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Structural Analysis of Digital Learning Management Based on the Golden Triangle in Optimizing Learning at Islamic Senior High Schools in Bogor City

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Abstract: This study aims to test the significance of the golden triangle-based digital learning management (people, process, and technology) on learning at MAN (Islamic State Senior High School) in Bogor City. This study employed a quantitative method with SEM (Structural Equation Modeling) analysis. The research location was at State Islamic Senior High Schools (Madrasah Aliyah) in Bogor City, with a sample size of 126 respondents. Data collection used a questionnaire analyzed using SmartPLS software. The path analysis results yielded: X1 -> Y has a T-statistic of 3.084 > 1.96 and a P-value of 0.002 < 0.05; X2 -> Y has a T-statistic of 2.615 > 1.96 and a P-value of 0.009 < 0.05; X3 -> Y has a T-statistic of 4.270 > 1.96 and a P-value of 0.000 < 0.05. All three hypotheses tested partially in this study demonstrated significant correlations between variables. The calculation results obtained a significant R-square value of 0.617. This indicates that the exogenous variables in the model simultaneously explain 61.7% of the variance in the endogenous variables, while the remaining 38.3% is influenced by other factors not analyzed in this study. The implication of this research is that the implementation of digital learning management based on the golden triangle can be a strategic framework for improving the quality of learning in State Islamic Senior High Schools (Madrasah Aliyah) throughout Bogor City. Strengthening teacher competencies (people), management processes (process), and the availability of digital infrastructure (technology) has been proven to provide positive contributions. Madrasas can strengthen digital training programs for teachers and increase digital support facilities so that learning implementation can run more optimally and align with the needs of 21st-century education.

INTRODUCTION

Based on Minister of Education and Culture Regulation No. 22 of 2016 concerning Standards for Elementary and Secondary Education Processes, information and communication technology must be utilized to improve the efficiency and effectiveness of learning. Information and communication technology must be implemented in an integrated, systematic, and effective manner, appropriate to the situation and conditions.

The Ministry of Religious Affairs, through the Research and Development and Training Center, also published a digital madrasah implementation guidebook in 2019. This guideline serves as a guide for madrasahs in implementing technology-based digital learning in madrasahs. This has been implemented in several madrasahs in Indonesia.

Based on statistical data from the Central Statistics Agency, it is stated that only 10.1% of teachers in Indonesia have qualifications in the field of information and communication technology (BPS, 2018). Additionally, 67% of teachers reported difficulties using digital devices for teaching. However, since the COVID-19 pandemic, more than 97.6% of schools have adopted distance learning (PJJ) using various methods such as digital platforms, offline learning packages, and TV/radio broadcasts (unicef, 2021). In the 2022/2023 academic year, Ministry of Education and Culture data shows a positive trend in the implementation of ICT devices in schools, especially at the elementary and secondary education levels (Kemendikdasmen, 2023). The government is consistently striving to encourage digital transformation through the Home Learning platform and other applications to increase the quantity and quality of technology-based learning. Currently, there are approximately 10.2 million users connected to digital education and Learning platforms (voaindonesia, 2022).

One of the challenges facing Islamic education today is the limited facilities and infrastructure, including buildings, learning media, and technological support. Many madrasas in rural areas still use buildings that are no longer suitable for learning activities.

Furthermore, the available learning media are inadequate to support the teaching process. In terms of scientific and technological developments, Islamic educational institutions still lag behind other public schools (Rahman D. , 2021).

Quality education cannot be achieved without effective governance. Therefore, sound management is a crucial prerequisite for strengthening the foundation of educational quality. The Golden Triangle concept in digital learning management emphasizes three main pillars: people, process, and technology. The people pillar focuses on the human resources involved in implementing digital learning. (Mulyadi, 2020). The process pillar emphasizes the effectiveness of managing the learning process, from planning to evaluation, using a technology-based approach. Meanwhile, the technology pillar refers to the optimal use of digital tools and platforms to support learning, such as Learning Management Systems (LMS), AI-based applications, and interactive multimedia (Fauzi, 2022).

Although digital technology has great potential to be implemented in Islamic educational institutions, various obstacles such as a lack of competent human resources, limited funds, and resistance to change are still obstacles (Rahman A. , 2021). Therefore, a study on the implementation of Golden Triangle-based digital learning management in State Islamic Senior High Schools throughout Bogor City is important to conduct.

However, some schools have successfully integrated information technology into their learning processes. Preliminary research indicates that several educational institutions in Indonesia have effectively adopted digital-based learning approaches. This is further strengthened by direct observations, where researchers noted that several State Islamic Senior High Schools (Madrasah Aliyah Negeri) in Bogor City have utilized computers, laptops, and mobile phones in the learning process and provided internet access. This indicates the implementation of digital-based learning, where teachers who previously relied on blackboards are now utilizing digital media. Students are encouraged to expand their references beyond textbooks by

searching directly on the internet. As a result, learning resources are no longer limited to books; they also include e-books, interactive quizzes, presentation slides, educational videos, and various e-learning platforms aligned with the school curriculum.

Given the phenomena described above, the researcher was motivated to conduct a study entitled "Golden Triangle-Based Digital Learning Management (People, Process, and Technology) in Optimizing Learning in State Islamic Senior High Schools (Madrasah Aliyah) throughout Bogor City." This research was conducted because of the importance of managing digital learning effectively and efficiently so that learning can be carried out optimally.

The purpose of this study was to determine the significant level of influence of the golden triangle (people, process, and technology) on learning in State Islamic Senior High Schools (Madrasah Aliyah) throughout Bogor City.

METHOD

This research used a quantitative approach with path analysis. The study was conducted at State Islamic Senior High Schools (Madrasah Aliyah) in Bogor City, namely MAN 1 Bogor City and MAN 2 Bogor City. These educational institutions were chosen because they are Islamic educational institutions with supporting facilities and have implemented digital-based learning.

The data collection technique used in this study was a questionnaire with a sample of 126 respondents. The researchers employed path analysis, a multivariate statistical analysis method used to analyze the relationship between variables and their indicators. This allows for understanding the causal relationships between the various constructs in the model, both directly and indirectly. (Ahmad Subagyo, 2024).

Data analysis in this study will be conducted in two stages: the measurement model and the structural model. The measurement model is used to determine the relationship between indicators. Tests for this measurement model include: individual item reliability, average variance extracted, and discriminant validity (Tanjung, 2021). Meanwhile, the structural model is a test carried out by testing the path

coefficient, t-test and R-square using the bootstrapping method.

RESULT & DISCUSSION

Results

The conceptual model in this study consists of 4 variables and their indicators, namely: X1 people (the role of the madrasah headmaster, IT developers, IT operators, teachers, parents, students, government), X2 processes (policies, planning, organizing, implementation, supervision, supporting software, supporting hardware), X3 technology (blended learning, online learning, use of technology in the classroom) and Y effective learning.

Testing is conducted in two stages: outer model measurement and inner model measurement.

The outer model is a model that explains the relationship between latent variables and their representative indicators (Hair J. F., 2014). In the outer model evaluation process, primary attention is paid to testing the validity and reliability of the indicators used to form the latent construct. Validity is tested using convergent and discriminant validity tests. Reliability is measured in two ways: Cronbach's alpha and composite reliability (Ghozali, 2015). The following is the results of the validity test test calculations:

Table 1 validity test

Variabel	Code	*Loading Factor*	*Average Variance Extracted*	Keterangan
People (X1)	X1 1	0.855	0.692	Valid
	X1 2	0.740		Valid
	X1 3	0.849		Valid
	X1 4	0.892		Valid
	X1 5	0.859		Valid
	X1 6	0.849		Valid
	X1 7	0.767		Valid
Process (X2)	X2 1	0.891	0.752	Valid
	X2 2	0.887		Valid
	X2 3	0.891		Valid
	X2 4	0.910		Valid
	X2 5	0.881		Valid
	X2 6	0.812		Valid
	X2 7	0.790		Valid
Technology (X3)	X3 1	0.895	0.718	Valid
	X3 2	0.836		Valid
	X3 3	0.845		Valid
	X3 4	0.863		Valid
	X3 5	0.828		Valid
	X3 6	0.816		Valid
Effective Learning (Y)	Y 1	0.828	0.702	Valid
	Y 2	0.772		Valid
	Y 3	0.852		Valid
	Y 4	0.819		Valid
	Y 5	0.837		Valid
	Y 6	0.850		Valid
	Y 7	0.854		Valid
	Y 8	0.824		Valid
	Y 9	0.876		Valid
	Y 10	0.856		Valid
	Y 11	0.861		Valid
	Y 12	0.832		Valid
	Y 13	0.847		Valid
	Y 14	0.828		Valid
	Y 15	0.833		Valid

Based on the validity test table after the reduction above, the measurement results in this study indicate that all indicator items have a loading factor value greater than 0.7. The people variable has 7 indicator items that all passed the test. The process variable has 7 indicator items with all indicator items passed the test. The technology variable has 7 indicator items with all indicator items passed the test. The effective

learning variable has 15 indicator items that all passed the test. Then for the Average Variance Extracted (AVE) value of the people variable is 0.692, the process variable is 0.752, the technology variable is 0.718, and the average variance extracted value of the effective learning variable is 0.702. These values indicate that the model can be considered valid with the interpretation that more than 50% of the variables can be explained by the existing indicators. The following are the calculation results for the reliability test:

Tabel 2 Reliability test

Code	Cronbach's alpha	Composite reliability
X1 (People)	0.926	0.938
X2 (Process)	0.945	0.948
X3 (Technology)	0.921	0.924
Y (Effective learning)	0.97	0.971

Reliability evaluation of variables measured using reflective indicators can be carried out using two approaches, namely Composite Reliability (CR) and Cronbach's Alpha (CA) (Hair J. F., 2014). A variable is said to be reliable if its CR and CA values are above 0.70, although a minimum value of 0.60 is still considered acceptable (Ghozali, 2015). The composite reliability and Cronbach's alpha values for this model exceeded 0.7. This indicates that the research model used has high reliability. In other words, this model is reliable enough to represent data from a larger number of respondents.

Next, the inner model was measured. The structural model (inner model) describes the causal relationships or influences between latent variables in a study. Testing the inner model aims to assess the stability and accuracy of the model structure. In this study, the evaluation was conducted by analyzing the path coefficients and assessing the R-square value of each latent variable. The following are the results of the inner model calculations using SmartPLS Version 4:

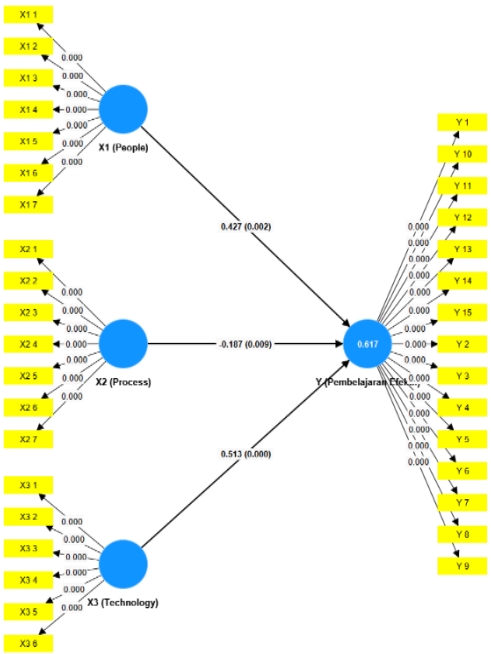

Figure 1 Inner model results

In the initial stage of evaluating the inner model, analysis is conducted by examining path coefficients to determine the extent of influence between variables. This analysis aims to describe the partial direct influence that exogenous variables have on endogenous variables.

Table 3 Path Coefficients

Variabel	Ori sample (O)	Sample mean (M)	Stand Dev	T stat	P val
X1 -> Y	0.427	0.423	0.139	3,084	0.002
X2 -> Y	-0.187	-0.189	0.072	2,615	0.009
X3 -> Y	0.513	0.520	0.120	4,270	0.000

The level of significance is determined based on the T-Statistic value which must be more than 1.96 and the P-Value which is less than 0.05 as obtained through the bootstrapping procedure (Hair J. F., 2014). Referring to the table above, from the three hypotheses that were partially tested, it is known that two variables show positive significance and have an influence on variable Y, while the other hypothesis shows negative significance but still has an influence on the relationship between the variables in question.

The next step is to evaluate the R-square value. The R-square value reflects the extent to which the exogenous (independent) variables simultaneously influence the endogenous (dependent) variables. The R-square values are as follows:

Table 4 R-Square

Variabel	R-square	R-square adjusted
Y (Effective Learning)	0.617	0.607

Based on the table above, the R-Square value for the Effective Learning variable is 0.617. This indicates that the exogenous variables in the model simultaneously explain 61.7% of the variance in the endogenous variables, while the remaining 38.3% is influenced by other factors not analyzed in this study. Referring to the classification proposed by (Chin, 1998) An R-square value above 0.67 is categorized as strong, between 0.33 and 0.67 as moderate, and between 0.19 and 0.33 as weak. Thus, an R-square value of 0.617 for the Effective Learning variable is classified as moderate.

Discussion

Empirical findings show that variable X1, which represents the human aspect (people) in the Golden Triangle model, has a positive path coefficient of 0.427 with a P-value of

0.002 (<0.05). These results indicate a positive and partially significant influence between human factors and learning effectiveness. The human dimension includes the strategic role of the madrasah principal and educators in facilitating the learning process, the level of students' internal motivation, and the quality of interaction and collaboration within the educational environment. In the context of effective digital learning, the "People" component plays a key role in supporting technology-based educational transformation. Qualitatively, stakeholder involvement reflects systemic and integral synergy.

The data processing results show that variable X2, which represents the process dimension within the Golden Triangle framework, partially has a negative path coefficient of -0.187 with a significance level of 0.009 (<0.05). Although the effect is statistically significant, this negative direction indicates obstacles in the implementation of the learning process, which impacts the effectiveness of learning. Interpretation of these results leads to the conclusion that non-adaptive learning structures such as rigid curriculum design, non-contextual operational procedures, and evaluation methods that are less responsive to student needs can hinder the achievement of optimal learning outcomes.

Within the framework of effective digital learning, the "Process" dimension is a crucial pillar that reflects order and systematization in the implementation of educational programs. Research from (Harianto, 2024) The results show that managing education with technology has a significant impact on improving the quality of learning in schools.

Variable X3, representing the technology aspect within the Golden Triangle framework, partially demonstrated a positive path coefficient of 0.513 with a P-value of 0.000 (<0.05), indicating a very high level of significance. The highest coefficient value among the three variables indicates that technology has the most dominant influence on learning effectiveness.

These findings underscore the importance of strategic and sustainable technology integration in learning design. Adequate digital infrastructure

support, technology skills training for educators, and the development of content that is relevant and adaptive to student needs are key factors in optimizing the role of technology as a primary driver of effective learning.

The R-Square value for the effective learning variable is 0.617. This indicates that the exogenous variables in this model simultaneously influence 61.7% of the variance in the endogenous variables, while the remaining 38.3% is influenced by other factors not analyzed in this study.

Based on the results of the data analysis, it can be identified that the Golden Triangle, consisting of people, process, and technology, simultaneously has a significant influence on effective learning. This discussion details how each element can influence learning outcomes in students at State Islamic Senior High Schools in Bogor City.

This finding aligns with research findings from (Nurhayati, 2025) This demonstrates that optimal educational management, including the development of technological infrastructure, improving the competency of educators through training programs, and implementing adaptive learning strategies for students, can drive improved learning outcomes, strengthen interactions between teachers and students, and ensure the quality and sustainability of education in the modern era.

The synergy between people, processes, and technology, as reflected in the golden triangle concept, significantly impacts learning effectiveness. These three components complement each other: people as the primary driver, processes as the driving force, and technology as the facilitator. If all three are managed effectively, digital learning in madrasas will not only be effective but also able to address the challenges of education in the digital age.

CONCLUSION

Based on the results and discussion presented above, it can be concluded that the results of the path analysis produce: a). X1 -> Y has a statistical T value of 3.084 > 1.96 and P values of 0.002 < 0.05, b). X2 -> Y has a statistical T value of 2.615 > 1.96 and P values of 0.009 < 0.05, c). X3 -> Y has a statistical T value of 4.270 > 1.96 and P values of 0.000 < 0.05. The three partial

hypotheses in this study show significant and influence the relationship between variables. Furthermore, an R-square test is carried out to determine the extent of the simultaneous influence of exogenous (independent) variables on endogenous (dependent) variables. From the calculation results, an R-square value of 0.617 is obtained. This shows that the exogenous variables in the model are able to explain 61.7% of the variance of the endogenous variables, while the remaining 38.3% is influenced by other factors not analyzed in this study.

The implication of this research is that the implementation of digital learning management based on the golden triangle can be a strategic framework for improving the quality of learning in State Islamic Senior High Schools (Madrasah Aliyah) throughout Bogor City. Strengthening teacher competencies (people), management processes (process), and the availability of digital infrastructure (technology) has been proven to provide positive contributions. Madrasas can strengthen digital training programs for teachers and increase digital support facilities so that learning implementation can run more optimally and align with the needs of 21st-century education.

The government through the Ministry of Religious Affairs and the Ministry of Education, Culture, Research, and Technology, can formulate policies that strengthen the capacity of human resources clarify standards for digital learning management processes, and ensure the availability and equitable technology infrastructure.

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