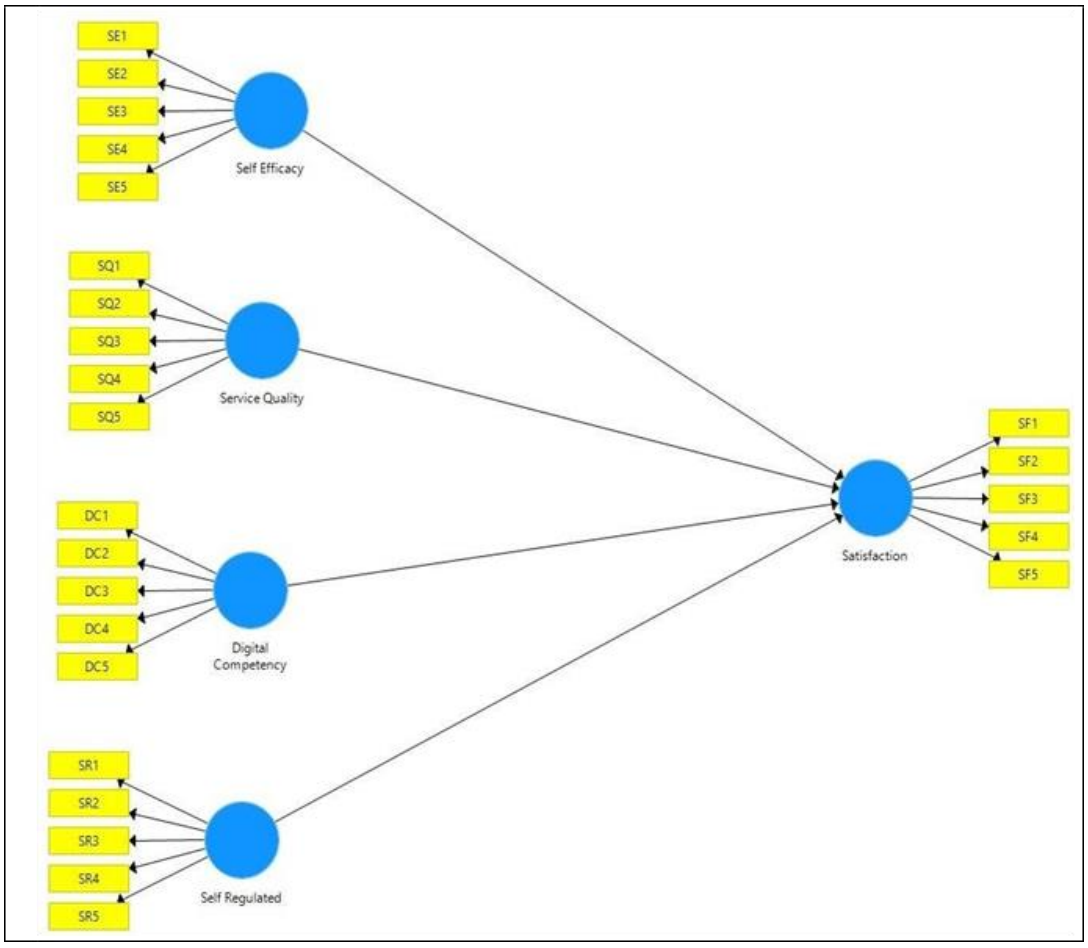

Figure 2. Research Path Diagram Model

RESULTS AND DISCUSSION

The research hypothesis was tested using a structural equation model (SEM) through a Partial Least Squares (PLS-SEM) approach with the help of SmartPLS software. The results of the research questionnaire were distributed to 155 respondents, namely students of the biology education study program at the Faculty of Teacher Training and Education, University of Jambi, which was distributed via a WhatsApp social media link to be filled in according to the research interests. The criteria for respondents can be seen in the frequency distribution chart below:

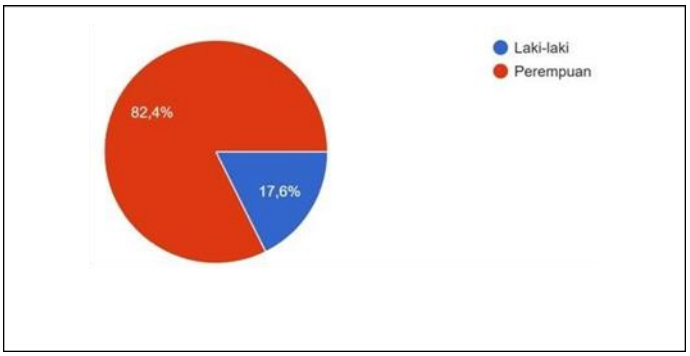

Figure 3. Frequency Distribution of Respondents Based on Gender

Based on the results shown in Figure 3, which are descriptive statistics, it is known that female respondents outnumber male respondents, with a percentage of 82.4%, while male respondents account for 17.6%.

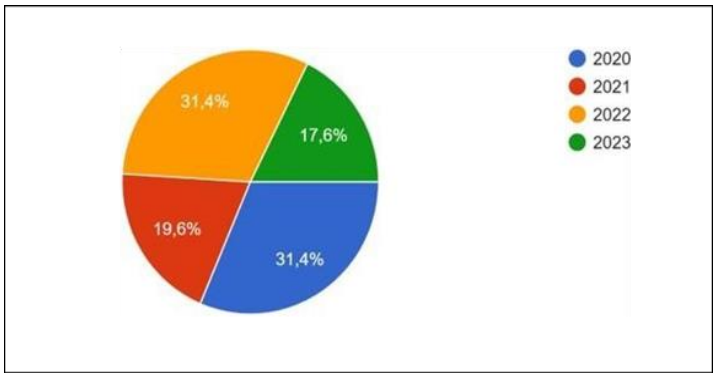

Figure 4. Frequency Distribution of Respondents Based on Cohort

Based on the descriptive statistical data obtained, as shown in Figure 4, it can be seen that the percentage of respondents from the 2020 cohort and the 2022 cohort is the same, at 31.4%. The 2021 cohort has a percentage of 19.6%, and the 2023 cohort has a percentage of 17.6%.

Evaluation of the Confirmatory Composite Analysis (CCA) Measurement Model in the SmartPLS technique, differences in multidimensional construct properties can be addressed simultaneously by calculating the loading values, AVE, communality for validity, and Cronbach's alpha and composite reliability for reliability testing on reflective constructs at any level. Meanwhile, formative constructs are calculated based on t-statistic values in the outer weight Table in bootstrapping to test the significance of the relationship between indicators and their constructs or the relationship between lower-order constructs and higher-order formative constructs.

Validity Test

The validity test of reflective indicators using the SmartPLS program can be seen from the loading factor value for each construct indicator. The rule of thumb for assessing convergent validity is that the factor loading value must be greater than 0.7 for confirmatory research and between 0.6 and 0.7 for exploratory research, and the average variance inflation factor (AVE) must be greater than 0.5. Based on the results in Table 1, it is known that all variables are valid because they have values greater than 0.50, ranging from 0.860 to 0.913. This is consistent with the statement by Ghozali (2015) that the average variance inflation factor (AVE) must be greater than 0.5. The results of the convergent validity test for the average variance inflation factor (AVE) value with the rule of thumb > 0.5 (Yusri, 2020).

Reliability Test

Reliability testing is used to prove the accuracy, consistency, and precision of an instrument in measuring a construct. Measuring the reliability of a construct with reflective indicators can be done in two ways, namely with Cronbach's Alpha and Composite Reliability. The rule of thumb for assessing construct reliability is that the Composite Reliability value must be greater than 0.70. However, using Cronbach's Alpha to test construct reliability will yield lower values (underestimate), so it is more advisable to use Composite Reliability. Based on the research data obtained, it can be seen that the Cronbach's Alpha value is > 0.7, so it is acceptable and categorized as reliable. This is in line with the opinion that all composite reliability values above 0.70 already have good reliability or are categorized as reliable.

Collinearity Statistics (VIF)

VIF is used to measure the standard criteria for detecting multicollinearity in linear regression involving two independent variables. Multicollinearity refers to a situation where there is correlation between independent variables that are not mutually independent (Akinwande et al., 2015). A VIF value > 10 indicates that there is a serious multicollinearity issue between variables. Based on Table 1, it was found that all items obtained a value <10, confirming that the data obtained did not have multicollinearity issues.

Table 1. Statistical description of Load Factors, Cronbach's Alpha, Reliability, AVE, and VIF

Variabel	Item	Loading)	α	CR	AVE	VIF
Self-Efficacy	SE1	0.928	0.959	0.968	0.858	5.055
	SE2	0.934				5.307
	SE3	0.948				6.397
	SE4	0.912				4.016
	SE5	0.911				4.180
Service Quality	SQ1	0.859	0.961	0.970	0.866	2.879
	SQ2	0.941				6.299
	SQ3	0.961				8.981
	SQ4	0.940				6.922
	SQ5	0.950				7.126
Digital Competency	DC1	0.927	0.959	0.968	0.860	5.626
	DC2	0.945				5.985
	DC3	0.927				5.683
	DC4	0.931				4.948
	DC5	0.908				3.993
Self-Regulated	SR1	0.954	0.961	0.976	0.913	7.376
	SR2	0.947				6.537
	SR3	0.959				8.275
	SR4	0.962				10.044
	SR5	0.955				8.551
Satisfaction	SF1	0.944	0.974	0.974	0.905	6.745
	SF2	0.953				7.361
	SF3	0.951				7.160
	SF4	0.952				8.092
	SF5	0.957				8.027

Path Coefficient

Path coefficients are used to analyse patterns of relationships between variables with the aim of determining the direct and indirect effects of a set of independent variables on a dependent variable (Duryadi, 2021). They are a measurement tool used to see how much influence one variable has on another. This can be seen through the level of significance. Path coefficient values range from 1 to -1; the closer the value is to 1 or -1, the stronger the relationship, and vice versa (Ghozali, 2015).

Table 2. Path coefficient

Hypothesis	Path Relationship	Original Sample (β)	Sample Mean (M)	Std. Dev (STDEV)	T-Statistic	P-Value	Decision
H1	Self-Efficacy → Satisfaction	0.103	0.097	0.101	1.025	0.306	Not Supported
H2	Service Quality → Satisfaction	0.361	0.365	0.147	2.449	0.015	Supported

Hypothesis	Path Relationship	Original Sample (β)	Sample Mean (M)	Std. Dev (STDEV)	T-Statistic	P-Value	Decision
H3	Digital Competence → Satisfaction	-0.023	-0.018	0.114	0.204	0.838	Not Supported
H4	Self-Regulated Learning → Satisfaction	0.516	0.513	0.076	6.831	0.000	Supported

Heterotrait-Monotrait Ratio (HTMT)

HTMT is a measurement used to assess discriminant validity (Rasoolimanesh, 2022). The accepted HTMT threshold value is < 0.9 (Roemer et al., 2021). Based on Table 2, the Path Coefficient values obtained from the research results indicate that the Service Quality (SQ) variable with a value of 0.015 and the Self-Regulated (SR) variable with a value of 0.000 are significantly positively correlated with Satisfaction (SF). This is consistent with Ghozali's (2015) statement that Path Coefficient values range from 1 to -1, and the closer the value is to 1 or -1, the stronger the relationship.

Table 3. Heterotrait-Monotrait Ratio

	Digital Competency	Self Efficacy	Satisfaction	Service Quality
Self Efficacy	0.876			
Satisfaction	0.898	0.891		
Service Quality	0.801	0.887	0.821	
Self Regulated Learning	0.802	0.880	0.826	0.814

The accepted limit value for the heterotrait-monotrait ratio (HTMT) is <0.9 (Roemer, et al., 2021). Based on the data in Table 3, the overall values range from 0.801 to 0.898, which is less than 0.9 (<0.9), so it can be concluded that the research instrument used is valid or acceptable (Hubona et al., 2021).

R-Square (R2)

The R-Square value is used to measure the degree of variation in changes in the independent variable (exogenous) relative to the dependent variable (endogenous). The criteria for assessing the coefficient of determination are as follows: an R-Square value of 0.75 is considered good, 0.50 is considered moderate, and 0.25 is considered weak.

Table 4. Score of R-Square

	R-Square	Adjusted R-Square
Satisfaction	0.857	0.853

Based on the output data from the analysis using the bootstrapping method, the R-Square value for the Satisfaction (SF) variable was 0.857. Thus, it can be concluded that the R-Square value for the Satisfaction (SF) variable, which means that the variability of satisfaction can be explained by the price variable in the model by 85.7%, is in the good category. The adjusted R-Square value for the Satisfaction (SF) variable is 0.853, meaning that 85.3% of the variability in Satisfaction (SF) or satisfaction can be explained by the price variable in the model, which also falls into the good category. The criteria for assessing the coefficient of determination R-Square value are 0.75 is considered good, 0.50 is considered moderate, and 0.25 is considered weak (Ghozali, 2015).

F Square (F2)

The F Square value is used to measure changes in the R Square value when a specific variable is removed from the model to determine whether the removed variable has a substantive effect on the dependent variable (endogenous). An F Square value of 0.02 indicates a small effect, 0.15 indicates a moderate effect, and 0.35 indicates a large effect (Hair, et al., 2014).

Table 5. Score of F-Square

	Satisfaction
Self-Efficacy	0.007
Service Quality	0.048
Digital Competence	0.000
Self-Regulated Learning	0.383

Based on Table 5, it can be seen that the ability of the self-efficacy variable in explaining the satisfaction variable (F2=0.007) has a small effect. The variable of service quality in explaining satisfaction (F2=0.048) also has a small effect. The ability of digital competence in explaining satisfaction (F2=0.000) also has a small effect, and the variable of learning independence in explaining satisfaction (F2=0.383) has a large effect.

Structural Model Assessment

Data processing in this study used Smart PLS-SEM. There are two stages of measurement model evaluation, namely the measurement model (outer model) and the structural model (inner model). The purpose of these two stages of measurement model evaluation is to assess the validity and reliability of a model. A concept and research model cannot be tested in a relational and causal prediction model if it has not passed the purification stage in the measurement model. The variables used in this study are self-efficacy, service quality, digital competence, and self-regulation of students in learning to see student satisfaction in learning biology in higher education.

For the first variable, self-efficacy, five statement items were used, coded SE1 to SE5. The measurement results of the factor loading values showed high values ranging from 0.911 to 0.948, which is greater than 0.70 (>0.70). The AVE value obtained was also high, at 0.858, indicating that it could explain 85.8% of the measured variable. This proves that the 5 statement items in the self-efficacy variable are valid. The Cronbach's alpha value was 0.959 and the composite reliability was 0.968, indicating that the statement items in the self-efficacy variable used were highly reliable. The highest VIF value obtained in the self-efficacy variable was 6.397, indicating that there was no serious multicollinearity between variables.

The second variable, service quality, uses 5 statement items coded SQ1 to SQ5. The measurement results show high factor loadings ranging from 0.859 to 0.961, which are greater than 0.70 (>0.70). The AVE value obtained was also high at 0.866, indicating that this variable can explain 86.8% of the measured variables. This proves that the 5 items of the service quality variable are valid. The Cronbach's Alpha value is 0.961 and the composite reliability is 0.970, indicating that the items of the service quality variable are highly reliable. The highest VIF value is 8.981, indicating the potential for serious multicollinearity between variables, but it is still within safe limits.

For the third variable, digital competence, 5 statement items with codes DC1 to DC5 were used. The factor loading values obtained were high, ranging from 0.908 to 0.945, which is greater than 0.70 (>0.70). The AVE value obtained was also high at 0.860, indicating that this variable can explain 86% of the measured variables. This proves that the 5 statement items in the digital competence variable fall into the valid category. The Cronbach's Alpha value was 0.959 and the composite reliability was 0.968, indicating that the statement items in the digital competence variable have high reliability. The highest VIF value was 5.985, indicating that there is no serious multicollinearity between variables.

The fourth variable, self-regulation of students in learning, uses 5 statement items coded SR1 to SR5. The measurement results show high factor loadings of 0.947–0.962, which are greater than 0.70 (>0.70). The AVE value obtained was also high at 0.913, indicating that this variable can explain 91.3% of the measured variables. This proves that the 5 statement items in the student self-regulation in learning variable fall into the valid category. The Cronbach's Alpha value of 0.961 and composite reliability of 0.976 indicate that the statement items in the self-regulation variable of students in learning are highly reliable. The highest VIF value of 10.044 with statement code SR4 indicates a serious multicollinearity issue among variables.

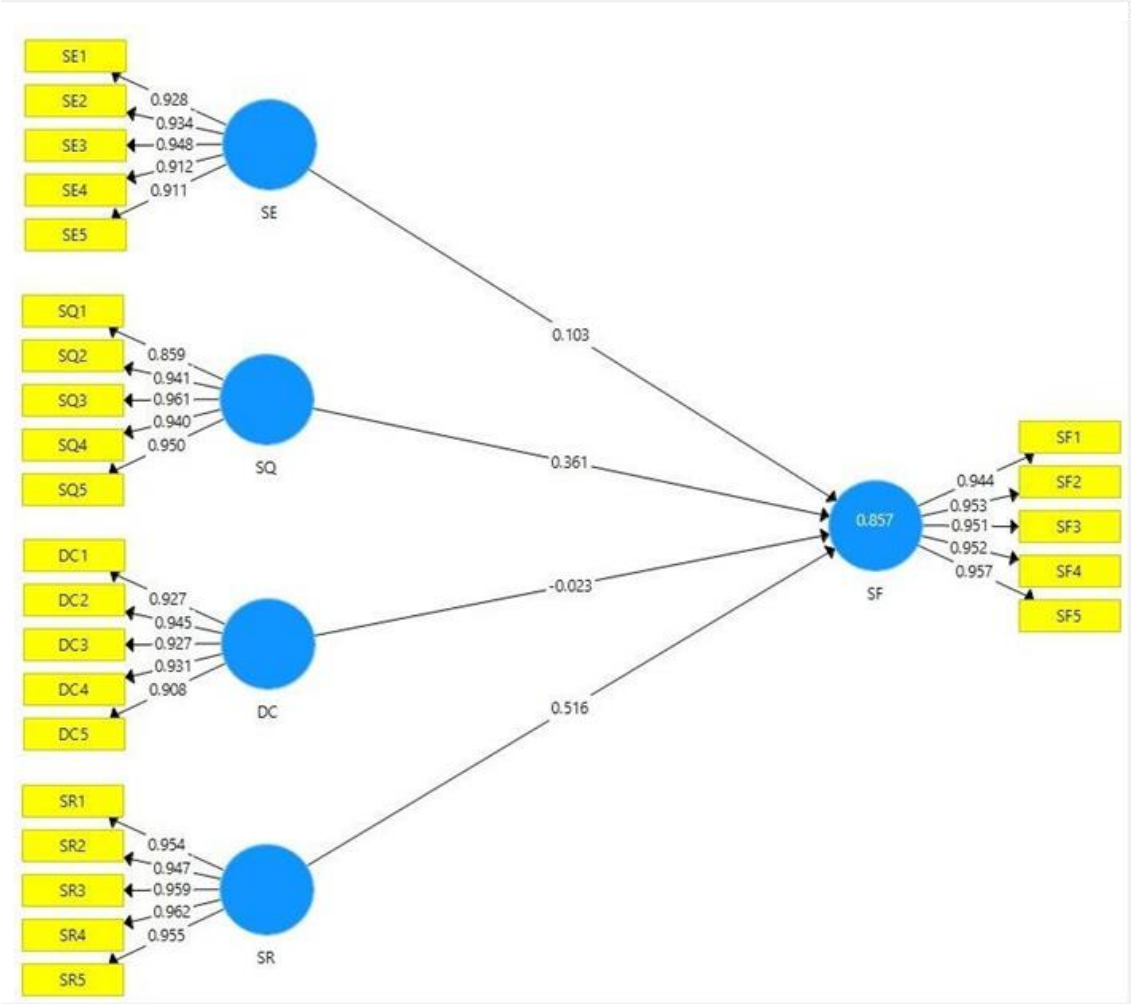

Figure 5. Structural Model Evaluation

Based on Table 2, the Path Coefficient values obtained from the research results show that the service quality variable with a value of 0.015 and self-regulation in learning with a value of 0.000 are variables that are significantly positively related to satisfaction. This aligns with Ghozali's (2015) statement that Path Coefficient values range between 1 and -1, and the closer the value is to 1 or -1, the stronger the relationship. The higher the quality of service, particularly academic service, and the higher the self-regulation of students, the higher the satisfaction of students in learning biology at the university. The characteristics of individuals who self-regulate in learning can be observed through its aspects. According to Zimmerman et al. (1989), there are three aspects of self-regulated learning: metacognition, motivation, and behavior. Someone with good metacognitive abilities will plan, organize, and instruct themselves and their behavior both in learning and in learning efforts. Additionally, (Zimmerman, et al., 1989) also noted that someone with good self-regulated learning will direct their behavior and optimize their activities toward their desired goals. Then, in

terms of service quality, if the perceived academic service quality is equal to or exceeds the expected service quality, then the service is said to be of high quality. Through good, fast, thorough, and accurate service, satisfaction can be created (Handayani, 2020).

Implications for Technology-Integrated Instructional Design

The findings of recent studies underline significant implications for the development of technology-integrated instructional design in higher education. In today's educational landscape, digital competence plays a pivotal yet complex role in shaping learning experiences. Although research has indicated that while digital competence may not exhibit a direct significant effect on overall learning satisfaction, it is an essential foundation for successful technology-supported learning environments (Peria et al., 2021; Osman, 2022). The ability of students to access, evaluate, and effectively utilize digital tools is fundamentally linked to the optimal functionality of instructional designs within LMS and digital academic platforms (Sari & Lapiana, 2022; Bonang et al., 2022). As such, digital competence should be positioned not merely as an individual skill; instead, it should be recognized as a prerequisite for effectively implementing technology-enhanced pedagogy, aligning it with frameworks that support sustainable digital literacy initiatives (Amrullah et al., 2024; Daire, 2024).

The strong influence of SRL on student satisfaction is another major finding that reinforces the importance of learner autonomy, especially within blended and online learning environments. Studies indicate that these technology-integrated instructional models necessitate a high degree of learner self-management, including time management, goal-setting, and progress monitoring all of which are critical for maintaining motivation outside traditional classroom settings (Baharuddin et al., 2022; Hayat et al., 2023). Given that SRL has emerged as a significant predictor of student satisfaction, instructional designers are urged to incorporate strategies that facilitate reflective activities and support structured self-monitoring mechanisms within LMS platforms (Kovačević et al., 2021; Mallillin et al., 2020). This understanding situates SRL not solely as a psychological attribute but also emphasizes its essential role as a design consideration within digital learning environments, where scaffolding and support structures are paramount (Dewi, 2022; Cocorada, 2025).

Furthermore, the findings suggest that academic service quality considerably influences learning satisfaction, particularly within technology-supported higher education contexts. The notion of service quality extends beyond conventional administrative functions and encompasses various dimensions, including the efficiency of online academic systems, responsiveness of digital communication channels, and the reliability of e-learning infrastructures (Phon & Phongsatha, 2024; Chasubuta et al., 2024). Therefore, institutions focused on enhancing student satisfaction must ensure that their instructional designs align closely with digital service systems and technological frameworks. This integrated approach not only elevates the overall technology-based learning experience but also supports the necessary instructional innovations that respond effectively to current educational demands (Tetteh et al., 2023; Jamil et al., 2023).

This study thus contributes significantly to the existing educational technology literature by providing empirical insights into how learner characteristics, digital competence, and academic service systems interact within a technology-integrated learning framework. The considerations laid out herein urge educational practitioners to foster environments that not only emphasize technological literacy but also enhance students' capabilities to thrive in digitally-enhanced learning contexts.

CONCLUSION

This study examined the determinants of student learning satisfaction within a technology-integrated higher education environment by analyzing the roles of self-efficacy, academic service quality, digital competence, and self-regulated learning using a PLS-SEM approach. The findings demonstrate that the proposed structural model possesses strong explanatory power, accounting for a substantial proportion of variance in student satisfaction. Empirically, academic service quality and self-regulated learning emerged as significant positive predictors of learning satisfaction. Self-regulated learning showed the strongest influence, indicating that students' ability to manage their cognitive, motivational, and behavioral processes is a central factor in shaping positive learning experiences in digitally mediated environments. This finding underscores that technology integration alone does not guarantee satisfaction; rather, student autonomy, goal-setting capacity, and strategic learning behaviors are critical for maximizing the benefits of technology-enhanced instruction.

Academic service quality also contributed significantly to satisfaction, highlighting the importance of reliable digital academic systems, responsive communication channels, and supportive institutional services. In technology-supported higher education, the alignment between instructional design and service infrastructure appears to be essential for sustaining positive student perceptions and institutional credibility. In contrast, self-efficacy and digital competence did not show significant direct effects on satisfaction. This suggests that in contexts where students are already familiar with digital tools, technical proficiency may function as a baseline requirement rather than a differentiating factor influencing satisfaction. Similarly, confidence in one's ability to perform academic tasks may not automatically translate into satisfaction without structured learning support and quality academic services.

Theoretically, this study contributes to the literature on technology-enhanced pedagogy by positioning self-regulated learning as a primary psychological mechanism underlying satisfaction in digital learning ecosystems. Practically, the findings recommend that higher education institutions prioritize the development of instructional strategies that scaffold self-regulation such as reflective activities, structured feedback mechanisms, and progress monitoring tools while simultaneously strengthening the quality of digital academic services.

Several limitations should be acknowledged. The study was conducted within a single study program and disciplinary context, which may limit generalizability. Future research is encouraged to test the model across diverse academic fields, institutional types, and cultural settings. Further investigations may also explore potential mediating or moderating mechanisms, including digital learning engagement or instructional design characteristics, to obtain a more nuanced understanding of satisfaction in technology-integrated higher education.

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