

RESEARCH ARTICLE

The impact of the digitalization of the financial mathematics module on budgetary governance through financial literacy: The readiness of prospective education managers

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ABSTRACT

Purpose – Budget management in Islamic educational institutions still faces significant challenges in the form of the low level of financial preparedness among prospective education managers, a gap that has not yet been adequately bridged by digital-based financial mathematics education; consequently, research that integrates the digitization of modules, financial literacy and budget management within a single structural model remains necessary. This study examines the role of the digitalization of Financial Mathematics modules in the budget management competencies of prospective education managers, as well as examining financial literacy as a mediating mechanism linking the digitalization of modules to budget management competencies.

Method – The study employed a quantitative approach, an explanatory design, and cross-sectional data collection using total sampling (a census) of students who met the inclusion criteria. Data were collected in August 2026 from 72 fifth-semester students (out of a population of 110 students) on the Islamic Education Management programme at UIN Sulthan Thaha Saifuddin Jambi who had used the 'Financial Mathematics' digital module and had complete data, via a 24-item Likert-scale questionnaire that had been tested for convergent validity, discriminant validity and reliability. This sample size met the minimum threshold of the priori statistical power analysis (68 respondents). The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4, including an evaluation of the measurement model and structural model, as well as mediation testing based on bootstrapping.

Findings – The digitisation of the Financial Mathematics module proved to be a key driver of improvements in both financial literacy and budgetary management competence amongst prospective education managers, with a strong direct effect on both constructs ($\beta = 0.438$; $p < 0.001$ and $\beta = 0.455$; $p < 0.001$). Financial literacy also contributes positively to budgetary management competence ($\beta = 0.239$; $p = 0.033$) and acts as a mediating mechanism, albeit partially, in the relationship between the digitisation of the module and this competence ($\beta = 0.105$; $p = 0.049$), indicating that mastery of financial concepts alone is insufficient without their application in budgeting practice. The model explains 19.2 per cent of the variance in financial literacy and 36.0 per cent of the variance in budgetary management competence.

Implications – These findings provide theoretical implications for the development of a mediation-based financial-managerial readiness model, as well as practical implications for strengthening the Financial Mathematics curriculum and budgetary management policies in Islamic educational institutions.

Keywords: Digitalisation of Financial Mathematics; financial literacy; budget management competence; prospective education managers; PLS-SEM.

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INTRODUCTION

Digital transformation has driven fundamental changes in higher education, not only in the learning process but also in the development of the competencies required to navigate an increasingly technology- and data-driven organisational landscape. Digitalisation in higher education encompasses coordinated changes to processes, educational models, strategic direction and the operational effectiveness of institutions; consequently, the use of technology must be directed towards creating broader value than merely converting conventional learning into a digital format (Gkrimpizi et al., 2024). In line with this, Fernández et al. (2023) demonstrate that the digital transformation of higher education institutions takes place across various organisational dimensions and requires the development of capabilities that can link technology to both academic and institutional needs. These changes also position students' digital competences as a crucial part of their readiness to face an increasingly digitalised professional environment (Farias-Gaytan, 2023). In the context of educating prospective managers, this situation underscores the need for a learning process that not only builds conceptual understanding but also develops the ability to utilise technology to support managerial analysis, planning and decision-making.

This issue becomes more concrete in the context of educating prospective managers in Islamic education. Financial Mathematics taught conventionally through lectures and calculation exercises without a direct link to institutional budgetary issues tends to stop at the mastery of calculation procedures and fails to meet students' needs to apply this knowledge in real-world budgeting decisions. It is this gap between procedural mastery and practical readiness that constitutes the specific empirical problem underpinning this study: to what extent can the digitisation of a Financial Mathematics module—designed to link mathematical concepts with budget problem simulations—address the limitations of conventional teaching methods in developing the managerial competencies of prospective education managers.

In educational management, the ability to manage finances is a crucial competence, as managers are involved in planning, allocating, monitoring and evaluating the use of budgets to achieve institutional objectives. Such management requires not only administrative compliance but also the ability to make decisions based on accurate financial calculations and information. Research indicates that financial management in educational institutions still faces challenges in terms of budgeting, transparency, managerial competence, and the effective utilisation of resources (Gaspar et al., 2022). The digitisation of budgeting systems does not automatically guarantee accountability without being supported by adequate financial management capacity (Setiawati et al., 2022). Therefore, prospective education managers need to be equipped with financial competencies that enable them to understand financial calculations and use them as a basis for budgetary decision-making.

Advances in educational technology open up opportunities to integrate Financial Mathematics into digital learning that is more flexible, contextual and problem-solving

oriented. Digital-based mathematics learning enables students not only to learn calculation procedures, but also to link mathematical concepts to practical situations requiring analysis and decision-making. Recent research indicates that proficiency in Financial Mathematics is relevant to the development of students' financial literacy, particularly when learning is able to link financial knowledge with the ability to apply it in real-world situations (Berlinger, 2025). At the same time, research on students' Financial Mathematics abilities indicates that applying mathematical knowledge to practical financial contexts remains a challenge (Putri et al., 2026). This situation reinforces the need for the digitalisation of Financial Mathematics modules that not only present computational concepts but also facilitate their application to financial problems relevant to the needs of prospective education managers.

Financial literacy is a competence that bridges the mastery of financial concepts with the ability to make sound financial decisions. Financial literacy represents not only knowledge of financial concepts but also the ability to understand, evaluate and use financial information in making rational choices. Recent empirical evidence suggests that the gap between financial knowledge and the ability to assess that knowledge can result in sub-optimal financial decisions (Merter & Balcıoğlu, 2025). Other research indicates that financial literacy plays a role in shaping budgeting, investment and saving behaviour; consequently, financial competence needs to be directed towards the application of knowledge in the decision-making process (Dheepiga & Sivakumar, 2025). Therefore, in the context of prospective education managers, financial literacy can be positioned as a mechanism linking an understanding of digital-based financial mathematics with the ability to manage and make decisions regarding education budgets.

A number of recent studies indicate that students' financial competence is determined not only by access to financial information, but also by educational experiences that enable that knowledge to be applied in decision-making. Huang et al. (2024) demonstrate that student engagement in finance-related education is associated with the development of financial literacy and habits, although the impact may vary depending on the type of education received. Another study indicates that the implementation of RBL-STEM-based learning can be directed towards developing students' financial literacy and changing their financial behaviour, with the relationships between constructs tested using SEM-PLS (Sumarno et al., 2024). In other higher education contexts, levels of financial literacy have also been found to be related to students' ability to understand and evaluate the financial decisions they face (Leone & Thompson, 2024).

Findings among Indonesian students further indicate that financial literacy and behaviour contribute positively to students' financial wellness (Asiah et al., 2024). Taken together, these findings reinforce the argument that financial education should be directed not only towards mastering concepts, but also towards the ability to translate that knowledge into financial management decisions and practices. Nevertheless, these studies have consistently remained within the realm of individual financial literacy and behaviour, whether through the use of '' (Huang et al., 2024), project-based learning (Sumarno et al.,

2024), or the evaluation of personal financial decisions (Leone & Thompson, 2024; Asiah et al., 2024), and none have yet positioned financial literacy as a pathway to budgetary management competence at the level of educational organisations; it is this theoretical gap that the present study explicitly addresses.

Although the relationship between financial education, financial literacy and financial decision-making has been extensively studied, previous research still demonstrates fragmentation in its focus and analytical context. Huang et al. (2024) examined students' engagement in finance-related education in relation to financial literacy and habits but did not address organisational budget management competence. Berlinger (2025) more specifically involved students on finance and financial mathematics programmes, but their study focused on the dimension of students' financial literacy. Leone and Thompson (2024) also centred their attention on the financial literacy of higher education students and their perceptions of financial advice. Meanwhile, recent research on students indicates that financial literacy can be incorporated into a structural model to explain investment behaviour and financial decision-making (YÜRÜK, 2025). Consequently, there remains scope for research that integrates the digitalisation of Financial Mathematics learning, financial literacy and budget management within a single structural model, particularly amongst students being prepared as prospective educational managers. This study fills this gap by positioning financial literacy as a mediating mechanism that explains how the digitalisation of Financial Mathematics modules can contribute to strengthening the budget management of prospective education managers.

Empirically, strengthening financial competence through education plays a vital role in developing financial literacy and decision-making skills. Rehman and Mia (2024) demonstrate that education is one of the key determinants in the development of financial literacy, although this development is also influenced by social, economic and psychological factors. Stronger evidence is provided by experimental studies on university students, which found that financial literacy training significantly improves objective financial literacy whilst encouraging more responsible financial behaviour, including budgeting, saving, insurance and investment planning (İlbasmış, et al., 2025). Furthermore, the accuracy of financial decision-making depends not only on the amount of knowledge possessed, but also on an individual's ability to evaluate and apply that knowledge appropriately; a gap between actual knowledge and one's perception of financial competence can result in sub-optimal decisions (Merter & Balcioğlu, 2025). These findings reinforce the argument that financial literacy can function as a mechanism that translates financial learning experiences into decision-making capabilities. In the context of this study, this mechanism is expected to bridge the digitalisation of the Financial Mathematics module with the ability of prospective education managers to plan, allocate, control and account for budgets.

Based on this conceptual framework, the digitisation of the Financial Mathematics module is expected to provide a learning experience that helps students develop an understanding of and the ability to apply financial concepts, which is subsequently reflected in their level of financial literacy. Financial literacy is important because it relates

not only to the mastery of financial knowledge but also to the ability to evaluate information and use it appropriately in financial decision-making (Rehman & Mia, 2024; Merter & Balcıoğlu, 2025). Recent research on students also indicates that budgeting, the use of digital financial tools, knowledge and behaviour are key dimensions in the development of students' financial literacy (Rodríguez-Correa et al., 2025).

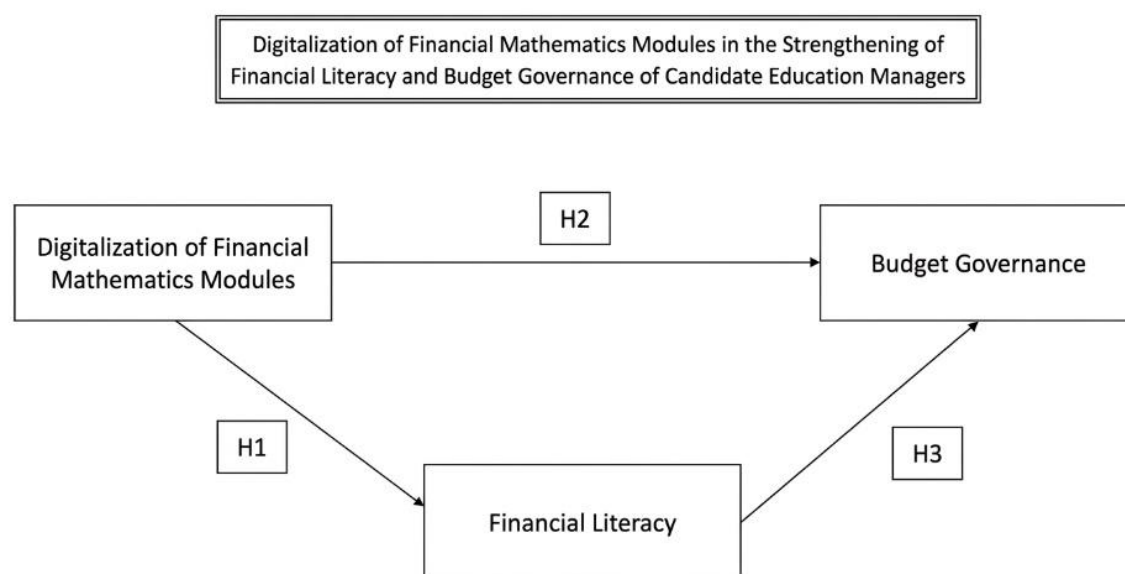
The rationale behind the relationships between variables in this study can be explained through a combination of Constructivist Learning Theory and Cognitive Load Theory. Constructivist Learning Theory explains that financial understanding is actively constructed when students reconstruct financial mathematics concepts through repeated interaction with digital modules and their application to contextual budgeting problems, thereby explaining why the digitisation of the Financial Mathematics module is expected to enhance financial literacy (H1) as well as budgeting management competence (H2). Cognitive Load Theory, on the other hand, explains that the gradual and interactive presentation of material via a digital format, as opposed to conventional, information-dense delivery, reduces students' extraneous cognitive load, thereby allowing remaining cognitive capacity to be redirected towards processing financial literacy into budgetary decision-making skills (H3), including explaining the mediating mechanism of financial literacy in the relationship between the digitisation of the module and budgetary management competence (H4). Together, these two theoretical frameworks provide the conceptual foundation for the structural model tested in this study.

Based on this reasoning, this study examines the effect of the digitisation of the Financial Mathematics module on financial literacy (H1), the effect of the digitisation of the Financial Mathematics module on budget management (H2), the effect of financial literacy on budget management (H3), and the mediating role of financial literacy in the relationship between the digitisation of the Financial Mathematics module and budget management (H4). This study aims to examine these relationships amongst students of Islamic Education Management as prospective education managers, thereby providing empirical evidence regarding the role of digital financial learning in strengthening budget management competencies (Figure 1).

The focus on students of Islamic Education Management as prospective education managers is not without reason. Budget management in Islamic educational institutions, such as madrasahs and faith-based schools, faces challenges that are relatively distinctive compared to educational institutions in general; these include limited financial training for administrators, funding sources that are more diverse yet less standardised, and demands for accountability to both internal and external stakeholders that are of a religious as well as institutional nature (Akhyar, 2024). These conditions make the strengthening of prospective managers' financial competencies from their undergraduate studies an urgent necessity, whilst also providing a local and contextual focus that distinguishes this research from studies on student financial literacy within the context of general education; it also has the potential to be relevant to international readers with an interest in the financial governance of faith-based educational institutions in developing countries.

Figure 1.

Conceptual Framework of the Research



METHOD

This study employs a quantitative approach with an explanatory design and cross-sectional data collection to examine the relationship between the digitisation of the Financial Mathematics module, financial literacy and budget management. The cross-sectional design allows data to be collected at a single observation period to analyse the relationships between variables in the research model, whilst PLS-SEM is appropriate for estimating predictive relationships between latent constructs in the structural model (Hair et al., 2022; Dash & Paul, 2021). The research was conducted in August 2026 amongst fifth-semester students on the Islamic Education Management programme at UIN Sulthan Thaha Saifuddin, Jambi. The selection of fifth-semester students was based on their use of the digital Financial Mathematics module as part of their preparatory training prior to undertaking their work placements; thus, the respondents had direct experience with the module that was the subject of the research. The study population comprised 110 students. The adequacy of the sample size was determined through an a priori statistical power analysis with a maximum of two predictors for the endogenous construct, a significance level of 5 per cent, statistical power of 80 per cent, and a moderate effect size ($f^2 = 0.15$), resulting in a minimum requirement of approximately 68 respondents. A statistical power-based approach was used as it is more appropriate for assessing sample adequacy in PLS-SEM than relying solely on rules of thumb, whilst the respondents were drawn from members of the population who had already used the 'Financial Mathematics' digital module and met the requirements for research data completeness.

The sampling technique used was total sampling (census) with the following inclusion criteria: all fifth-semester students on the Islamic Education Management programme who had used the 'Financial Mathematics' digital module and were willing to participate. Of the 110 students comprising the population, 72 provided responses with

complete data and met the analysis criteria, resulting in a response rate of approximately 65.5 per cent. A census approach to a population with clearly defined boundaries (as opposed to a probability sample drawn from a broader population) minimises the risk of selection bias, as all members of the population who meet the criteria have an equal opportunity to participate without any subjective screening process by the researcher.

Table 1.

Research Instrument

Variable	Primary Dimensions	Initial Number of Item
Digitisation of the Financial Mathematics Module (X)	system quality/accessibility, content quality, ease of use, interactivity & relevance	8
Financial Literacy (M)	knowledge, attitudes/evaluation skills, application of financial decisions	8
Budget Management Competence (Y)	planning, allocation, transparency and accountability, monitoring and evaluation	8

Sources: Wolniak & Stecula, 2024; Wang et al., 2025; Al-Hail et al., 2024; Prado et al., 2022; Méndez-Prado et al., 2023; Potrich et al., 2025; Rohman et al., 2024; Akhyar, 2024; OECD, 2025.

The research instrument (Table 1) took the form of a structured questionnaire comprising 24 items designed to measure three constructs: the digitisation of the Financial Mathematics module, financial literacy and budget management, with each construct represented by eight items. The measurement of the digitisation of the Financial Mathematics module was adapted from studies on the quality and user experience of digital learning (Wolniak et al., 2024; Wang et al., 2025), whilst financial literacy drew upon the development of financial literacy instruments for young adults (Méndez-Prado et al., 2022; Méndez-Prado et al., 2023). Budget governance was measured through the aspects of planning, allocation, efficiency, transparency and accountability, as well as budget monitoring and evaluation. All items were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Given that some items were adapted from international instruments (including the OECD's and other English-language literature), the adaptation process was carried out using a back-translation procedure, whereby items were first translated into Indonesian and then back into the source language to verify that the meaning was accurate. Subsequently, the instrument was reviewed through expert judgement by education management specialists to assess its content validity and suitability for the local context and was pilot-tested on a small number of students outside the main sample to ensure linguistic clarity and face validity before the instrument was distributed to the research sample.

Data collection took place in August 2026 after the students had gained experience using the 'Financial Mathematics' digital module as part of their preparation for their work placements. Questionnaires were distributed to fifth-semester students who met the research criteria, following an explanation of the research objectives and the voluntary

nature of participation. Respondents were asked to provide assessments based on their actual experiences whilst using the module, whilst personal identifiers were not used in the analysis process to ensure data confidentiality. Once data collection was complete, the data were checked to ensure the completeness of responses and to identify data that did not meet the analysis criteria. As the data were collected via self-reporting and were cross-sectional in a single time wave, non-statistical prevention procedures were also applied from the survey administration stage, namely the randomisation of item order across constructs and the guarantee of respondent confidentiality, as additional steps to mitigate common method bias prior to data analysis (Podsakoff et al., 2003). Data quality checks were carried out prior to PLS-SEM model estimation, as the presence of missing values and their handling can affect parameter estimates and the precision of the analysis results (Amusa & Hossana, 2024).

The research data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4 software. The analysis was carried out in stages through the evaluation of the measurement model and the structural model. In addition, Common Method Bias (CMB) was assessed using the comprehensive collinearity assessment recommended by Kock (2015), with a VIF threshold of <3.3 as an indication of the absence of common method bias, to minimise potential bias associated with self-reported cross-sectional survey data. This procedure ensures that the measurement instruments and structural model meet the recommended psychometric standards before hypothesis testing is carried out.

The three research constructs—the digitisation of the Financial Mathematics module (X), financial literacy (M), and budget management competence (Y)—were theoretically conceptualised as reflective indicators, as each item is regarded as representing a manifestation of the underlying latent construct; thus, changes in the latent construct are expected to be reflected across all its indicators. Establishing the nature of these constructs is important as it determines the appropriate evaluation criteria at the measurement stage. At the measurement model stage, the quality of these reflective constructs was evaluated through: indicator reliability, internal consistency, convergent validity and discriminant validity (Ringle, C. M. 2023; Guenther et al., 2023). Indicator reliability was assessed based on outer loading, whilst internal consistency was examined using Cronbach's alpha, rho_A and composite reliability. Convergent validity was assessed using the Average Variance Extracted (AVE) with a value of ≥ 0.50 , whilst discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT). The use of HTMT was prioritised as it provides a stronger assessment of discriminant validity compared to relying solely on traditional criteria such as Fornell-Larcker.

Once the measurement model met the criteria for reliability and validity, the evaluation proceeded to the structural model to test the relationships between constructs and the research hypotheses. The evaluation was carried out by examining multicollinearity using the Variance Inflation Factor (VIF), the coefficient of determination (R^2), the effect size (f^2), and path coefficients to assess the direction and strength of relationships between variables, following the recommended PLS-SEM reporting

guidelines (Ringle, C. M. 2023; Guenther et al., 2023; Hair et al., 2019). The significance of direct and indirect effects was tested using the bootstrapping procedure in SmartPLS 4, taking into account path coefficients, t-statistics, p-values and confidence intervals. Mediation testing was conducted via the specific indirect effect on the pathways between the digitisation of the Financial Mathematics module, financial literacy and budget management. Structural equation modelling was used to test all direct relationships (H1–H3) as well as the mediating role of financial literacy (H4).

RESULTS AND DISCUSSION

Results

This study involved 72 students who met the study criteria and for whom complete data was available for analysis. By gender, the respondents comprised 46 women (63.9 per cent) and 26 men (36.1 per cent). The respondents' ages ranged from 20 to 22 years, with a mean of 20.79 years ($SD = 0.71$). The majority of respondents were aged 21, namely 33 students (45.8 per cent), followed by 27 students (37.5 per cent) aged 20 and 12 students (16.7 per cent) aged 22. All respondents were fifth-semester students on the Islamic Education Management programme and had been using the 'Financial Mathematics' digital module for two months. These characteristics (table 2) indicate that the respondents had a relatively homogeneous academic background and experience of using the module, in line with the context of the study.

Table 2.

Respondent Characteristics

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Female	46	63.9
	Male	26	36.1
Age	20 years	27	37.5
	21 years	33	45.8
	22 years	12	16.7
Study Programme	Islamic Education Management	72	100.0
Semester	Semester 5	72	100.0
Duration of Module Use	2 months	72	100.0
Total Respondents		72	100.0

Source: Author's survey data (2026)

Common Method Bias (CMB)

The results of the multicollinearity (Table 3) test show that all VIF values fall within the range of 1.000–1.238, well below the recommended threshold (3.3). It can therefore be concluded that there is no issue of multicollinearity amongst the predictor constructs; consequently, the structural model meets the criteria and is suitable for proceeding to the structural relationship testing.

Table 3.

Full Collinearity Assessment

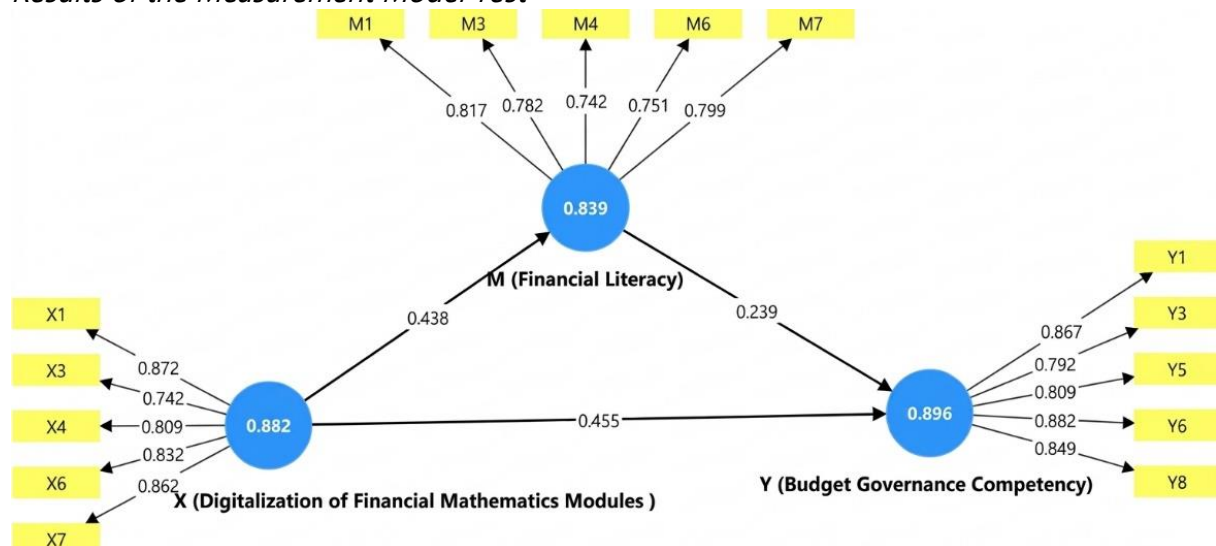
Endogenous Construct	Predictor	VIF	Conclusion
M – Financial Literacy	X – Digitalisation of the Financial Mathematics Module	1.000	No issues with multicollinearity
Y – Budget Management Competence	X – Digitalisation of the Financial Mathematics Module	1,238	No issues with multicollinearity
Y – Budget Management Competence	M – Financial Literacy	1,238	No issues with multicollinearity

Source: Author's calculations based on survey data (2026).

Evaluation of the Measurement Model (Outer Model)

Figure 2.

Results of the Measurement Model Test



Of the 24 indicators initially assessed, nine were removed due to their relatively low outer loadings (0.234–0.602). After re-estimation, the remaining 15 indicators exhibited outer loadings ranging from 0.742 to 0.882, indicating that all retained indicators met the criteria for indicator reliability.

Specifically, the nine indicators that were eliminated were M2, M5 and M8 within the financial literacy construct; X2, X5 and X8 within the digitalisation construct of the Financial Mathematics module; and Y2, Y4 and Y7 within the budget management competence construct. These items were eliminated because their outer loadings fell below the recommended threshold of 0.70 for reflective constructs; consequently, their inclusion would, from a methodological perspective, have reduced the reliability of the indicators and the convergent validity of the measurement model. Conceptually, the items that were excluded largely represent dimensions that are already adequately represented by other indicators within the same construct; consequently, their elimination does not alter the substantive scope of the construct being measured.

Table 4.

Descriptive Statistics, Factor Loadings, Average Variance Extracted, and Reliability Measures

Reflective Latent Construct	Item	Loading
Financial Literacy: AVE = 0.609; α = 0.839; CR = 0.885; SD = 0.893; M = 3.735	M1	0.817
	M3	0.782
	M4	0.742
	M6	0.751
	M7	0.799
Digitisation of the Financial Mathematics Module: AVE = 0.680; α = 0.882; CR = 0.914; SD = 0.929; M = 3.700	X1	0.872
	X3	0.742
	X4	0.809
	X6	0.832
	X7	0.862
Budget Management Competence: AVE = 0.707; α = 0.896; CR = 0.923; SD = 0.897; M = 3.672	Y1	0.867
	Y3	0.792
	Y5	0.809
	Y6	0.882
	Y8	0.849

Source: AVE = Average Variance Extracted; CR = Composite Reliability; M = Mean; SD = Standard Deviation. All factor loadings were significant at $p < 0.001$. All constructs were measured using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

The results of the measurement model evaluation (Figure 2) indicate that all retained indicators have outer loadings of 0.742–0.882, thereby meeting the criteria for indicator reliability. All three constructs (table 4) also demonstrated good internal consistency, with Cronbach's alpha ranging from 0.839 to 0.896 and composite reliability (CR) ranging from 0.885 to 0.923, all exceeding the threshold of 0.70. Convergent validity was also met, as the AVE values for Financial Literacy (0.609), Digitalisation of the Financial Mathematics Module (0.680), and Budget Management Competence (0.707) were all above 0.50. Descriptively, the three constructs achieved relatively high mean scores of 3.735, 3.700 and 3.672, respectively, indicating a tendency towards positive responses to the constructs being measured. Thus, the measurement model has met the criteria for indicator reliability, internal consistency and convergent validity.

Table 5.

Discriminant Validity (Fornell–Larcker Criteria and HTMT Ratio)

Construct	M-(LK)	X-(DMFM)	Y-(KTKA)	HTMT-M(LK)	HTMT-Y(DMFM)
M- (Financial Literacy)	0,779				
X- (Digitisation of the Financial Mathematics Module)	0,438	0,825		0,494	
Y-(Budget Management Competence)	0,439	0,560	0,841	0,494	0,610

Source: Data processed by the author (2026).

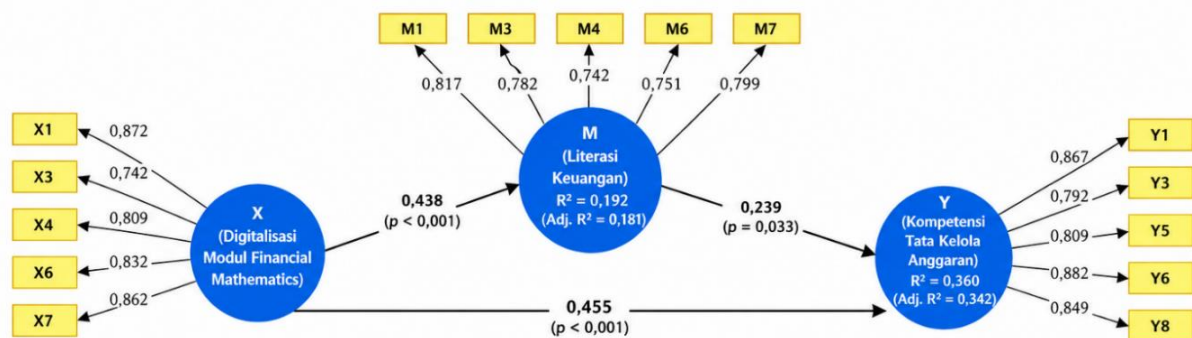
The results of the discriminant validity tests (table 5) showed that the root mean square error of approximation (RMSEA) values on the diagonal—namely 0.779 for Financial Literacy, 0.825 for the Digitalisation of the Financial Mathematics Module, and 0.841 for Budget Management Competence—were higher than the interconstruct correlations. Furthermore, the HTMT values ranged from 0.494 to 0.610, all of which were below the 0.85 threshold. Consequently, the Fornell–Larcker and HTMT criteria were met, meaning that all constructs possess good discriminant validity.

Structural Model Evaluation and Hypothesis Testing (Inner Model)

Assessment of the Structural Model

Figure 3.

Structural Model with Beta Coefficients



Notes:

- Values on the arrows between constructs are path coefficients (β) with p -values.
- R^2 = coefficient of determination.
- Values beside the indicator arrows are *outer loadings*.
- p -values are based on bootstrapping results.
- Significance level: $p < 0,05$.

Specific Indirect Effect

Indirect Relationship	Path Coefficient (β)	t-statistic	p-value	95% Confidence Interval	
				Lower	Upper
X (DMFM) → M (LK) → Y (KTKA)	0,105	1,968	0,049	0,001	0,209
Total Indirect Effect (Total Mediation)		0,105	1,968	0,049	0,209

R-square

Construct	R-square	R-square Adjusted
M (Literasi Keuangan)	0,192	0,181
Y (Kompetensi Tata Kelola Anggaran)	0,360	0,342

f-square (Effect Size)

Path	f-square	Interpretation
X (DMFM) → M (LK)	0,238	Medium
X (DMFM) → Y (KTKA)	0,262	Medium
M (LK) → Y (KTKA)	0,072	Small

Keterangan: X = Digitalisasi Modul Financial Mathematics (DMFM); M = Literasi Keuangan (LK); Y = Kompetensi Tata Kelola Anggaran (KTKA).

The results of the structural model indicate (figure 3) that the digitisation of the Financial Mathematics module has a positive and significant effect on financial literacy ($\beta = 0.438$; $p < 0.001$) and budget management competence ($\beta = 0.455$; $p < 0.001$). Financial literacy also has a positive and significant effect on budget management competence ($\beta = 0.239$; $p = 0.033$). The model explains 19.2 per cent of the variance in financial literacy and 36.0 per cent of the variance in budget management competence. Furthermore, financial literacy significantly mediates the relationship between the digitisation of the module and budget management competence ($\beta = 0.105$; $p = 0.049$).

Table 6.

Hypothesis Testing Results

Hypothesis	Relationship	β	STDEV	t	p	f^2	95% CI
H1	$X \rightarrow M$	0,438	0,087	5,067	<0,001	0,238	[0,267; 0,609]
H2	$X \rightarrow Y$	0,455	0,105	4,317	<0,001	0,262	[0,249; 0,661]
H3	$M \rightarrow Y$	0,239	0,112	2,129	0,033	0,072	[0,019; 0,459]
H4	$X \rightarrow M \rightarrow Y$	0,105	0,053	1,968	0,049	-	[0,001; 0,209]

Source: Data processed by the author (2026).

The results of the hypothesis testing (table 6) indicate that all relationships in the model are significant. The digitisation of the Financial Mathematics module has a positive effect on financial literacy (H1: $\beta = 0.438$; $p < 0.001$; $f^2 = 0.238$) and budget management competence (H2: $\beta = 0.455$; $p < 0.001$; $f^2 = 0.262$), both with moderate effect sizes. Financial literacy also has a positive effect on budget management competence (H3: $\beta = 0.239$; $p = 0.033$; $f^2 = 0.072$), although the effect size is small. Furthermore, the indirect effect $X \rightarrow M \rightarrow Y$ was also significant (H4: $\beta = 0.105$; $p = 0.049$), indicating partial mediation, as the direct effect $X \rightarrow Y$ remained significant. None of the 95% confidence intervals crossed zero; therefore, H1, H2, H3 and H4 are supported. H4 must still be interpreted with caution given that the path coefficient is relatively small ($\beta = 0.105$) with a p-value close to the significance threshold ($p = 0.049$) and the lower limit of the 95% confidence interval very close to zero ([0.001; 0.209]), meaning that this mediation finding is sensitive to data fluctuations given the limited sample size.

PIS Predict (Q^2)

Table 7.

PLS-Predict Test Results

	Q^2 predict	RMSE	MAE
M (Financial Literacy)	0,163	0,938	0,764
Y (Budget Management Competence)	0,288	0,862	0,712

Source: SmartPLS 4. Data processed by the author (2026).

Based on the results of the evaluation of predictive ability (table 7) using Q^2 predict, it was found that all endogenous constructs in the research model had Q^2 predict values greater than zero, indicating that the model possesses predictive relevance. The Financial Literacy construct (M) obtained a Q^2 predict value of 0.163, with an RMSE of 0.938 and an MAE of 0.764. These results indicate that the model possesses predictive power for the

Financial Literacy construct, although the level of predictive power remains in the low to moderate category. Meanwhile, the Budgetary Governance Competence construct (Y) yielded a Q^2_{predict} value of 0.288, with an RMSE of 0.862 and an MAE of 0.712. These values indicate that the model possesses better predictive capability compared to the Financial Literacy construct, as evidenced by the higher Q^2_{predict} value and lower levels of prediction error (RMSE and MAE). Consequently, it can be concluded that the research model possesses adequate predictive capability in explaining the endogenous construct, particularly the Budget Management Competence variable. A positive Q^2_{predict} value indicates that the predictor variables in the model are able to contribute to the prediction of the variable under study, meaning that the structural model constructed has good predictive relevance.

To complement the evaluation of the structural model, the model's out-of-sample predictive capacity was also examined using the blindfolding procedure to obtain the Predictive Relevance (Q^2) value, as well as the PLS-predict (Q^2_{predict}) procedure, as recommended by [Shmueli et al. \(2019\)](#). The results of the PLS-Predict procedure showed a Q^2 value of [financial literacy Q^2 value] for the financial literacy construct and [budget management competence Q^2 value] for the budget management competence construct; both values were above 0, indicating that the model possesses adequate predictive relevance for these two endogenous constructs. Consequently, the tested structural model not only explains in-sample variance (R^2) but also demonstrates relevant out-of-sample predictive capacity.

Discussion

H1 – The Effect of the Digitalisation of the Financial Mathematics Module on Financial Literacy

The digitisation of the Financial Mathematics module was found to have a positive and significant effect on students' financial literacy ($\beta = 0.438$; $p < 0.001$), with a moderate effect size ($f^2 = 0.238$). This finding indicates that the function of digital modules extends beyond merely facilitating access to material; they also provide a learning environment that enables students to revisit relatively complex financial concepts in a more flexible manner. Topics such as the time value of money, present value, discounting, annuities and loan amortisation require both conceptual understanding and computational skills; their presentation via PDFs and e-modules allows students to access and revise the material as required. This mechanism is consistent with findings that financial education for students can enhance financial literacy, including when learning is delivered online ([Salas-Velasco, 2022](#); [Agasisti et al., 2023](#)).

This effect can also be explained by the modules' practical focus. Students not only learn financial formulas but also use them to draw up activity budgets, calculate cost requirements, compare alternative uses of funds, and carry out cost-benefit, break-even and budget variance analyses as preparation for their work placements. Thus, financial literacy develops through the integration of numerical understanding and problem-solving that approximates managerial practice. Previous empirical evidence suggests that financial education situated within a real-life context can enhance financial knowledge, whilst

problem-based learning approaches have also been reported to strengthen learners' financial literacy (Amagir et al., 2022; Sumarno et al., 2024). In the context of this study, these findings expand the role of the digitalisation of financial learning from merely a medium for delivering content to an instrument for building the financial readiness of prospective education managers, particularly when financial mathematics content is directly linked to the budgetary decisions they are likely to face during their field placements.

H2 – The Impact of the Digitalisation of the Financial Mathematics Module on Budget Management Competence

The digitisation of the Financial Mathematics module has a positive and significant effect on budget management competence ($\beta = 0.455$; $p < 0.001$), with a moderate effect size ($f^2 = 0.262$). These findings indicate that the digital module not only serves as a medium for conveying financial mathematics concepts but is also linked to students' ability to apply these concepts to budgeting activities. This can be explained by the structure of the material, which progressively links the time value of money, present value, discounting and annuities to more managerial issues, such as the amortisation of institutional loans, cost-benefit analysis, break-even analysis, revenue projections and budget variance analysis. With this structure, students do not merely acquire the ability to perform calculations, but gain a quantitative foundation for assessing cost requirements, setting priorities, comparing alternatives for resource allocation, and evaluating the alignment between budget plans and actual outcomes. These findings are consistent with those of Tan et al. (2025), who demonstrated a link between financial education at university and students' budgeting behaviour, whilst emphasising the importance of explicitly incorporating budgeting competencies into financial education.

The context of internship preparation reinforces the significance of these findings. Students use the module not only for self-directed learning and lectures but also as a foundation for engaging in activities such as drawing up activity budgets, calculating cost requirements, comparing alternative uses of funds, and evaluating budgets when entering a practical setting. This orientation is important because the financial governance of educational institutions demands more than mere calculation skills; managers must also consider efficiency, transparency, accountability and control over the use of resources. Studies on Islamic educational institutions indicate that limited financial training remains one of the barriers to sound financial management practices and recommend strengthening training and technological support to enhance accountability in resource management (Akhyar, 2024). The findings of this study therefore place a different emphasis: the budgetary management competencies of prospective education managers can begin to be developed before students enter institutional placements, through digital financial mathematics materials designed around educational budgeting issues. With, digitalisation is thus valuable not merely because it is an electronic medium, but because it provides repeated access to analytical exercises relevant to the financial decisions students will face in their managerial practice.

H3 – Financial Literacy and Budget Management Competence

Financial literacy has a positive and significant effect on budget management competence ($\beta = 0.239$; $p = 0.033$), although it has a relatively small effect size ($f^2 = 0.072$). This finding indicates that a grasp of financial concepts serves as a foundation for students to understand and make decisions regarding budgets but does not in itself constitute the entirety of budget management competence. These findings are consistent with those of

[Sinnewe and Nicholson \(2023\)](#), who demonstrated a link between subjective financial literacy, engagement with financial matters, and the quality of financial decision-making amongst young adults. In the context of Indonesian students, [Rahmadani and Asandimitra \(2022\)](#) also found that higher education and financial knowledge are significantly associated with financial behaviour, including the ability to manage expenditure and make financial decisions.

The findings of this study extend this relationship from the realm of individual financial management to budgeting competence within the context of educational organisations. After studying the module, students not only carried out financial calculations but also began to understand the basic concepts, types and components of school budgets, as well as budget analysis techniques. In practical exercises, students were also faced with decisions regarding the prioritisation of fund allocation, the rationality of needs, the approval process, comparisons between plans and actual outcomes, and the evaluation of budget deviations. Such competencies are relevant to the nature of financial management in educational institutions, which regard budgeting and reporting as crucial mechanisms for ensuring the accountable use of resources. [Nakabago and Hofisi \(2024\)](#), for example, highlight the importance of budgeting and financial reporting for the financial accountability of educational programmes, whilst [Akhyar \(2024\)](#) emphasises the importance of transparency, financial training, stakeholder engagement, and accountability practices in the financial management of Islamic educational institutions.

The f^2 value of 0.072 also provides a finding worthy of note. Financial literacy is necessary, but its contribution to budgetary governance competence is not dominant. Budgetary governance demands a broader range of skills than merely understanding financial concepts, as students must be able to use this information to set priorities, account for decisions, monitor implementation, and evaluate the use of resources. This helps explain why financial literacy exerts a significant but small- e effect on budgetary management competence. Consequently, the training of prospective education managers should not stop at enhancing financial knowledge, but should integrate it with practice in decision-making, budget analysis, transparency, and financial accountability that mirrors the realities of managing educational institutions. Practices of accountability and transparency are indeed central elements in the financial management of educational institutions ([Akhyar, 2024](#); [Nakabago & Hofisi, 2024](#)).

H4 – The Mediating Role of Financial Literacy in the Relationship between the Digitalisation of the ‘Financial Mathematics’ Module and Budget Management Competence

The research findings indicate that financial literacy significantly mediates the relationship between the digitalisation of the Financial Mathematics module and budget management competence ($\beta = 0.105$; $t = 1.968$; $p = 0.049$). However, the direct effect of module digitalisation on budget management competence remains positive and significant ($\beta = 0.455$; $p < 0.001$). This pattern indicates partial mediation, meaning that improvements in budget management competence do not occur solely through the enhancement of financial literacy. This finding can be explained by the nature of the learning process within the module, which progresses gradually from mastering financial concepts towards their application in managerial contexts. The module’s structure is indeed designed in a tiered manner, moving from basic concepts towards integrated managerial applications, including the time value of money, present and future value, discounting, annuities, amortisation, cost-benefit analysis, break-even analysis, and budget variance analysis. Thus, financial literacy functions as a cognitive mechanism that helps students transform their mathematical and financial understanding into a foundation for interpreting, analysing and evaluating budgetary decisions. Such a mechanism is consistent with evidence that financial education interventions can influence student outcomes partly through improved financial knowledge, whilst other effects continue to operate through direct mechanisms outside this mediator.

Interestingly, the indirect effects observed were relatively limited compared to the module’s direct impact on budget management competencies. This finding makes sense when viewed in the context of the module’s learning design, which goes beyond the mere transfer of financial knowledge. Students are placed in decision-making situations that resemble the challenges faced by educational institutions. In the ‘time value of money’ exercise, for example, students must calculate financial values, compare alternatives, determine the most efficient option, and then draw up recommendations for decision-makers. In the more integrative section, students are asked to compare the budget with actual expenditure, identify favourable and unfavourable variances, pinpoint problematic budget items, and produce recommendations in the form of evaluations, budget reforecasting, and improved budget monitoring. Experience during the use of the module also shows that students become more active in discussing the material and find it easier to complete budget preparation and evaluation case studies. Consequently, competence is built not only through what students know about finance, but also through what they are able to do with that knowledge when faced with budgetary decisions. This argument is consistent with [Suleiman \(2024\)](#), who emphasises the limitations of financial education that is merely conventional in nature and highlights the importance of experiential learning—including scenario-based budgeting and practical tasks—to link financial theory with its application. Other findings also highlight the importance of simulations and active learning in enhancing the effectiveness of financial education ([Senduk et al., 2024](#)).

These mediation findings simultaneously provide a more comprehensive explanation of the mechanism underlying the digitisation of the Financial Mathematics module. Financial literacy is a significant intermediary pathway but not the sole pathway to budgetary management competence. From a pedagogical perspective, the digitisation of the module introduces interactivity into the learning media through financial calculation simulations, cost-benefit analysis scenarios, and break-even point simulations, which function as cognitive scaffolding—that is, gradual support that helps students move from understanding quantitative concepts towards the ability to evaluate alternatives and make budgetary decisions. These features enable students to progress from the process of understanding and calculating to the process of evaluating alternatives and reaching decisions. The problem-based approach to financial learning also receives empirical support; [Sumarno et al. \(2024\)](#), for example, found through PLS-SEM that the implementation of RBL-STEM learning is associated with an increase in students' financial literacy, demonstrating the relevance of integrating financial issues with learning activities that require analysis and problem-solving.

The contribution of these findings lies in positioning financial literacy not merely as an outcome of financial learning, but as a bridging mechanism between digital Financial Mathematics learning and the development of budget management competencies in prospective education managers. Nevertheless, the relatively small indirect effect size and its significance level, which is close to the 0.05 threshold ($p = 0.049$), suggest that this mediating role should be interpreted proportionately. Budget management competencies appear to be developed more effectively when financial understanding is combined with experience of applying concepts to authentic institutional problems. This is relevant to the fundamental objective of the 'Financial Mathematics' digital module, which is specifically designed to bridge formal mathematical concepts with decision-making in educational budget management. Consequently, for the education of prospective managers, mastery of financial formulas should not be the ultimate learning objective, but rather an analytical tool for assessing efficiency, setting priorities, evaluating implementation, and accounting for budgetary decisions.

Integration of Research Findings and Contributions

Overall, the research findings indicate that the digitisation of the Financial Mathematics module operates through mechanisms that extend beyond merely providing learning materials in a digital format. The stronger direct influence on budgetary management competencies compared to the indirect influence via financial literacy suggests that the development of managerial competencies cannot be achieved solely by enhancing financial knowledge. Students also need to be confronted with situations that require the application of this knowledge to analyse problems and make decisions. This pattern is consistent with experimental evidence that digital financial education can enhance students' financial knowledge ([Oberrauch & Kaiser, 2024](#)), whilst experience-based financial learning enables students to link concepts to practical activities such as budgeting and decision evaluation ([Suleiman, 2024](#)). In this study, this mechanism is

evident in the design of the 'Financial Mathematics' digital module, which explicitly progresses from basic concepts towards integrated managerial applications.

Students do not merely calculate financial values; they are required to compare alternatives, assess efficiency, analyse budget variances, and generate managerial recommendations based on the results of their analysis. These findings are further supported by a PLS-SEM-based study demonstrating the relevance of problem-based learning in enhancing students' financial literacy (Sumarno et al., 2024), as well as research on work-placement students which found a positive contribution of financial literacy to professional practice readiness (Yordudom et al., 2024).

This pattern of direct influences dominating over indirect influences also needs to be interpreted critically, rather than merely being seen as confirming previous findings. From the perspective of Information Processing Theory, budgetary management competence demands more than merely the storage of financial knowledge within students' cognitive structures (represented by financial literacy); it requires the active processing of this information into decisions through repeated practice provided directly by digital modules, thereby making the direct pathway from the digitisation of modules to budgetary management competence stronger than the pathway that must pass through financial literacy as an intermediary. This explanation is consistent with Kolb's Experiential Learning Theory, which emphasises that competence is optimally formed through a cycle of concrete experience, reflection, conceptualisation and active experimentation, rather than solely through the accumulation of declarative knowledge. Consequently, the discrepancy between the magnitude of direct and indirect effects in this study is not an anomaly, but rather an indication that the applied experience within the digital module makes a contribution that is not fully captured by financial literacy acting as the sole mediator.

The contribution of this study thus lies in the shift in the position of Financial - Mathematics from a numerical competence towards an instrument for the development of managerial competence in prospective education administrators. Recent financial education literature has demonstrated the effectiveness of online, digital and experience-based learning in enhancing students' financial knowledge or literacy. However, this study expands upon this discussion by positioning financial literacy as a mediating mechanism and educational budget management competence as a managerial outcome. In other words, the ability to understand present value, annuities, cost-benefit analysis, or break-even points acquires managerial value when students are able to use these concepts to set priorities, evaluate efficiency, identify budget deviations, and formulate recommendations for the use of resources. This orientation aligns with the objectives of the 'Financial Mathematics' digital module, which was designed from the outset to bridge the gap between formal mathematical understanding and decision-making in educational budget management. Consequently, the novelty of this research lies not merely in the use of a digital module, but in the integration of the digitalisation of Financial Mathematics, financial literacy, and budget management competence within a single structural mechanism to explain the financial-managerial readiness of prospective education managers.

This novelty simultaneously reaffirms the relevance of Constructivist Learning Theory and Cognitive Load Theory, which underpin the hypotheses of this study: the empirical findings indicate that the active construction of financial understanding through the digital module (H1, H2) does indeed need to be followed up by a reduction in cognitive load through gradual practice so that financial literacy can function as a cognitive mechanism leading to budgetary management competence (H3, H4). By explicitly linking the empirical results to these two theoretical frameworks, this study not only confirms the existing literature on digital financial education but also expands upon it with a mediation model that has not previously been tested in the context of Islamic educational budget management.

Practical Implications

The findings of this study have practical implications for the development of teaching on the Islamic Education Management degree programme, particularly in preparing students to fulfil their financial responsibilities during work placements and whilst working in educational institutions. The teaching of Financial Mathematics should not be limited to the mastery of formulas but should be directed towards the ability to use financial information to set budgetary priorities, compare funding alternatives, assess programme efficiency, and evaluate budget plans and actual expenditure. These competency requirements are relevant to the practice of educational financial management, which demands accurate allocation, efficiency, transparency and accountability. Recent studies in the higher education sector also indicate that accurate allocation and transparency-accountability are key aspects of effective budget management. Therefore, the use of digital modules can be positioned as part of pre-placement training by integrating cost-benefit analysis, break-even analysis, budget variance analysis, and budget decision-making case studies. This approach aligns with the needs of educational finance management, which emphasises needs-based planning, prioritisation, monitoring, and accountability for the use of funds. Consequently, the strengthening of financial literacy and budgetary analysis training must be carried out in an integrated manner so that students not only understand financial aspects conceptually but also possess the analytical readiness to carry out budgeting functions efficiently, transparently and accountably as prospective education managers.

CONCLUSION

The digitisation of the Financial Mathematics module has proven to play a crucial role in strengthening the financial literacy and budget management competencies of prospective education managers, with financial literacy acting as a partial mediating mechanism. The core findings of this study confirm that mastery of financial literacy alone is insufficient to develop comprehensive budget management competencies; these competencies are formed most effectively when an understanding of financial concepts is combined with analytical exercises and simulations of budgeting problems that resemble institutional situations. Consequently, Financial Mathematics can be developed beyond its role in numerical learning to become a tool for fostering students' managerial readiness,

particularly in setting priorities, assessing efficiency, evaluating implementation, and accounting for budgetary decisions. Consequently, the Islamic Education Management Study Programme could integrate digital-based Financial Mathematics learning with educational budgeting case studies as part of the preparation before students undertake their work placements. Further development should strengthen decision-making simulations, cost-benefit analysis, break-even analysis, budget variance analysis, and case studies on school or madrasah financial management so that financial literacy is more closely linked to professional competencies. It should also be acknowledged that this study has a number of methodological limitations, namely a relatively small sample size (72 respondents) and a focus on a single study programme; the use of cross-sectional data from a single time wave, which cannot capture longitudinal changes in competencies; and the potential for self-reporting bias, as all data were measured based on the respondents' own perceptions. Future research should also test this model on a broader population and across a wider range of institutions and utilise longitudinal or experimental designs to examine the development of students' competencies before and after the use of the module.

DECLARATIONS

Author Contributions

Syahbani, N., contributed to the conceptualisation of the research, the development of the methodology, the formal analysis of the data, and the drafting of the original manuscript; **Saputri, R., Safithri, R., and Jesica, M.**, contributed to the conduct of the investigation, data curation, and the review and editing of the manuscript. All authors have read and approved the final published manuscript.

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Conflict of Interest

The authors declare that there are no conflicts of interest in this study.

Declaration of AI Use

Generative AI (Claude, Anthropic) was used to a limited extent to assist the authors in the manuscript preparation process, specifically for brainstorming word choices, refining sentence structure, and adapting the language to comply with the IJEMAL author guidelines (including font type, spacing, margins, tables, and section structure). These AI tools were not used to generate, interpret, or analyse data or research findings, nor did they contribute to the scientific content, conclusions, or authorship of the manuscript. All suggestions generated by AI have been critically reviewed, edited, and verified by the authors, who bear full responsibility for the accuracy, originality, and scientific integrity of this manuscript.

Additional Information

Not applicable.

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