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Transformation of digital communication: Students' timely graduation model in blended learning post COVID-19 pandemic

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A B S T R A C T

The shift in learning communication patterns in higher education emerged along with the end of the pandemic, accelerating the transformation of digital communication. This study aims to explain the digital communication variable of the CMC model, the digital technology variable of the technology and determinism model, the SIKA LMS variable of the technology acceptance model (TAM), the discipline variable of the Attitude and Behavior theory model, and the graduation variable of the Media Dependence model as part of the communication using the computer. Quantitative research method with SEM PLS analysis. Furthermore, the data collection technique was used with a proportionate stratified random sampling population of 3416 students and a sample of 302 active students working on the final project. The analysis in this study uses Structural Equation Modeling, with 5 variables, namely digital communication (X_1), digital technology (X_2), SIKA LMS (X_3), student discipline (X_4) and timely graduation (X_5), conducting outer model tests, goodness of fit models, and model testing inner. Results show that the discipline variable obtained the highest average of 4.22. In contrast, the digital communication transformation obtained a very significant direct influence on the shift in learning patterns for timely graduation.

1. Introduction

Digital technology skyrocketed during and after the COVID-19 pandemic, and various education sectors in higher education have adopted digitalization. The shift in learning communication patterns in higher education emerged along with the significant changes and developments in communication technology after the COVID-19 pandemic; the shift in computer-mediated communication became a pattern in digital technology-based learning (Siebel, 2019). The interaction pattern in computer-mediated communication technology has a media channel as a means (Thurlow et al., 2004). Computer-mediated Communication (CMC) has two dimensions: online interaction with multimedia and the adoption of communication technology (Walther, 2018). The phenomenon of learning accustomed to face-to-face is now changing with technological advances into a blended learning pattern. This means that the media continues to change and shift into a reliable technological tool that can be used in education, especially in learning. Blended learning is not a new concept, but recently, it has experienced an extraordinary increase in popularity, especially during and after the COVID-19 pandemic (Ball et al., 2021). Effective and optimal communication in LMS media between lecturers and students is significantly important to achieve maximum learning outcomes. Moreover, communication in digital media has become an important element in education, especially online learning (Griffin et al., 2018).

Fig. 1 shows that informatics engineering has the most enthusiastic students compared to other study programs. However, the graduation rate of informatics engineering students is not balanced with the number of enthusiasts. Subsequently, the increasing number of enthusiasts is not balanced with timely graduation.

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This study reveals factors that influence the timely graduation rate of informatics engineering students with variables of digital communication (X_1), digital technology (X_2), LMS (X_3), and student discipline (X_4) towards the timely graduation rate of students (X_5) (Thurlow et al., 2004) .This study looks through the digital communication variable using the CMC model, the digital technology variable using the technology and determinism model, the SIKA LMS variable using the technology acceptance Model–TAM (Saputra & Darma, 2022) model, the discipline variable using the Attitude and Behavior theory model,11 and the graduation variable using the media dependency model (Sridharan, 2022).

No.	Kode	Nama Program Studi	Status	Jenjang	Akreditasi	Data Pelaporan Tahun Ganjil 2023					
						Jumlah Dosen Penghitung Rasio	Jumlah Dosen Homebase			Jumlah mahasiswa	Rasio Dosen / Mahasiswa
							NIDN	NIDK	Total		
1	86906	Pendidikan Profesi Guru	Aktif	Profesi	Baik	31	5	0	5	205	1 : 6.61
2	23201	Arsitektur	Aktif	S1	B	48	38	1	39	1306	1 : 27.21
3	86201	Bimbingan Dan Konseling	Aktif	S1	B	111	73	0	73	4029	1 : 36.30
4	61209	Bisnis Digital	Aktif	S1	Baik	18	9	0	9	377	1 : 20.94
5	90241	Desain Komunikasi Visual	Aktif	S1	B	82	79	0	79	4444	1 : 54.20
6	61216	Manajemen Ritel	Aktif	S1	Baik	16	7	0	7	265	1 : 16.56
7	88201	Pendidikan Bahasa Dan Sastra Indonesia	Aktif	S1	B	55	50	0	50	2110	1 : 38.36
8	88203	Pendidikan Bahasa Inggris	Aktif	S1	B	106	97	2	99	3453	1 : 32.58
9	84205	Pendidikan Biologi	Aktif	S1	Baik Sekali	39	26	0	26	738	1 : 18.92
10	87203	Pendidikan Ekonomi	Aktif	S1	Baik Sekali	135	118	6	124	4658	1 : 34.50
11	84203	Pendidikan Fisika	Aktif	S1	Unggul	20	13	1	14	238	1 : 11.90
12	84202	Pendidikan Matematika	Aktif	S1	Baik Sekali	76	62	1	63	1380	1 : 18.16
13	87201	Pendidikan Sejarah	Aktif	S1	B	35	24	0	24	935	1 : 26.71
14	57201	Sistem Informasi	Aktif	S1	Baik	11	9	0	9	388	1 : 35.27
15	26201	Teknik Industri	Aktif	S1	B	71	68	0	68	3303	1 : 46.52
16	55201	Teknik Informatika	Aktif	S1	B	328	327	1	328	11938	1 : 36.40
17	88101	Pendidikan Bahasa Indonesia	Aktif	S2	Baik Sekali	33	5	4	9	466	1 : 14.12
18	88103	Pendidikan Bahasa Inggris	Aktif	S2	A	34	9	2	11	663	1 : 19.50
19	87120	Pendidikan Ilmu Pengetahuan Sosial	Aktif	S2	Baik Sekali	38	18	3	21	644	1 : 16.95
20	84101	Pendidikan MIPA	Aktif	S2	Baik Sekali	38	13	3	16	796	1 : 20.95

Fig. 1. Student Reporting Data for Each Semester

Digital communication has influenced the changes in society and learning patterns carried out by students. The changes describe the pattern of each student's learning habits, both in lecture times and adjusted learning habits (Shafira Bani Anshori, 2022).

2. Literature Review and Theoretical Framework

2.1 Digital technology

Digital technology greatly influences the world of education, and several post-COVID-19 studies on digital technology reveal that digital technology has a positive impact on the learning process in higher education. Online learning through the Learning Management System (LMS) can improve the quality of education (Ramli et al., 2023). It explains that LMS is a source of support for blended learning, learning evaluation models, and interactions between teachers and students through various interactions (Vashty et al., 2022). The increasing use of LMS can encourage students to be ready for the time and tasks presented. The duration and discipline patterns in the LMS in Higher Education were recorded in students' performance and academic performance (Hu et al., 2021).

2.2 Blended learning

Blended learning in universities features online communication between lecturers and students in the new media Learning Management System (Chaudhry et al., 2023).The COVID-19 pandemic cultivated digital modernity in every activity in various sectors. Digital communication transformation is influenced by the shift in communication patterns, including face-to-face learning, into learning activities using digital technology along with the pandemic outbreak (Huong & Duc, 2023).

Role of digital technology is crucial in supporting student success in achieving learning time, habits, and technology support (Budiyanto et al., 2024).

2.3 Discipline

Discipline with a blended learning model describes the pattern of each student's habits in learning habits, both in lecture time adjusted in learning and assignments and examination (Glazer, 2023). The hypothesis models are illustrated in Fig. 2.

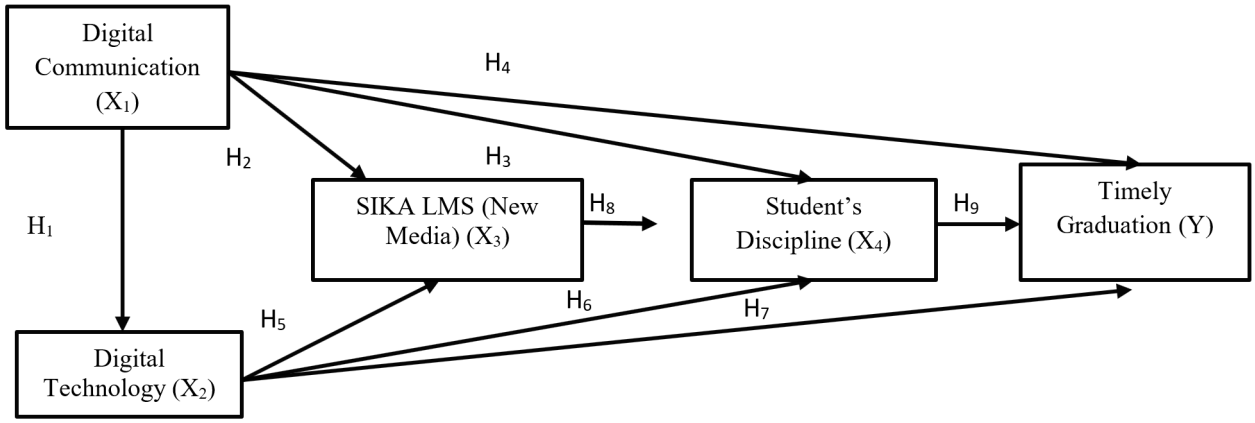


Fig. 2. Research Concept Framework Model

Each variable with the conceptual model in Fig. 2 shows a statement or assumption formulated to be tested for truth through research with stages. Each hypothesis tries to answer the research question and measure the direction of the relationship between the variables (Rudini, 2017). The hypothesis has an interactive or interdependent relationship between the variables of digital communication, digital technology, SIKA LMS, student discipline, and timely graduation, which have a mutually influencing nature (Ketchen, 2013).

H1: *Digital communication (X_1) has an effect on digital technology (X_2).*
H2: *Digital communication (X_1) has an effect on SIKA LMS (X_3).*
H3: *Digital communication (X_1) has an effect on student discipline (X_4).*
H4: *Digital communication (X_1) has an effect on timely graduation (X_4).*
H5: Digital technology (X_2) has an effect on SIKA LMS (X_3).
H6: Digital technology (X_2) has an effect on student discipline (X_4).
H7: *Digital technology (X_2) has an effect on timely graduation Y.*
H8: *SIKA LMS (X_3) has an effect on student discipline (X_4).*
H9: *Student discipline (X_4) has an effect on timely graduation of students Y.*

3. Methodology

This study applies a quantitative approach through path analysis, using SEM in collecting primary data based on survey results and findings in the field. Data collected from respondents is based on questionnaire results (Ghozali & Latan, 2015). This study uses the survey results to generalize, obtain the current data, and analyze the characteristics and behavior. Meanwhile, the relationship between variables is used to test hypotheses related to sociological and psychological variables from the samples taken (Sugiyono, 2022). The sample size was determined for a population of 3416 students using slovin's equation is used to determine the sample size (Tumembow et al., 2021), with an error margin of 5%. Refers to the Slovin formula,

$$n = \frac{N}{1 + N \times e^2},$$

where *n, N* and *e* represent sample size, population size and error term, respectively.

The number of samples of 3416 instruments presented in the Slovin formula is 301.6 ~ 302 respondents. Based on the calculation of the Slovin formula, the researcher took 302 Informatics Engineering students as samples in the study (Agustian, 2021). The formula for determining sample size is known as the Slovin equation calculates the minimum number of samples if the behavior in the population is not yet clearly known. Objective data shows there are timely graduations of Informatics Engineering students in a 4-year period (timely graduation) and new students each year. Therefore, the distribution for the study's sample size in two periods of timely graduation and students sampling of students who graduated on time (8 semesters) and students who graduated not on time in the same batch, namely students of the 2020 and 2019

batch. Variables of digital communication, digital technology, SIKA LMS, student discipline, and timely graduation with a quantitative method design through the stages can be seen in Fig. 3.

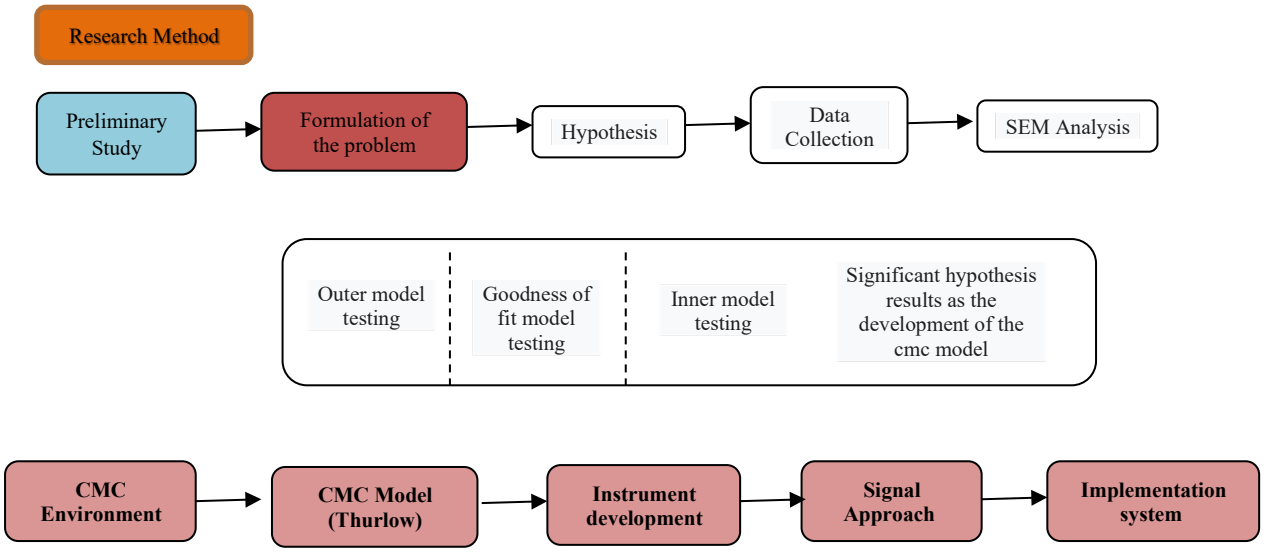


Fig. 3. Quantitative research method design

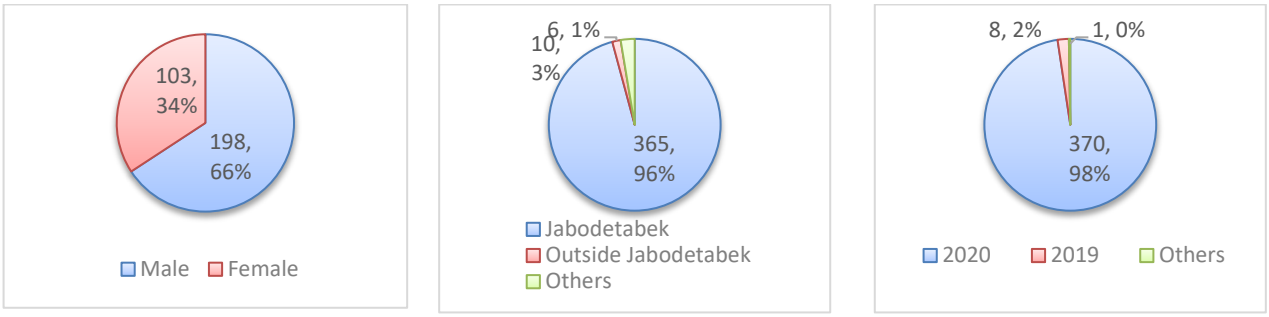
Quantitative method design through stages and tests, including background and formulating problems to explore hypothesis steps, is derived from the introduction. Hypothesis testing and data collection are based on facts and information extracted from the questionnaire results of each variable of digital communication, digital technology, LMS, student discipline, and timely graduation of students from primary data from the survey results (Muhson, 2022). A probability sampling approach was used with a stratified proportionate stratified random sampling model. The population in the stratified random sampling is divided into groups with the same characteristics, called strata. Proportional stratified random sampling involves taking random samples from groups that have been stratified proportionally to the population; the technique is carried out by calculating the number of samples required proportionally in the study (Sugiyono, 2018).

4. Results

Structural equation modeling analysis was conducted based on primary questionnaire data in the field using the Lisrel 8.80 application. The analysis results were obtained through several tests based on respondent characteristics using the Structural Modeling approach. Moreover, the researchers collected primary data based on survey results and findings in the field to be processed (Ghozali & Latan, 2015). Results of the SEM analysis include 3 stages: the outer model testing, the Goodness of fit test, and the inner model evaluation. As a final step, the findings were developed using the Computer-Mediated Communication (CMC) model (Hair Jr. et al., 2019).

4.1 Respondent Characteristics

The respondent characteristics show gender, domicile (residence), year of entry (batch), and year of graduation. The results of the analysis of these characteristics are described in Fig. 4 as follows:



Gender Residential identity Year of entry

Fig. 4. Personal characteristics of the participants

According to Fig. 4, most respondents are men, with a percentage above 65%. The figure also shows respondent characteristics by residence where DKI Jakarta, Bogor, and Depok have the highest percentages, with 96%.

4.2 Outer model testing

Outer model test is one of the ways to see and test the model measurement. The aim is to assess the validation and estimate the reliability of each indicator and construct. Three test requirements must be met, including:

a) Loading factor (LF) value for variables from the cut-off value indicator > 0.5.

The test results of each variable X1, X1, X3, X4, and X5 with Structural Equation Modeling (SEM) Analysis are shown in Fig. 5. The cut-off value for each variable > 0.50 is valid. Cut-off values <0.50 are removed from the analysis model. Evaluating the inner or structural model is an important step in evaluating model fit, including coefficient of determination, predictive relevance, and hypothesis testing. Fig. 5 (Structural Equation Modeling (SEM) Analysis) explains each aspect. Results of the SEM Analysis of each variable X1, X1, X3, X4, and X5 with a cutoff value > 0.5, as shown in Fig. 5, all variables have valid values and meet the test criteria.

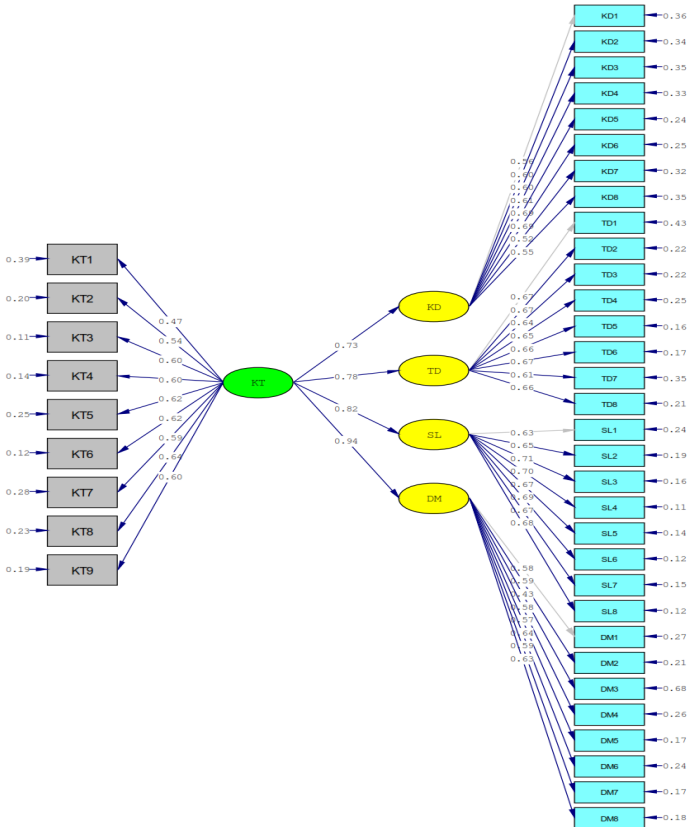


Fig. 5. Results of Structural Equation Modeling (SEM) Analysis

Table 1
Validity Test Results After Reduction of X1.7, X4.3 and Y.1

Variable	Indicator	Standardized Factor Loading (SLF)	Average Variance Extracted (AVE)
Digital Communication	KD1	0.60	0.54
	KD2	0.60	
	KD3	0.61	
	KD4	0.71	
	KD5	0.71	
	KD6	0.53	
	KD8	0.68	
Digital Technology	TD1	0.68	0.63
	TD2	0.63	
	TD3	0.66	
	TD4	0.66	
	TD5	0.66	
	TD6	0.61	
	TD7	0.66	
	TD8	0.63	
New Media SIKA LMS	SL1	0.65	0.74
	SL2	0.71	
	SL3	0.70	
	SL4	0.67	
	SL5	0.69	
	SL6	0.67	
	SL7	0.68	
	SL8	0.57	
Student Discipline	DM1	0.58	0.54
	DM2	0.57	
	DM4	0.57	
	DM5	0.64	
	DM6	0.60	
	DM7	0.62	
	DM8	0.53	
Timely Graduation	KT1	0.61	0.62
	KT3	0.61	
	KT4	0.62	
	KT5	0.62	
	KT6	0.59	
	KT7	0.64	
	KT8	0.60	
	KT9	0.60	

b) Reflective construct AVE value >0.5

A convergent validity calculation is performed to evaluate construct validity. Loading factor value and AVE (average variance extracted) are used to assess convergent validity. The instrument is considered convergently valid if the AVE result is more than 0.5 and has a SLF, standard loading factor value of more than 0.5. Results of the convergent validity test using AVE and Standardized factor loading (SLF) obtained each value of the question item variable above or >0.5, as shown in Table 1. This means that the AVE and SLF tests are met.

c) *The value of the CA (Cronbach Alpha) test is > 0.7, and CR (construct reliability) is > 0.7*

Table 2
Results of the Cronbach Alpha & CR Test

Matrix	Cronbach's Alpha	rho_A	Construct Reliability	Average Variance Extracted (AVE)
X1	0.901	0.902	0.920	0.592
X2	0.941	0.944	0.951	0.707
X3	0.962	0.962	0.968	0.788
X4	0.917	0.923	0.933	0.640
X5	0.941	0.948	0.951	0.682

The threshold value used to assess the acceptable level of reliability is based on the construct reliability value. If the CR and Cronbach alpha values are >0.7, it meets the reliability test requirements.

4.3 The goodness of fit model testing

The extent of the strength of the prediction results of the model and the feasibility of the model, where several criteria are met, namely:

a) The value of predictive relevance is used to see the results of predictive strength of the SEM blindfolding output model. Results of the blindfolding test by looking at the Normed Fit Index (NFI) value ≥ 0.9. As seen in Table 3, the NFI criterion of 0.97 means that the model evaluation has a good fit value.

Table 3
Results of the Goodness of Fit Test

Criteria	***Goodness of Fit Value***	***Cut-off Value***	**Model Evaluation**
Parsimony goodness of fit index	0.67	≥ 0.9	*Bad Fit*
Adjusted goodness of fit index	0.73	≥ 0.9	*Bad Fit*
Normed fit index	0.97	≥ 0.9	*Good Fit*
Incremental fit index	0.98	≥ 0.9	*Good Fit*
Comparative fit index	0.98	≥ 0.9	*Good Fit*
Relative fit index	0.97	≥ 0.9	*Good Fit*
Root means error approximation	0.073	< 0.08	*Good Fit*
Non normed fit index	0.98	≥ 0.9	*Good Fit*

a) Model Fit Value can be seen from the test results by looking at the value of RMSEA, where the test has a real influence on the variable. The RMSEA value is in the interval of less than <0.08. The test results were carried out, and the goodness of fit model value can be seen in result Table 3. The Root RMSEA value is 0.073, meaning less than <0.08, the criteria are met for testing.

In the SEM-PLS model, parameter estimation in the measurement and structural models is carried out simultaneously and must meet the model fit criteria. Therefore, the model must be based on a solid foundation and supportive theory. Table 3 shows the results with two criteria: Good fit and Bad fit. The evaluation results show that six Goodfit criteria have met the cutoff value, which can be interpreted as the model is good (Ketchen, 2013). This finding of this study indicates that the applied model produces predictions that are in accordance with expectations. Thus, this model can be considered good and very suitable in explaining the relationship between variables X_1, X_2, X_3, and X_4.

4.4 Inner models testing

Inner model testing aims to test the significance of the hypothesis of the influence of exogenous variables on endogenous variables (Zhou, 2023).

a) The significance test sees the number with a very significant influence at a p-value <0.05, and the T-value can be above > 1.96, which can be seen in the Smart-PLS bootstrapping output display.
b) The partial influence of the F2 value is seen in the Smart-PLS algorithm output display.
c) The simultaneous influence of the R2 value is seen in the SEM Path Analysis display.

Seen in the Table 4.

The inner model test after most of the goodness of fit criteria are met. The inner model test is carried out to test the significance of the hypothesis results with a significant influence, as shown in Table 4. T-value > 1.96 means that three hypotheses do not have a significant direct influence, and six hypotheses have a significant direct influence. Thus, the coefficient of each factor becomes more reliable. The test is carried out with the criterion that if the T-value is more than 1.96, meaning there is a significant influence. The results of the simultaneous influence causality test of the R2 value can be seen in the SEM Path Analysis in Fig. 6.

The SEM (structural equation modeling) Path Analysis Results contain the final results and visualization with equations in path analysis. The visualization of the results and equations indicates:

$y = 0.679 (X_4) + 0.482 (X_2) +0.654 (X_1) +0.152 (X_3)$
$y = 0.679 + 0.482 +0.654 +0.152$

As seen in Fig. 6, optimal result in the path analysis is 0.679 for the discipline variable.

Table 4
Results of Inner Model Test and Hypothesis Significance

Hypothesis	Correlation	Estimate	*T-Value*	*Cut-Off*	Notes
1	Digital communication towards digital technology	0.809	29.880	>1.96	Significant
2	Digital communication towards SIKA LMS	0.695	3.214	>1.96	Significant
3	Digital communication towards student discipline	0.634	1.888	>1.96	Insignificant
4	Digital communication towards timely graduation	0.654	0.468	>1.96	Insignificant
5	Digital technology towards SIKA LMS	0.575	7.707	>1.96	Significant
6	Digital technology towards student discipline	0.399	0.871	>1.96	Insignificant
7	Digital technology towards timely graduation	0.487	3.052	>1.96	Significant
8	SIKA LMS towards student discipline	0.531	6.820	>1.96	Significant
9	Student discipline towards timely graduation	0.740	18.162	>1.96	Significant

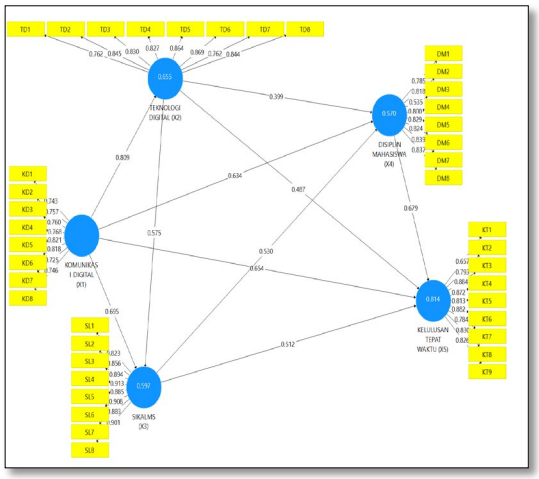


Fig. 5. Results of SEM Path Analysis

5. Discussion

Digital communication (X_1) directly and indirectly affects timely graduation (y). Digital communication (X_1) does not directly affect student discipline (X_4); however, it has an effect if it goes through the discipline path (X_4). Digital communication (X_1) does not directly affect timely graduation (X_4); however, it will have an effect if it goes through discipline (X_4). Digital technology (X_2) does not directly affect student discipline (X_4); however, it will have an effect if it goes through discipline (X_4). The results of the path analysis test processed through testing show that student discipline is the key to achieving timely graduation through several digital communication channels, digital technology, and SIKA LMS, where passing through the discipline path will achieve timely graduation.

6. Conclusion

The test results were obtained based on nine hypotheses; six had a significant influence, while three were insignificant. Digital communication (X_1) towards digital technology (X_2) estimated at 0.809 with a t-value of 29.88 significant; Digital communication (X_1) towards SIKA LMS (X_3) estimated at 0.634 with a T-Value of 3.214 significant; Digital communication (X_1) towards student discipline (X_4) was estimated at 0.695 with a t value of 1.888 insignificant; Digital communication (X_1) towards timely graduation (X_5) estimated at 0.654 with a T-Value of 0.648 insignificant, Digital technology (X_2) towards SIKA LMS (X_3) was estimated 0.575 with a T-Value of 7.707 significant; Digital technology (X_2) towards student discipline (X_4) estimated at 0.399 with a T-Value of 0.871 insignificant; Digital technology (X_2) towards timely graduation (X_5) was estimated at 0.487 with a T-value of 3.052 significant; SIKA LMS (X_3) towards Student Discipline (X_5) was estimated at 0.531 with a T-value of 6.820 significant; and Student Discipline (X_4) towards Student Timely Graduation (X_5) was estimated 0.740 with a T-value of 18.162 significant.

These results indicate that students felt helped by the flexibility of blended learning. Still, around 30% of others admitted difficulties caused by several factors such as network devices, different computer availability among students, and

independent study time. In addition, these results show a significant difference between groups of students who had adequate access to technology and those who did not, in terms of their academic achievement, namely timely graduation. This significant influence can be used as the basis for the timely graduation model in transforming digital communication.

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