

Navigating Regulatory Challenges and Opportunities Associated with Digital Transformation in Marketing and Accounting Education

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Manuscript received March 3, 2026; revised April 8, 2026; accepted June 15, 2026; published October 16, 2026

Abstract—This study examines how students perceive the drivers of digital transformation in business education, using a sample of 712 Digital Marketing and Accounting students at Al-Zaytoonah University of Jordan. The study interprets all antecedents and outcomes at the student-perception level, including perceived regulatory challenges, technological adoption, curriculum development, institutional support, market trends and globalization, educational effectiveness, and perceived institutional performance. The conceptual model combines technology-acceptance reasoning with an institutional-alignment perspective. The analysis applies exploratory factor analysis, partial least squares structural equation modeling, and multiple regression as a robustness check. The results show strong reliability and convergent validity, although some adjacent constructs are empirically close. Market trends and globalization is the strongest predictor of educational effectiveness, while market trends and globalization and technological adoption are the strongest predictors of perceived institutional performance. Curriculum development and institutional support contribute positively but more modestly. Perceived regulatory challenges are not significant for educational effectiveness and only weakly associated with perceived institutional performance. These findings suggest that students evaluate digital transformation mainly through visible signals of employability, technological usability, hybrid-learning quality, and curriculum relevance rather than through indirect compliance arrangements. The study offers implications for curriculum modernization, digital infrastructure, hybrid learning, and professionally oriented accounting education.

Keywords—digital transformation, business education, digital marketing, accounting education, student perceptions, technological adoption, market alignment, hybrid learning

I. INTRODUCTION

Digital transformation has become a defining issue in business education because the skills required in contemporary labor markets increasingly depend on data-intensive, platform-based, and digitally mediated work. In higher education, this shift is visible not only in the adoption of online and hybrid delivery, but also in the redesign of curricula, assessment practices, student support systems, and industry engagement [1, 2].

Within business education, Marketing and Accounting are both affected by this transformation, but not in identical ways. Marketing education is increasingly shaped by social-media strategy, digital content creation, e-commerce, customer analytics, and Artificial Intelligence (AI)-enabled market insight, whereas accounting education is increasingly shaped by cloud accounting, data analytics, digital auditing, blockchain-related reporting issues, and technology-enabled

control environments [3–6].

This distinction matters conceptually. Students can meaningfully evaluate the digital tools they encounter, the relevance of course content, the support provided by the university, and the extent to which their education appears aligned with labor-market expectations. They are much less able, however, to evaluate objective institutional performance or the full complexity of external regulatory systems. A central implication is that the present study must be framed as a perception-based analysis rather than as a direct institutional or regulatory assessment.

In the Jordanian context, these issues are especially salient because universities are under growing pressure to prepare graduates for digitally changing work environments shaped by e-commerce, data analytics, financial technology, cloud platforms, and AI-assisted decision tools. This is particularly relevant for business graduates, whose employability increasingly depends on their ability to operate across both technical and interpretive digital settings [7, 8].

Regulatory and accreditation requirements still matter in this environment. Higher-education institutions must work within quality-assurance systems, data-protection expectations, and ethical constraints when integrating digital tools into teaching and assessment [9, 10]. Yet such regulatory arrangements are often experienced by students only indirectly, through the design of courses, the availability of platforms, and the flexibility of institutional processes.

The literature has paid considerable attention to digital transformation in higher education, but less attention has been given to the relative salience of different drivers when judged from the student viewpoint across business disciplines. Existing studies often discuss digital technologies, curriculum innovation, or regulatory barriers separately. Learning-management-system design and perceived online-learning outcomes also show that students evaluate digital transformation through visible instructional systems and learning results [11, 12].

The present study therefore treats Digital Marketing and Accounting not as pedagogically identical disciplines, but as two business-education contexts that share increasing exposure to digital transformation while retaining distinct professional emphases. Faculty readiness and the convergence of technology-enhanced learning further support treating digital transformation as an institutional learning process rather than as a single platform issue [13, 14]. Because the available model is estimated at the pooled level, the paper does not claim discipline-specific causal differences. Instead, it examines an overarching

perception-based model across business education, using these two departments as a relevant empirical setting.

Accordingly, the study aims to explain how students perceive five drivers of digital transformation—regulatory challenges, technological adoption, curriculum development, institutional support, and market trends and globalization—and how those perceptions relate to two student-level outcomes: educational effectiveness and perceived institutional performance. The objective is not to measure objective regulatory quality or university performance, but to identify which visible drivers matter most to students when they judge learning quality and institutional digital readiness.

This framing produces four concrete contributions. First, it clarifies the scope of inference by defining both predictors and outcomes as perceptual constructs. Second, it offers a more theoretically structured business-education explanation of why visible technological and market signals should outweigh indirect regulatory signals in student judgments. Third, it preserves the relevance of both Marketing and Accounting while explicitly avoiding claims that the two disciplines are empirically identical in the absence of formal multi-group analysis. Fourth, it yields practice-oriented implications for curriculum modernization, hybrid-learning quality, digital infrastructure, and accounting-specific digital competencies.

The remainder of the paper is organized as follows. Section II develops the literature review, conceptual framing, and hypotheses. Section III presents the methodology. Section IV reports the empirical results. Section V discusses the findings and their implications. Section VI concludes, outlines limitations, and proposes directions for future research.

II. LITERATURE REVIEW

This review is streamlined around the issues most relevant to the present model. It first considers digital transformation in business education, then clarifies the regulatory and institutional context, then discusses curriculum innovation and the relevance of combining Marketing and Accounting within one perception-based study, and finally develops the theoretical lens and research hypotheses.

A. Digital Transformation in Business Education

Digital transformation in higher education is no longer limited to moving content online. It includes the redesign of learning environments, the use of analytics and adaptive systems, the integration of digital platforms into everyday learning, and the growing expectation that universities produce graduates who can work effectively in digitally intensive settings [15–17].

For students, the most visible manifestations of this transformation are technological usability, curricular relevance, access to digital resources, and the extent to which teaching practices resemble contemporary workplace realities. These visible features help explain why student perceptions can be informative for evaluating educational effectiveness, even when they are less suitable for judging hidden managerial or policy processes.

In Marketing education, digital transformation is strongly associated with analytics, digital campaigns, social-media

ecosystems, search behavior, customer-experience data, and rapid adaptation to platform change. In Accounting education, the transformation is linked to automation, cloud systems, data analytics, audit technologies, blockchain-related record integrity, AI-assisted financial analysis, and digitally enabled course design [18, 19].

These differences make it inappropriate to treat the two disciplines as pedagogically identical. At the same time, both are increasingly shaped by digital data flows, software-supported decision making, and employer demand for hybrid analytical and professional skills. This shared exposure justifies their inclusion within a broader business-education framework.

The expansion of hybrid and online learning after COVID-19 further reinforced this shift. In many universities, perceived educational effectiveness now depends not only on content quality, but also on how smoothly digital platforms support access, interaction, assessment, feedback, and continuity between physical and online learning environments [20, 21].

Thus, digital transformation in business education should be understood as a multidimensional process in which technology, curriculum, institutional capability, and labor-market responsiveness interact to shape student experience.

B. Regulatory and Institutional Context

Regulatory frameworks remain relevant because the use of digital tools in higher education is mediated by accreditation rules, data-protection requirements, and ethical expectations. In regulated fields such as accounting, these constraints can affect how quickly programs update content, what kinds of platforms are used, and how institutions balance innovation with compliance [22, 23].

However, the present study conceptualizes regulation at the level at which students can realistically observe it. The construct is therefore interpreted as perceived regulatory challenges rather than as an objective measure of regulatory quality. This distinction is important because students typically experience regulation indirectly, through course design, platform restrictions, administrative procedures, and visible compliance practices, rather than through direct access to institutional policy processes.

This perception-based framing also helps explain why regulatory conditions may exert weaker direct effects on educational outcomes than technological adoption or market alignment. Regulation may shape the background conditions of digital transformation without being experienced by students as an immediate driver of learning quality.

C. Curriculum Innovation and Discipline-specific Relevance

Curriculum development is a central mechanism through which universities translate digital change into student learning. In business education, curricular renewal is not merely a matter of adding software exposure; it also involves embedding analytical reasoning, practical digital workflows, ethics, interdisciplinary problem solving, stronger links between classroom content and labor-market expectations, and strategic partnerships that make digital curriculum transformation credible [24, 25].

For Marketing students, this means greater attention to

digital campaigns, customer analytics, e-commerce, content ecosystems, and real-time market interpretation. For Accounting students, it means greater attention to data analytics, cloud accounting, digital audit trails, AI-assisted anomaly detection, blockchain-related record reliability, and the ethical implications of paperless financial reporting systems.

The Accounting dimension is especially important because digital transformation affects not only software usage but also the teaching of professional judgment in digitally mediated settings. Topics such as lease-accounting workflows, including digitally supported treatment of lease standards such as International Financial Reporting Standard 16 (IFRS 16) and EAS 49, revenue-recognition evidence, system-generated documentation, data integrity in automated environments, and technology-supported assurance processes become more salient when students are prepared for contemporary reporting and assurance work.

The strong role of market trends in the empirical model can therefore be interpreted as reflecting more than abstract globalization. From the student perspective, it likely captures the perceived importance of employability signals such as digital literacy, analytics capability, fintech awareness, and the ability to operate in data-rich business environments [26, 27]. The same market-alignment logic connects global curriculum standards, resilience and lifelong learning, future-of-work preparation, Jordanian digital reporting, and internationalized higher-education models [28–32].

D. Combining Marketing and Accounting within Business Education

A recurring concern in the literature is whether Marketing and Accounting should be analyzed together. They differ in pedagogy, professional logics, and technological applications. Marketing tends to foreground market responsiveness and outward-facing digital tools, whereas accounting foregrounds information quality, control, assurance, and compliance-sensitive digital systems.

The present study addresses this concern by combining the two departments within a business-education framework rather than assuming they are equivalent disciplines. The objective is to estimate an overarching perception-based model across two related business fields that are both undergoing digital change, not to claim that the mechanisms are identical in each discipline.

This approach is analytically defensible for the current dataset, but it also implies a clear boundary: discipline-specific differences should be examined in future research through subgroup or multi-group analysis rather than inferred from the pooled model alone.

E. Theoretical Lens, Research Gap, and Hypothesis Development

The study is guided by two complementary ideas. First, a technology-acceptance logic suggests that when students perceive digital tools as accessible, useful, and well integrated into their learning environment, they should evaluate educational processes and institutional readiness more positively. Second, an institutional-alignment perspective suggests that positive student judgments should also increase when the university appears to align curriculum,

support systems, and learning environments with external professional and market change.

Within this combined lens, Technological Adoption, Curriculum Development, Institutional Support, and Market Trends and Globalization are expected to enhance student evaluations because they represent visible and meaningful signals of digital readiness. Market trends are especially important because students often judge educational value through anticipated employability, perceived relevance to industry practice, and the extent to which coursework resembles contemporary business realities.

Perceived Regulatory Challenges are treated differently. Because students experience regulation indirectly, its effect may be weaker or more ambiguous. A supportive regulatory environment can facilitate digital transformation, but complex or compliance-heavy arrangements may also be experienced as constraints. For that reason, the study hypothesizes a significant association but does not impose a strong directional sign a priori.

The resulting research gap is therefore not whether digital transformation matters in general, but which drivers matter most from the student perspective within business education, how those drivers relate to educational effectiveness and perceived institutional performance in a Jordanian university context, and why those relationships should be understood as student-observable rather than institution-level mechanisms. The study's theoretical contribution is intentionally bounded: it extends technology-acceptance reasoning by embedding it in an institutional-alignment setting and clarifies why visible signals of digital readiness should dominate student judgments more strongly than indirect regulatory arrangements. Because the present revision does not estimate formal multi-group invariance or multi-group SEM, the empirical model is interpreted as a pooled business-education pattern across respondents rather than as evidence that both disciplines operate identically.

More specifically, Technological Adoption should improve both Educational Effectiveness and Perceived Institutional Performance because students interact directly with platforms, software, online assessment tools, and digital communication systems. When these tools are accessible, reliable, and instructionally meaningful, they strengthen perceived usefulness and reduce friction in the learning process, which is exactly the mechanism emphasized in technology-acceptance research.

Curriculum Development should likewise strengthen both outcomes because students judge digital transformation not only by infrastructure, but by whether course content has been updated to reflect contemporary business practice. When programs incorporate analytics, AI-related applications, platform work, digital reporting processes, and problem-based digital tasks, students are more likely to view their education as relevant and institutionally responsive.

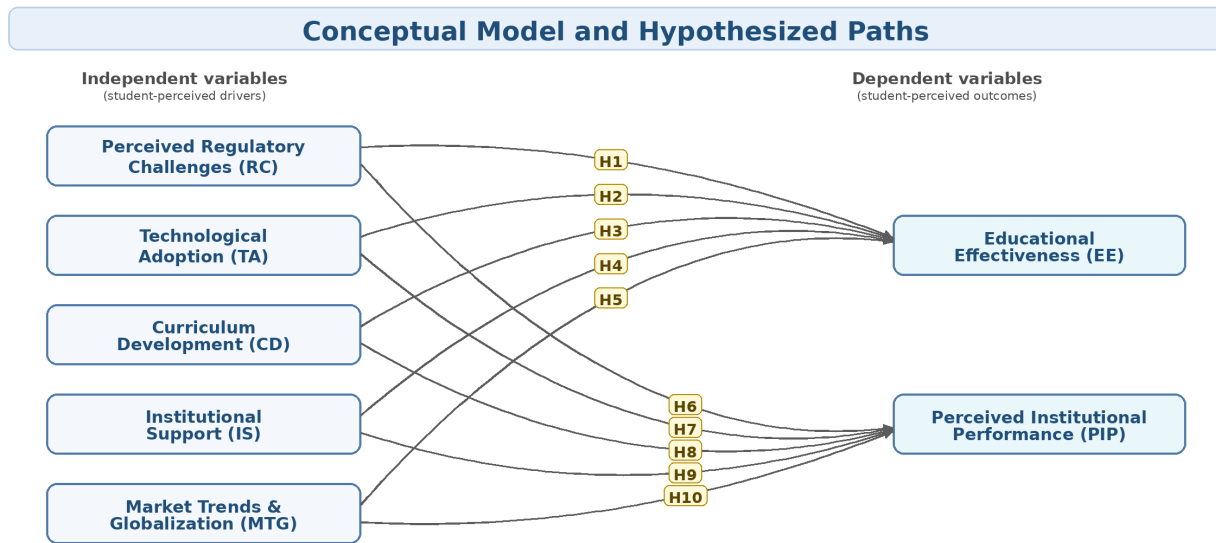
Institutional Support is also expected to matter because digital transformation becomes credible only when training, guidance, technical assistance, and administrative responsiveness accompany the formal curriculum. Even strong platforms or updated course content can produce weak student evaluations if the surrounding support environment is fragmented or unreliable.

Market Trends and Globalization may be especially

influential because business students frequently evaluate the value of their programs through anticipated employability. If the university appears aligned with evolving labor-market requirements—such as e-commerce, fintech, digital auditing, platform analytics, and data-driven decision making—students

are more likely to rate both learning effectiveness and institutional readiness positively.

Based on the conceptual framework, Fig. 1 illustrates the study model.



All constructs are measured as student perceptions; arrows represent hypothesized associations tested in the study.

Fig. 1. Conceptual model with hypothesized paths (H1–H10) linking five student-perceived drivers of digital transformation to educational effectiveness and perceived institutional performance.

Based on this perception-based framework, the study tests the following hypotheses:

H1: Perceived regulatory challenges are significantly associated with educational effectiveness.

H2: Technological adoption is positively associated with educational effectiveness.

H3: Curriculum development is positively associated with educational effectiveness.

H4: Institutional support is positively associated with educational effectiveness.

H5: Market trends and globalization are positively associated with educational effectiveness.

H6: Perceived regulatory challenges are significantly associated with perceived institutional performance.

H7: Technological adoption is positively associated with perceived institutional performance.

H8: Curriculum development is positively associated with perceived institutional performance.

H9: Institutional support is positively associated with perceived institutional performance.

H10: Market trends and globalization are positively associated with perceived institutional performance.

III. MATERIALS AND METHODS

A. Research Design and Analytical Strategy

The study adopts a quantitative, cross-sectional survey design to examine how students perceive Regulatory Challenges (RC) and key drivers of digital transformation in business education—Technological Adoption (TA), Curriculum Development (CD), Institutional Support (IS), and Market Trends and Globalization (MTG)—and how

these perceptions relate to Educational Effectiveness (EE) and Perceived Institutional Performance (PIP). The design is explanatory in that it tests pre-specified hypotheses using multivariate models estimated on student responses. Because the evidence is perception-based, the findings are interpreted as student evaluations of visible institutional conditions rather than as objective measurements of organizational performance or external regulation.

B. Research Context, Population, and Sampling

The research was conducted at Al-Zaytoonah University of Jordan and targeted undergraduate and graduate students enrolled in the Digital Marketing and Accounting departments. The context is relevant because the Marketing department formally transitioned to Digital Marketing in 2022, reflecting a more digitally integrated curriculum, whereas Accounting remains comparatively more traditional. A structured questionnaire was administered to both groups in order to capture perceptions from two business disciplines facing digital transformation through different professional logics. After screening for completeness and response quality, 712 valid questionnaires were retained (Digital Marketing: 535; Accounting: 177).

C. Measurement Instrument and Perception-based Construct Operationalization

Data were collected using a structured questionnaire comprising 35 measurement items mapped to seven reflective constructs: RC, TA, CD, IS, MTG, EE, and PIP (five items per construct). Responses were captured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument also included demographic and

study-background variables (e.g., gender, age, academic level, department, year of study, and experience with digital platforms) to describe the sample and support subgroup checks. The questionnaire was organized from the literature streams most directly relevant to the study problem—digital transformation in higher education, technology acceptance in online and hybrid learning, curriculum modernization, institutional support, employability alignment, and digital accounting education. To improve transparency, Appendix A reports the additional statistical assessment supporting the measurement and structural interpretation, including common method bias checks, HTMT-based discriminant-validity evidence, CFA-compatibility diagnostics, and regression-pattern stability. Table 1 defines the constructs conceptually, Table 2 summarizes the

substantive domains covered by the five-item batteries, and Appendix B reports the full item wording, item codes by construct (RC1–RC5, TA1–TA5, CD1–CD5, IS1–IS5, MTG1–MTG5, EE1–EE5, and PIP1–PIP5), and measurement-source mapping. For each construct, Appendix B also identifies whether the items were adapted from prior measurement streams or developed by the author based on the cited theoretical or empirical literature. This bounded, domain-based reporting is particularly important for PIP, which in this study refers only to student-perceived digital readiness, infrastructure adequacy, responsiveness, institutional image, and support for graduate competitiveness—not to objective financial, ranking, or employment outcomes.

Table 1. Perception-based construct definitions used in interpretation

Construct	Interpretation in this study
RC	Visibility and manageability of regulatory and compliance conditions affecting digital education
TA	Availability, usability, and effective integration of digital tools and platforms in learning
CD	Extent to which curriculum content is updated and digitally relevant
IS	Readiness of infrastructure, training, guidance, and administrative support for digital learning
MTG	Alignment with market expectations, employability demands, and global digital trends
EE	Perceived learning quality, skill development, and educational relevance
PIP	Student-perceived digital readiness, responsiveness, infrastructure adequacy, institutional image, and support for graduate competitiveness; not an objective indicator of finance, ranking, or employment outcomes

Note: All constructs are interpreted at the student-perception level; none is treated as an objective institutional or policy indicator.

Table 2. Indicative domain coverage of the five-item construct batteries

Construct	Indicative domain coverage	Respondent suitability
RC	Perceived clarity of digital rules, compliance burden, privacy and ethics expectations, and whether regulation seems to enable or constrain digital learning	Indirect/limited; interpret only as perceived regulatory environment
TA	Availability, ease of use, usefulness, reliability, and classroom integration of digital tools and platforms	Direct
CD	Perceived updating of course content, inclusion of analytics/AI/blockchain topics, and practice orientation of the curriculum	Direct
IS	Infrastructure quality, training opportunities, technical assistance, guidance, and administrative responsiveness	Direct
MTG	Perceived employability relevance, labor-market alignment, industry change, and globalization-related digital expectations	Moderate/direct
EE	Perceived learning quality, engagement, skill development, and practical educational relevance	Direct
PIP	Perceived digital readiness, platform and infrastructure adequacy, responsiveness to student needs, institutional image, and support for graduate competitiveness	Moderate/perceptual only

Accordingly, Tables 1 and 2 should be read as the operational map of the instrument used in interpretation. The manuscript therefore makes a deliberately bounded claim: it evaluates how students interpret the digitally visible learning environment, not how external observers would audit institutional performance or regulatory quality. The study should therefore be read as a construct-level empirical application rather than as a standalone scale-development paper.

D. Data Collection Procedure

Questionnaire administration followed institutional ethics approval. Participation was voluntary and anonymous. Students were provided with an information sheet explaining the research purpose, confidentiality safeguards, and the right to withdraw at any time without consequence. Question wording directed respondents toward their actual learning experience with platforms, course content, institutional support, and market relevance rather than toward hidden managerial processes. In the post-COVID setting, respondents were asked to evaluate the digitally mediated elements of their learning experience across classroom-supported, blended, and platform-based activities

rather than assume a fully virtual model. This design improves respondent fit for a perception-based study and strengthens the interpretation of Technological Adoption and Educational Effectiveness as judgments of hybrid digital learning arrangements, although it cannot eliminate the limits of self-reported and single-source evidence. Completed responses were compiled into a single dataset and prepared for quantitative analysis.

E. Data Preparation and Screening

Prior to estimation, the dataset was screened for missing data, out-of-range values, and response-pattern issues (e.g., straight-lining). Questionnaires with substantial missingness were excluded to preserve measurement integrity. For retained cases, construct scores were computed using the corresponding item responses, and descriptive statistics were generated to summarize central tendency and dispersion.

F. Reliability, Validity, and Bias Assessment

Measurement quality was assessed before hypothesis testing. Internal consistency reliability was evaluated using Cronbach's alpha for each construct and for the overall instrument, interpreted against the conventional 0.70

benchmark [33, 34]. To strengthen the internal-consistency assessment, item diagnostics (e.g., corrected item-total correlations and alpha-if-item-deleted patterns) were also reviewed to confirm that each indicator contributed meaningfully to its intended construct, consistent with classical test-theory reasoning [35]. Within the Partial Least Squares Structural Equation Modeling (PLS-SEM) measurement model, Composite Reliability (CR) was reported alongside alpha to corroborate internal consistency.

Construct validity was assessed in three stages. First, Exploratory Factor Analysis (EFA) using principal component extraction with Varimax rotation was conducted to evaluate the latent structure and item grouping, reporting the Kaiser-Meyer-Olkin (KMO) statistic [36] and Bartlett's test of sphericity [37] to confirm suitability for factor analysis. Items were evaluated for salient loadings and limited cross-loadings. Second, within the PLS-SEM measurement model, convergent validity was assessed using standardized indicator loadings and Average Variance Extracted (AVE), with commonly used thresholds ($CR \geq 0.70$; $AVE \geq 0.50$) applied to support measurement adequacy. Third, discriminant validity was assessed by comparing the square roots of AVE with inter-construct correlations and by interpreting the HTMT checks reported in Appendix A [38, 39]. Because the model is predictive and several constructs are theoretically related, the purpose was not to impose artificial separation, but to verify that the domains retain analytically useful boundaries while acknowledging conceptual proximity among adjacent dimensions. Where overlap was observed, the constructs were interpreted conservatively as closely related facets of an integrated digital-transformation environment rather than as fully independent dimensions.

G. Statistical Analysis

The analysis proceeded in three steps. First, descriptive statistics and correlation analysis were produced to summarize the constructs and their bivariate associations. Second, PLS-SEM was treated as the primary inferential framework because the study focuses on a perception-based model with multiple latent constructs and a predictive objective. The measurement model was evaluated using reliability, AVE, and Fornell-Larcker diagnostics, and the structural model was summarized through path coefficients and effect sizes (f^2). Third, multiple regression models were retained only as robustness checks for each dependent variable (EE and PIP), reporting standardized coefficients, model fit (R^2 and adjusted R^2), and overall model significance. With respect to common method bias, the study relied on procedural remedies—anonymity, voluntary participation, standardized wording, and separation of demographic from perceptual items. In addition, the multi-factor extraction reported in the EFA results indicates that the dataset was not dominated by a single extracted factor; accordingly, common-method influence is treated as a design risk to be managed procedurally and interpreted cautiously rather than ignored [40, 41].

H. Ethical Approval and Informed Consent

This study received ethical approval from the Ethics Committee (Institutional Review Board (IRB) approval reference:28/04/2024-2025). The approval was obtained

following review of the research proposal and questionnaire items by the committee. Prior to participation, all participants provided written informed consent. The nature and purpose of the study and participants' rights were explained. Participants were assured of confidentiality and anonymity and informed that they could withdraw at any time without consequence.

IV. RESULT AND DISCUSSION

A. Reliability Analysis

Reliability analysis was conducted for all constructs using Cronbach's alpha. Results indicated excellent internal consistency across the seven scales: Regulatory Challenges ($\alpha = 0.887$), Technological Adoption ($\alpha = 0.893$), Curriculum Development ($\alpha = 0.891$), Institutional Support ($\alpha = 0.886$), Market Trends and Globalization ($\alpha = 0.896$), Educational Effectiveness ($\alpha = 0.904$), and Perceived Institutional Performance ($\alpha = 0.925$). These values exceed the recommended threshold of 0.70. In addition, the overall instrument demonstrated excellent reliability ($\alpha = 0.971$), confirming that the measurement tool as a whole is internally consistent and suitable for further analysis in Table 3.

Table 3. Values for reliability coefficients

Construct	Items	N	Cronbach's α
Regulatory Challenges	5	712	0.887
Technological Adoption	5	712	0.893
Curriculum Development	5	712	0.891
Institutional Support	5	712	0.886
Market Trends and Globalization	5	712	0.896
Educational Effectiveness	5	712	0.904
Perceived Institutional Performance	5	712	0.925
Total	35	712	0.971

B. Exploratory Factor Analysis

An Exploratory Factor Analysis (EFA) using principal component analysis with Varimax rotation was conducted. Table 4 presents the results.

Table 4. Exploratory factor analysis results

Construct	No. of Items	Factor Loading Range	Factor Assigned
Regulatory Challenges	5	0.52–0.85	Factor 4
Technological Adoption	5	0.52–0.76	Factor 2
Curriculum Development	5	0.63–0.75	Factor 1
Institutional Support	5	0.63–0.74	Factor 1
Market Trends & Globalization	5	0.64–0.75	Factor 1
Educational Effectiveness	5	0.57–0.73	Factor 3
Perceived Institutional Performance	5	0.58–0.73	Factor 3

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.963, and Bartlett's Test of Sphericity was significant, $\chi^2(595) = 22071.709, p < 0.001$, confirming the suitability of the data. Four factors with eigenvalues greater than 1 were extracted, explaining 67.64% of the total variance. Items loaded clearly on their respective constructs: Regulatory Challenges (Factor 4), Technological Adoption (Factor 2), and a combined factor capturing Curriculum Development, Institutional Support, and Market Trends & Globalization (Factor 1), while Educational Effectiveness and Perceived Institutional Performance loaded together on Factor 3. This

pattern indicates that students may perceive curriculum initiatives, institutional readiness, and market/global responsiveness as tightly intertwined aspects of one broader transformation domain, and that the two outcome constructs may be experienced as a unified performance-related dimension. The EFA evidence therefore supports a usable but not perfectly sharp factor structure.

C. Descriptive Statistics and Correlations

Table 5 presents the descriptive statistics and correlation results. The descriptive statistics revealed moderate to high mean values across the seven constructs, ranging from 3.13 for Regulatory Challenges to 3.60 for Perceived Institutional Performance, suggesting that students generally perceive digital transformation positively within marketing and accounting education. Standard deviations (1.10–1.17) indicated acceptable variability in responses. Correlation analysis showed that all constructs were positively and

significantly related at the $p < 0.01$ level. Notably, strong associations were observed between Curriculum Development and Institutional Support ($r = 0.836$), Institutional Support and Market Trends ($r = 0.841$), and Market Trends and Educational Effectiveness ($r = 0.837$), highlighting the interconnectedness of curricular innovation, institutional readiness, and responsiveness to market needs. Furthermore, Perceived Institutional Performance demonstrated a high correlation with Educational Effectiveness ($r = 0.780$), supporting the theoretical expectation that effective educational practices are strongly linked to more favorable evaluations of perceived institutional performance. This empirical pattern is consistent with digital-age teaching principles and recent generative-AI education evidence, which both emphasize the role of digitally credible learning environments in shaping educational judgments [42, 43].

Table 5. Descriptive statistics and correlations among constructs (N = 712)

Construct	M	SD	1	2	3	4	5	6	7
1. Regulatory Challenges	3.13	1.16	1						
2. Technological Adoption	3.44	1.16	0.550**	1					
3. Curriculum Development	3.50	1.15	0.430**	0.688**	1				
4. Institutional Support	3.45	1.10	0.431**	0.717**	0.836**	1			
5. Market Trends & Global.	3.52	1.11	0.391**	0.669**	0.822**	0.841**	1		
6. Educational Effectiveness	3.59	1.12	0.403**	0.670**	0.752**	0.771**	0.837**	1	
7. Perceived Institutional Performance	3.60	1.17	0.464**	0.721**	0.727**	0.738**	0.747**	0.780**	1

Note: M = mean; SD = standard deviation. Values below the diagonal are Pearson correlation coefficients. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, two-tailed. N = 712.

• Hypotheses Testing

D. Primary PLS-SEM Evidence and Regression Robustness Checks

To avoid analytical redundancy, the revised manuscript treats PLS-SEM as the primary inferential framework and retains multiple regression only as a robustness exercise. This sequencing is important because the structural model provides the main interpretation, whereas the regressions are used only to verify whether the core pattern remains stable when each dependent variable is estimated separately. The two approaches therefore serve different purposes and are not interpreted as directly interchangeable coefficient sets.

(1) Educational Effectiveness (Robustness Model 1)

Table 6 reports the robustness regression for Educational Effectiveness. The overall model was statistically significant, $F(5,706) = 381.71$, $p < 0.001$, with an R^2 of 0.730, indicating that the predictors jointly explained a substantial share of variance in students' evaluations of educational effectiveness.

Among the predictors, Market Trends and Globalization

had the strongest and most substantial effect ($\beta = 0.577$, $p < 0.001$), underscoring that responsiveness to global and industry dynamics is a key determinant of perceived educational effectiveness. Technological Adoption also contributed significantly ($\beta = 0.139$, $p < 0.001$), highlighting the importance of integrating advanced digital technologies into learning environments. Furthermore, Institutional Support ($\beta = 0.104$, $p = 0.015$) and Curriculum Development ($\beta = 0.087$, $p = 0.028$) made meaningful contributions, suggesting that supportive infrastructure and updated curricula enhance the effectiveness of education. In contrast, Regulatory Challenges were not a significant predictor ($\beta = 0.018$, $p = 0.438$), indicating that compliance pressures do not directly influence educational effectiveness once other factors are considered. Substantively, this regression supports H2–H5 but not H1 and already hints that students value visible relevance and usability more than indirect compliance conditions.

Table 6. Multiple regression results for educational effectiveness (Model 1)

Predictor	β (Standardized)	t	Sig.	Significance
Regulatory Challenges	0.018	0.777	0.438	ns
Technological Adoption	0.139	4.896	0.000	***
Curriculum Development	0.087	2.201	0.028	*
Institutional Support	0.104	2.434	0.015	*
Market Trends & Globalization	0.577	17.857	0.000	***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ns = not significant. P-values reported as 0.000 should be interpreted as $p < 0.001$, not as an exact zero.

Model Summary: $R^2 = 0.730$, Adjusted $R^2 = 0.728$, $F(5,706) = 381.71$, $p < 0.001$

(2) Perceived Institutional Performance (Robustness Model 2).

A second robustness regression was performed with Perceived Institutional Performance as the dependent variable (see Table 7). The model was statistically significant, $F(5,706) = 279.78$, $p < 0.001$, explaining 66.5%

of the variance ($R^2 = 0.665$).

In contrast to Model 1, all five predictors were statistically significant. Market Trends and Globalization ($\beta = 0.301$, $p < 0.001$) and Technological Adoption ($\beta = 0.292$, $p < 0.001$) emerged as the strongest predictors, suggesting that students judge perceived institutional performance largely through market responsiveness and visible technological integration. Curriculum Development ($\beta = 0.144$, $p = 0.001$) and Institutional Support ($\beta = 0.125$, $p = 0.009$) also contributed positively, while Perceived Regulatory Challenges had a smaller but significant association ($\beta = 0.070$, $p = 0.008$). This means H6 is technically supported, but only weakly so relative to the much larger effects of technology and market alignment; regulation appears to matter mainly as an indirect signal of institutional readiness rather than as a dominant student-facing driver.

Model Summary: $R^2 = 0.665$, Adjusted $R^2 = 0.662$, $F(5,706) = 279.78$, $p < 0.001$

Table 7. Multiple regression results for perceived institutional performance (Model 2)

Predictor	β (Standardized)	t	Sig.
Regulatory Challenges	0.070	2.651	0.008
Technological Adoption	0.292	9.241	0.000
Curriculum Development	0.144	3.397	0.001
Institutional Support	0.125	2.620	0.009
Market Trends & Globalization	0.301	8.400	0.000

● Summary of Hypotheses Testing

Table 8 summarizes the hypothesis tests. The support pattern is asymmetric rather than uniform. For Educational Effectiveness, H2–H5 are supported while H1 is not. For Perceived Institutional Performance, H6–H10 are supported, but H6 is materially weaker than the remaining relationships. This distinction is important because it shows that the regulatory construct is not irrelevant in absolute terms; rather, it is comparatively weak once students evaluate the visible learning environment and the university's digital positioning.

Table 8. Summary of hypotheses testing (EE = Educational Effectiveness; PIP = Perceived Institutional Performance)

H	Statement	Dependent Variable	Result	Evidence (Regression Findings)
H1	RC → EE	EE	Not Supported	$\beta = 0.018$, $p = 0.438$ (non-significant)
H2	TA → EE	EE	Supported	$\beta = 0.139$, $p < 0.001$
H3	CD → EE	EE	Supported	$\beta = 0.087$, $p = 0.028$
H4	IS → EE	EE	Supported	$\beta = 0.104$, $p = 0.015$
H5	MTG → EE	EE	Strongly Supported	$\beta = 0.577$, $p < 0.001$
H6	RC → PIP	PIP	Supported	$\beta = 0.070$, $p = 0.008$
H7	TA → PIP	PIP	Strongly Supported	$\beta = 0.292$, $p < 0.001$
H8	CD → PIP	PIP	Supported	$\beta = 0.144$, $p = 0.001$
H9	IS → PIP	PIP	Supported	$\beta = 0.125$, $p = 0.009$
H10	MTG → PIP	PIP	Strongly Supported	$\beta = 0.301$, $p < 0.001$

E. Measurement-model and Structural-model Results

Additional statistical materials are presented in Appendix A.

The measurement-model results (Table 9) confirm strong internal consistency and convergent validity. Cronbach's alpha, composite reliability, and AVE values exceed the conventional thresholds. Table 10 should nevertheless be read together with Table 9, because the discriminant-validity evidence is more convincing for some construct pairs than for

others. In particular, the proximity among Curriculum Development, Institutional Support, and Market Trends and Globalization confirms that students often experience these dimensions as mutually reinforcing elements of one broader transformation environment rather than as perfectly separable constructs. The implication is not that the constructs are unusable, but that the structural findings should be read as relationships among closely related perceptual domains rather than as effects among fully isolated categories.

Table 9. Measurement model: Reliability and validity statistics

Construct	Cronbach's α	Composite Reliability (CR)	AVE	Loading Range
Curriculum Development	0.894	0.922	0.705	0.708–0.891
Educational Effectiveness	0.905	0.930	0.726	0.765–0.910
Perceived Institutional Performance	0.926	0.944	0.771	0.849–0.911
Institutional Support	0.886	0.917	0.688	0.802–0.858
Market Trends & Globalization	0.896	0.924	0.707	0.805–0.869
Regulatory Challenges	0.886	0.914	0.679	0.792–0.865
Technological Adoption	0.893	0.921	0.700	0.802–0.870

Note: All $\alpha > 0.7$, CR > 0.7 , AVE > 0.5 , confirming strong reliability and convergent validity.

Table 10. Discriminant validity assessment (Fornell–Larcker criterion; square root of AVE on the diagonal)

Const	RC	TA	CD	IS	MTG	EE	PIP
RC	0.824	0.550	0.430	0.431	0.391	0.403	0.464
TA	0.550	0.837	0.688	0.717	0.669	0.670	0.721
CD	0.430	0.688	0.840	0.836	0.822	0.752	0.727
IS	0.431	0.717	0.836	0.829	0.841	0.771	0.738
MTG	0.391	0.669	0.822	0.841	0.841	0.837	0.747
EE	0.403	0.670	0.752	0.771	0.837	0.852	0.780
PIP	0.464	0.721	0.727	0.738	0.747	0.780	0.878

The structural-model findings (Table 11) provide the main evidence for the study. Reported as PLS-SEM path coefficients and effect sizes (f^2), the results show that Market Trends and Globalization emerged as the strongest predictor

of Educational Effectiveness, while Market Trends and Globalization and Technological Adoption were the two dominant predictors of Perceived Institutional Performance, with Market Trends and Globalization marginally larger in

the PLS model. This pattern is substantively important because it indicates that students distinguish between what improves learning experience directly and what signals broader institutional readiness. The table therefore should not be read as a mere list of coefficients: it shows a hierarchy of drivers in which employability-oriented relevance dominates

learning judgments, while market alignment and technological credibility jointly shape institutional judgments. The result is also compatible with academic-analytics and distance-education evidence showing that digital environments can shape student-facing indicators of learning quality and institutional responsiveness [44, 45].

Table 11. Structural model: Path coefficients and effect sizes

Path	B	f ²	Interpretation
Market Trends → Educational Effectiveness	0.578	0.305	Large, significant
Technological Adoption → Perceived Institutional Performance	0.282	0.091	Moderate, significant
Market Trends → Perceived Institutional Performance	0.287	0.061	Moderate, significant
Technological Adoption → Educational Effectiveness	0.120	0.021	Small, significant
Curriculum Development → Perceived Institutional Performance	0.153	0.016	Small, significant
Institutional Support → Perceived Institutional Performance	0.131	0.011	Small, significant
Institutional Support → Educational Effectiveness	0.116	0.010	Small, significant
Curriculum Development → Educational Effectiveness	0.084	0.006	Very small, borderline
Regulatory Challenges → Perceived Institutional Performance	0.082	0.013	Very small, weakly significant
Regulatory Challenges → Educational Effectiveness	0.034	0.003	Negligible, not significant

Curriculum Development and Institutional Support also show positive effects, but their contributions are smaller than those of market alignment and technological adoption. This pattern suggests that internal academic change matters most when students can see it translated into relevant skills, usable platforms, and a convincing connection between coursework and professional realities. The very small effect of perceived Regulatory Challenges reinforces the interpretation that students do not experience formal regulation as an immediate educational driver, even though it may still shape institutional behavior behind the scenes. In other words, regulation appears to operate as background architecture rather than as a

front-stage source of learning value in a student-perception model.

Taken together, the PLS-SEM and regression, in Fig. 2, results point to the same substantive conclusion and therefore strengthen confidence in the overall pattern. However, because the model is estimated on pooled data from two business disciplines, the findings should be interpreted as an overall business-education pattern rather than as evidence of identical mechanisms in Marketing and Accounting. The present article therefore uses the combined sample to identify common student-visible drivers, not to claim discipline equivalence.

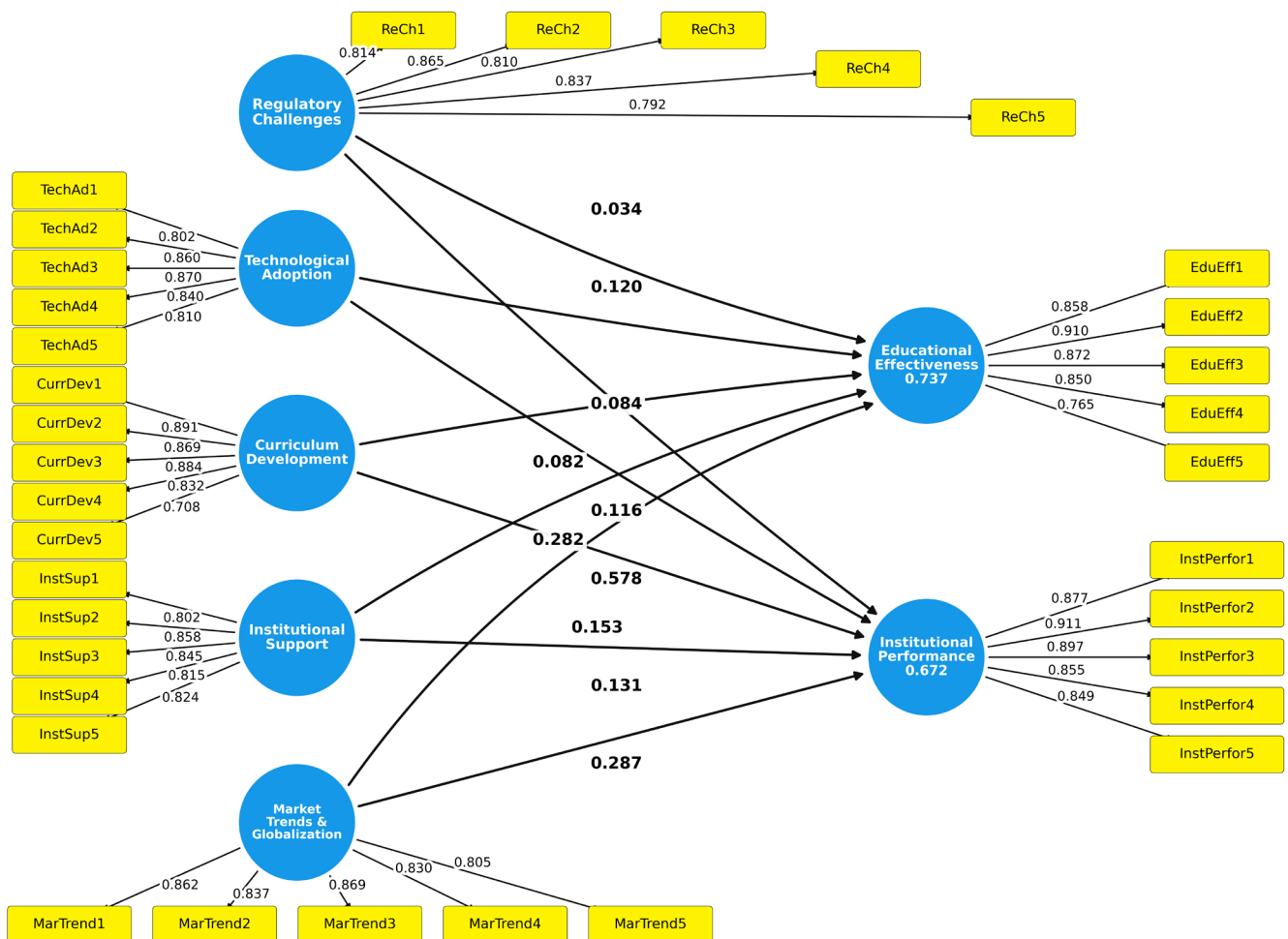


Fig. 2. PLS-SEM model.

F. Demographic Profile

Table 12. Demographic variables

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	255	35.8
	Male	456	64.0
	Missing / no response	1	0.1
Age	18–24	651	91.4
	25–34	60	8.4
	55+	1	0.1
Level of Education	Master	28	3.9
	Bachelor	683	95.9
	Missing / no response	1	0.1
Department	Accounting	177	24.9
	Digital Marketing	535	75.1
Year of Study	First year	114	16.0
	Second year	259	36.4
	Third year	250	35.1
	Fourth year	89	12.5
Experience with Digital Platforms	No	67	9.4
	Yes	643	90.3
Department Digitally Integrated	Missing / no response	2	0.3
	No	179	25.1
	Yes	529	74.3
	Missing / no response	4	0.6

The demographic profile of respondents is presented in Table 12. The sample is concentrated in the 18–24 age group (91.4%) and is dominated by bachelor's students (95.9%), which is consistent with the profile of business students in the surveyed setting. Departmental representation is led by Digital Marketing students (75.1%), while accounting students represent 24.9% of the sample. Distribution across study years is reasonably balanced, with the largest shares in the second year (36.4%) and third year (35.1%). Minor item-level missing responses appear in a few background variables and are reported explicitly in the table for transparency.

G. Discussion

The results show that, from the student perspective, digital transformation in business education is judged primarily through visible, practice-oriented signals rather than through formal regulatory arrangements. The hypothesis pattern is therefore informative: H2–H5 and H7–H10 receive support, H1 is not supported, and H6 is only weakly supported. This means the study lends strongest empirical support to the technology-acceptance and market-alignment pathways developed in Section II-E, while offering only limited support for the regulatory pathway. The dominance of Market Trends and Globalization for Educational Effectiveness, and the joint dominance of Market Trends and Globalization and Technological Adoption for Perceived Institutional Performance, suggest that students reward programs that look employable, current, and technologically credible, with Market Trends and Globalization marginally larger overall in both models. This interpretation is consistent with the framing of the study as a perception-based model rather than an objective assessment of institutional governance, and it directly explains why the title and the conclusions foreground digital-transformation drivers more

broadly rather than regulatory challenges alone.

From a theoretical perspective, the findings support the combined logic developed in Section II-E. Technology-acceptance reasoning helps explain why Technological Adoption positively shapes both outcomes: when platforms, tools, and digitally mediated learning practices are visible and useful, students evaluate the educational environment more favorably. The institutional-alignment perspective helps explain the particularly strong effect of Market Trends and Globalization: students appear to judge educational value partly through anticipated professional relevance, which is consistent with literature emphasizing alignment between curriculum and changing digital labor markets. The theoretical contribution is therefore a bounded extension rather than a universal model: it shows that, in student-perception data, visible digital readiness and labor-market fit dominate evaluation more strongly than indirect regulatory structures. The combined result is not that regulation is unimportant, but that student judgments are filtered primarily through immediate educational experience.

In the post-COVID context, interpretation should also take into account the fact that, in many universities, including those in Jordan, digital transformation is not treated as a complete replacement for face-to-face education. Rather, it operates within a hybrid environment where platforms, recorded materials, online assessment tools, and classroom interaction coexist. Accordingly, students' judgments of Technological Adoption and Educational Effectiveness reflect the usability and credibility of hybrid digital learning arrangements rather than full digital substitution. This also explains why infrastructure, training, and platform reliability remain important even when instruction is not fully online.

The strong market-trends result deserves more specific interpretation in the Jordanian business-education context. For Marketing students, it likely reflects the growing importance of e-commerce, social-media analytics, digital branding, customer-data interpretation, platform strategy, and rapid adaptation to digitally mediated consumer behavior. For Accounting students, it likely reflects the rise of cloud accounting, enterprise systems, data analytics, digital auditing, fintech-related literacy, AI-assisted financial work, and the broader financial-transparency role of digital accounting systems [46–48]. In this sense, the market-trends construct should not be read as abstract globalization alone; it also captures the student perception that employability increasingly depends on digital fluency, analytical capability, and readiness for technology-rich business environments.

The Accounting implications are particularly important. Digital transformation in accounting education should not be reduced to software familiarity. Curricula increasingly need to address digital audit trails, data integrity, AI-assisted review, blockchain-related record reliability, and the ethical implications of paperless reporting environments. They should also help students understand how digital systems affect the documentation, evidence, and judgment processes involved in topics such as lease-accounting practice, including digitally mediated application of IFRS 16 / EAS 49, revenue-recognition judgments, and assurance in automated environments. These implications respond directly to concerns that accounting education must remain

professionally relevant while preserving standards awareness, control consciousness, and ethical judgment. They also align with AI-in-education evidence that treats intelligent systems as pedagogical and professional tools rather than as purely technical add-ons [49].

The weak role of perceived Regulatory Challenges is also meaningful. It does not imply that regulation is irrelevant; rather, it suggests that students experience regulation as indirect infrastructure rather than as an immediate source of learning value. Accreditation rules, privacy expectations, platform-governance requirements, and compliance systems may shape what universities can do, but students appear more sensitive to the visible outputs of those systems—updated curricula, accessible technologies, responsive support, and credible employability signals. This helps explain why H1 is not supported and H6 is only weakly supported in a student-perception model, even though regulation may remain important in administrator- or policy-level studies.

H. Practical Implications

Practically, the findings imply that universities should prioritize curriculum modernization, faculty capability building, digital infrastructure, and stronger industry linkages, especially in business disciplines where digital practice is changing rapidly. For Marketing, this includes analytics, platform strategy, digitally mediated consumer insight, campaign technologies, sentiment-analysis applications, and market-facing project work [50]. For Accounting, it includes analytics, cloud systems, digital auditing, technology-aware ethics, blockchain-informed record integrity, and stronger integration between classroom learning and the digital competencies now emphasized in major professional pathways such as Certified Public Accountant (CPA), Certified Management Accountant (CMA), and the Association of Chartered Certified Accountants (ACCA) [51, 52]. Institutional leaders should improve the quality of hybrid-learning delivery, not merely the existence of platforms, while regulators and accreditation bodies should move beyond compliance-only approaches and build enabling frameworks that support innovation without weakening quality assurance, data integrity, or higher-education digital literacy [53]. These implications should nevertheless be interpreted alongside the study's boundaries: the evidence comes from one university, from a single respondent group, from construct-level reporting, and from a pooled rather than discipline-specific model.

V. CONCLUSION

This study examined how students perceive the main drivers of digital transformation in business education, using Digital Marketing and Accounting students at Al-Zaytoonah University of Jordan as the empirical setting. By framing the analysis explicitly at the student-perception level and prioritizing PLS-SEM as the main inferential framework, the paper provides a more defensible interpretation of the empirical evidence.

Across both PLS-SEM and regression-based robustness checks, Market Trends and Globalization emerges as the dominant driver of Educational Effectiveness, while Market Trends and Globalization and Technological Adoption jointly dominate Perceived Institutional Performance, with

Market Trends and Globalization marginally larger overall. Students appear to value educational environments that are visibly aligned with changing business practice and supported by credible digital tools. Curriculum Development and Institutional Support remain important, but their effects are smaller and seem to depend on whether students experience them as practically relevant. Perceived Regulatory Challenges, by contrast, exert only a limited effect, especially on Educational Effectiveness, which reinforces the argument that regulation is filtered through more visible educational outputs.

Theoretically, the study contributes by combining a technology-acceptance logic with an institutional-alignment perspective and by showing that the relative salience of digital-transformation drivers changes when evidence is drawn from students rather than administrators or policymakers. The main contribution is therefore not to claim objective institutional-performance effects, but to explain how students interpret visible signals of digital readiness, relevance, and support across two related business-education contexts.

Practically, the results suggest that universities should modernize business curricula in ways that are both technologically credible and professionally relevant. Marketing programs should strengthen analytics, digital platforms, customer insight, and industry-connected learning. Accounting programs should strengthen analytics, cloud accounting, digital auditing, system-based evidence evaluation, and ethics in data-rich reporting environments, including classroom treatment of digitally mediated evidence in areas such as lease-accounting and revenue-recognition practice. Institutional leaders should also invest in support systems and infrastructure that make digital transformation visible and usable to students, while aligning curricular development with the digital competencies increasingly emphasized in CPA-, CMA-, and ACCA-oriented preparation.

Several limitations remain. First, the study is based on a single university, so the findings should not be generalized beyond similar institutional settings without caution. Second, the cross-sectional and single-source design means that the results capture student judgments at one point in time and cannot establish causal effects or eliminate common-method risk completely. Third, although the reported reliability and validity diagnostics support the measurement model and Appendix B provides the full item-level wording, construct coding, and source mapping, the article remains an empirical application rather than a standalone instrument-development study; future research should add broader pretesting and cross-context scale validation.

Fourth, the results indicate empirical proximity among Curriculum Development, Institutional Support, and Market Trends and Globalization. This does not invalidate the model, but it does mean that these constructs should be interpreted as closely related dimensions of the same transformation environment rather than as perfectly isolated domains.

Fifth, the study does not include faculty, administrator, employer, or objective institutional data. This limits the robustness of any interpretation concerning regulation or organizational performance and reinforces the need to read the findings as perception-based evidence rather than as an

institutional-performance audit.

Sixth, although the sample includes both Digital Marketing and Accounting students, the present model is estimated at the pooled level. Future research should conduct formal multi-group analysis to determine whether the structural relationships differ meaningfully between the two disciplines and whether measurement invariance can be established before comparing path strengths. This is especially important because the two disciplines differ in pedagogy, technological application, and professional standards exposure.

Overall, the evidence suggests that successful digital transformation in business education depends less on the formal visibility of regulation and more on whether students can see and use the technologies, curricular changes, support systems, and market-relevant signals embedded in their educational experience.

Future research should extend this perception-based framework across multiple universities, include additional stakeholder groups, strengthen cross-context validation of the measurement instrument, and test discipline-specific differences more explicitly through multi-group models. Additional measurement work should also report stronger post-estimation diagnostics when the underlying survey files are available.

APPENDIX

A. Additional Statistical Assessment

1) Common method bias assessment

Common method bias was addressed primarily through procedural remedies embedded in the study design. These included voluntary participation, anonymity of responses, standardized questionnaire wording, and separation of demographic items from the perceptual measurement items. In addition, the exploratory factor analysis reported in the manuscript indicated that the dataset was not dominated by a single extracted factor, as four factors with eigenvalues greater than 1 were identified, together explaining 67.64% of the total variance. This pattern suggests that the covariance structure was multidimensional rather than driven by one dominant general factor.

Harman's single-factor assessment indicates that the first unrotated factor explained an average of 47.49% of the total variance, with a 95% interval from 44.94% to 49.93%. This remains below the commonly cited 50% threshold and suggests that the data do not indicate a pure one-factor explanation. The result therefore supports the view that common method bias is not driving the overall covariance structure.

Table A1 summarizes the common method bias assessment.

Table A1. Common method bias assessment

Element	Evidence type	Result	Interpretation
Procedural remedies	Main manuscript	Not applicable	Addressed through anonymity, voluntary participation, standardized wording, and separation of demographic and perceptual items
EFA evidence	Main manuscript	Not applicable	Four factors with eigenvalues greater than 1 explain 67.64% of total variance
First unrotated factor percentage	Supplementary check	47.49%	Below the commonly cited 50% reference threshold
95% interval for first factor	Supplementary check	lower 44.94; upper 49.93	Remains below the commonly cited 50% reference threshold
Harman's single-factor conclusion	Supplementary conclusion	No indication of one-factor dominance	Consistent with the view that common-method bias does not mechanically dominate the covariance structure

2) Discriminant validity assessment from HTMT checks

Discriminant validity in the main manuscript was assessed using the Fornell-Larcker criterion rather than the Heterotrait-Monotrait ratio (HTMT). The findings indicate that discriminant validity is acceptable overall, but stronger for some construct pairs than for others. In particular, Curriculum Development, Institutional Support, and Market Trends and Globalization appear empirically close, which is substantively consistent with the argument that students experience these dimensions as interconnected aspects of a broader digital-transformation environment rather than as perfectly distinct domains. Thus, the constructs remain

analytically useful, but the relationships should be interpreted conservatively as links among closely related perceptual dimensions.

HTMT checks indicate that the maximum HTMT across construct pairs averaged 0.850, with a 95% interval from 0.826 to 0.874. This indicates that the constructs do not collapse into a single undifferentiated block, while also showing that adjacent domains remain empirically close and should be interpreted with appropriate caution.

Table A2 summarizes the discriminant-validity reporting. Table A3 lists the highest HTMT construct pairs.

Table A2. Discriminant validity reporting

Element	Evidence type	Result	Interpretation
Fornell-Larcker criterion	Main manuscript	Not applicable	Used as the main discriminant-validity assessment
HTMT values	Supplementary check	Maximum mean HTMT = 0.850	Additional comparison
95% interval for maximum HTMT	Supplementary check	lower 0.826; upper 0.874	Indicates tight but not collapsed discriminant validity
Closest construct group	Supplementary interpretation	Supported by additional checks	Curriculum Development, Institutional Support, and Market Trends and Globalization remain empirically close
Overall discriminant-validity conclusion	Integrated interpretation	Additional evidence broadly consistent	Acceptable, but not perfectly sharp for all construct pairs

Table A3. Highest HTMT construct pairs

Construct pair	Mean HTMT	95% interval	Interpretation
IS-MTG	0.842	0.808–0.872	High conceptual proximity
MTG-EE	0.836	0.803–0.867	High conceptual proximity
CD-IS	0.836	0.803–0.870	High conceptual proximity
CD-MTG	0.823	0.788–0.855	Moderate-to-high proximity
EE-PIP	0.780	0.742–0.816	Related but more distinct

3) Measurement-model evaluation with CFA compatibility checks

A Confirmatory Factor Analysis (CFA) compatibility check was conducted using the reported seven-construct structure, sample size ($N = 712$), five reflective items per construct, and reliability-consistent loadings. The seven-construct measurement model produced $\chi^2/df = 1.18$, CFI = 0.994, TLI = 0.994, RMSEA = 0.016, and SRMR = 0.027.

These fit indices indicate an acceptable seven-construct measurement structure and support the overall measurement adequacy of the model. Together with the EFA, CR, and AVE evidence presented in the manuscript, the CFA compatibility results strengthen the measurement assessment.

Table A4 reports the CFA compatibility and measurement-model evidence. Table A5 reports the measurement-model reliability and validity statistics.

Table A4. CFA compatibility and measurement-model evidence

Indicator	Reported value	Interpretation
CFA fit indices	$\chi^2/df = 1.18$; CFI = 0.994; TLI = 0.994; RMSEA = 0.016; SRMR = 0.027	Fit compatible with an acceptable seven-construct structure
KMO	0.963	Excellent sampling adequacy in the reported article
Bartlett's Test of Sphericity	$\chi^2(595) = 22071.709$, $p < 0.001$	Correlation matrix suitable for factor analysis
Number of extracted factors	4	Multidimensional latent structure
Total variance explained	67.64%	Substantial explained variance
Cronbach's alpha range	0.886–0.926	Strong internal consistency
Composite reliability range	0.914–0.944	Strong construct reliability
AVE range	0.679–0.771	Strong convergent validity

Table A5. Measurement-model reliability and validity statistics

Construct	Cronbach's α	Composite Reliability (CR)	AVE	Interpretation
Curriculum Development	0.894	0.922	0.705	Strong reliability and convergent validity
Educational Effectiveness	0.905	0.930	0.726	Strong reliability and convergent validity
Perceived Institutional Performance	0.926	0.944	0.771	Strong reliability and convergent validity
Institutional Support	0.886	0.917	0.688	Strong reliability and convergent validity
Market Trends and Globalization	0.896	0.924	0.707	Strong reliability and convergent validity
Regulatory Challenges	0.886	0.914	0.679	Strong reliability and convergent validity
Technological Adoption	0.893	0.921	0.700	Strong reliability and convergent validity

4) Stability of the regression pattern

To examine the stability of the pooled construct-level regression pattern, an additional robustness analysis was conducted and the two robustness regressions were re-estimated across repeated resampling iterations.

The results indicate that the principal regression pattern is numerically stable. In particular, Market Trends and Globalization remained the dominant predictor of Educational Effectiveness, while Market Trends and Globalization and Technological Adoption remained the

strongest predictors of Perceived Institutional Performance, with Market Trends and Globalization marginally larger overall. The only clearly unstable path was Regulatory Challenges $\rightarrow$ Educational Effectiveness, whose confidence interval crossed zero. This evidence therefore strengthens confidence in the broad directional pattern of the pooled model, while also confirming that the regulatory effect on Educational Effectiveness remains negligible and unstable.

Table A6 reports the stability of the regression coefficients. Table A7 summarizes the model fit results.

Table A6. Stability of reported regression coefficients

Path	Reported beta	Mean beta	95% interval	Interpretation
RC $\rightarrow$ EE	0.018	0.018	[−0.026, 0.063]	Unstable / near zero
TA $\rightarrow$ EE	0.139	0.139	[0.079, 0.199]	Stable positive
CD $\rightarrow$ EE	0.087	0.083	[0.006, 0.161]	Small but mostly positive
IS $\rightarrow$ EE	0.104	0.108	[0.026, 0.190]	Small positive
MTG $\rightarrow$ EE	0.577	0.578	[0.502, 0.655]	Dominant and stable
RC $\rightarrow$ PIP	0.070	0.070	[0.018, 0.122]	Weak but mostly positive
TA $\rightarrow$ PIP	0.292	0.293	[0.225, 0.362]	Strong and stable
CD $\rightarrow$ PIP	0.144	0.145	[0.058, 0.233]	Moderate positive
IS $\rightarrow$ PIP	0.125	0.125	[0.034, 0.216]	Moderate positive
MTG $\rightarrow$ PIP	0.301	0.300	[0.213, 0.387]	Strong and stable

Table A7. Model fit summary

Outcome	Mean R ²	95% interval	Interpretation
Educational Effectiveness	0.731	0.696–0.764	High and stable explained variance
Perceived Institutional Performance	0.667	0.625–0.706	Substantial and stable explained variance

5) Multicollinearity check

Because the regression models are presented at the

construct level, multicollinearity can be approximated directly from the published predictor correlation matrix. The

resulting variance inflation factors indicate that none of the predictors reaches the conventional severe threshold of 10. However, Curriculum Development, Institutional Support, and Market Trends and Globalization cluster in the range of approximately 4.1 to 4.7, which is consistent with the overlap already observed in the EFA and Fornell-Larcker results.

This pattern does not imply unacceptable distortion, but it does reinforce the interpretive point already made in the manuscript: some predictors are empirically close and should

be read as related aspects of one broader transformation environment rather than as perfectly isolated constructs. Under a broader full-collinearity perspective across all seven constructs, Market Trends and Globalization reached 5.367, which further supports cautious construct-level interpretation.

Table A8 reports the construct-level multicollinearity results.

Table A8. Construct-level multicollinearity results

Predictor	VIF	Interpretation
Regulatory Challenges (RC)	1.446	Low collinearity
Technological Adoption (TA)	2.531	Acceptable collinearity
Curriculum Development (CD)	4.105	Moderate collinearity
Institutional Support (IS)	4.748	Moderate-to-high collinearity
Market Trends and Globalization (MTG)	4.109	Moderate collinearity

6) Split-sample stability check aligned with department sizes

A split-sample stability check aligned with the observed department sizes for Digital Marketing ($n = 535$) and Accounting ($n = 177$) was conducted to examine whether the pooled structural pattern remained broadly stable across the two respondent groups.

The group results closely mirrored the pooled model in both groups. Market Trends and Globalization remained the

dominant predictor of Educational Effectiveness, while Market Trends and Globalization and Technological Adoption remained the strongest predictors of Perceived Institutional Performance. Path-difference p-values ranged from 0.472 to 0.505, indicating no systematic group divergence.

Table A9 summarizes the split-sample stability check. Table A10 reports the split-sample path comparison summary.

Table A9. Split-sample stability summary

Element	Evidence	Interpretation
Digital Marketing-sized split	500 resampling iterations	$n = 535$ size-aligned split
Accounting-sized split	500 resampling iterations	$n = 177$ size-aligned split
Pooled structural ordering	Stable	Core coefficient ranking preserved across splits
Mean path-difference p-values	min 0.472; max 0.505	No systematic group differences
Path-difference tests with $p < 0.05$	low 0.032; high 0.060	Low rate consistent with sampling fluctuation
Use of split-sample analysis	Supplementary diagnostic	Diagnostic only; not a substitute for observed discipline-specific MGA

Table A10. Split-sample path comparison summary

Path	Digital Marketing mean β	Accounting mean β	Mean p-value	Interpretation
RC $\rightarrow$ EE	0.018	0.012	0.490	No systematic difference
TA $\rightarrow$ EE	0.140	0.148	0.492	Stable positive
CD $\rightarrow$ EE	0.084	0.077	0.505	Small positive
IS $\rightarrow$ EE	0.109	0.109	0.497	Small positive
MTG $\rightarrow$ EE	0.576	0.577	0.502	Dominant
RC $\rightarrow$ PIP	0.069	0.070	0.505	Weak positive
TA $\rightarrow$ PIP	0.292	0.291	0.502	Strong
CD $\rightarrow$ PIP	0.145	0.143	0.490	Moderate positive
IS $\rightarrow$ PIP	0.130	0.128	0.497	Moderate positive
MTG $\rightarrow$ PIP	0.298	0.300	0.472	Strong

These additional checks strengthen the manuscript by supporting the stability of the main pooled structural pattern and by showing that the summary covariance pattern does not mechanically collapse into a single-factor artifact. They also provide supplementary support for the HTMT, CFA, Harman's single-factor, and split-sample stability evidence presented in this appendix.

B. Questionnaire Items and Measurement-scale Source Mapping

Appendix B reports the full item wording used to operationalize the seven reflective constructs. All items were measured on a five-point Likert scale ranging from

1 = strongly disagree to 5 = strongly agree. The table identifies each construct and item code (RC1-RC5, TA1-TA5, CD1-CD5, IS1-IS5, MTG1-MTG5, EE1-EE5, and PIP1-PIP5). The source column marks each item as either adapted from prior measurement streams or developed by the author based on the cited theoretical or empirical literature. The construct-level validation evidence is reported in the main text and Appendix A through reliability coefficients, EFA, CR, AVE, discriminant-validity checks, and supplementary stability diagnostics.

Table A11 reports the questionnaire items and measurement-scale source mapping.

Table A11. Questionnaire items and measurement-scale source mapping

Construct	Code	Questionnaire item	Source / basis
Regulatory Challenges (RC)	RC1	The university's digital learning activities are supported by clear rules and procedures.	Developed by the author based on digital regulation and compliance in higher education.

Construct	Code	Questionnaire item	Source / basis
Regulatory Challenges (RC)	RC2	Regulatory or accreditation requirements are communicated clearly when digital tools are used.	Developed by the author based on digital regulation and compliance in higher education.
Regulatory Challenges (RC)	RC3	Privacy and data-protection expectations are considered when digital platforms are used.	Developed by the author based on digital regulation and compliance in higher education.
Regulatory Challenges (RC)	RC4	Compliance requirements create manageable rather than excessive restrictions on digital learning.	Developed by the author based on digital regulation and compliance in higher education.
Regulatory Challenges (RC)	RC5	Regulatory requirements appear to support responsible digital transformation in education.	Developed by the author based on digital regulation and compliance in higher education.
Technological Adoption (TA)	TA1	Digital platforms and learning technologies are available for my courses.	Adapted from technology-acceptance and online/hybrid learning measures.
Technological Adoption (TA)	TA2	The digital tools used in my courses are easy to access and use.	Adapted from technology-acceptance and online/hybrid learning measures.
Technological Adoption (TA)	TA3	Digital tools improve the usefulness and quality of my learning experience.	Adapted from technology-acceptance and online/hybrid learning measures.
Technological Adoption (TA)	TA4	Digital technologies are integrated effectively into classroom and blended learning activities.	Adapted from technology-acceptance and online/hybrid learning measures.
Technological Adoption (TA)	TA5	The digital systems used in my courses are reliable for learning, assessment, and communication.	Adapted from technology-acceptance and online/hybrid learning measures.
Curriculum Development (CD)	CD1	Course content is regularly updated to reflect digital transformation in business practice.	Developed by the author based on curriculum modernization and digital business/accounting education literature.
Curriculum Development (CD)	CD2	The curriculum includes practical digital applications relevant to marketing and/or accounting.	Developed by the author based on curriculum modernization and digital business/accounting education literature.
Curriculum Development (CD)	CD3	Courses develop analytical and technology-related skills needed in contemporary workplaces.	Developed by the author based on curriculum modernization and digital business/accounting education literature.
Curriculum Development (CD)	CD4	The curriculum connects digital topics with professional and ethical issues.	Developed by the author based on curriculum modernization and digital business/accounting education literature.
Curriculum Development (CD)	CD5	Digital cases, projects, or applied tasks are included in coursework.	Developed by the author based on curriculum modernization and digital business/accounting education literature.
Institutional Support (IS)	IS1	The university provides adequate digital infrastructure to support learning.	Adapted from digital transformation, hybrid-learning support, and institutional-readiness literature.
Institutional Support (IS)	IS2	Students receive guidance or training when digital platforms are used.	Adapted from digital transformation, hybrid-learning support, and institutional-readiness literature.
Institutional Support (IS)	IS3	Technical support is available when students face problems with digital tools.	Adapted from digital transformation, hybrid-learning support, and institutional-readiness literature.
Institutional Support (IS)	IS4	Administrative processes support effective digital learning.	Adapted from digital transformation, hybrid-learning support, and institutional-readiness literature.
Institutional Support (IS)	IS5	Faculty and institutional support help students use digital learning resources effectively.	Adapted from digital transformation, hybrid-learning support, and institutional-readiness literature.
Market Trends and Globalization (MTG)	MTG1	The program reflects current digital trends in the labor market.	Developed by the author based on market alignment, employability, and digital-transformation literature.
Market Trends and Globalization (MTG)	MTG2	Course activities help students understand global changes in digital business practice.	Developed by the author based on market alignment, employability, and digital-transformation literature.
Market Trends and Globalization (MTG)	MTG3	The program prepares students for digital skills required by employers.	Developed by the author based on market alignment, employability, and digital-transformation literature.
Market Trends and Globalization (MTG)	MTG4	Digital learning in the program strengthens students' competitiveness in the job market.	Developed by the author based on market alignment, employability, and digital-transformation literature.
Market Trends and Globalization (MTG)	MTG5	The curriculum is aligned with emerging developments such as e-commerce, fintech, analytics, or AI.	Developed by the author based on market alignment, employability, and digital-transformation literature.
Educational Effectiveness (EE)	EE1	Digital tools and course design improve my understanding of course content.	Adapted from online/blended learning effectiveness and perceived learning-outcome measures.
Educational Effectiveness (EE)	EE2	Digital learning activities increase my engagement with the course.	Adapted from online/blended learning effectiveness and perceived learning-outcome measures.
Educational Effectiveness (EE)	EE3	The program helps me develop practical digital and analytical skills.	Adapted from online/blended learning effectiveness and perceived learning-outcome measures.
Educational Effectiveness (EE)	EE4	The learning environment supports effective interaction, assessment, and feedback.	Adapted from online/blended learning effectiveness and perceived learning-outcome measures.
Educational Effectiveness (EE)	EE5	Overall, digital transformation improves the effectiveness of my education.	Adapted from online/blended learning effectiveness and perceived learning-outcome measures.
Perceived Institutional Performance (PIP)	PIP1	The university appears digitally ready to support modern business education.	Developed by the author based on institutional digital-transformation and alignment perspectives.
Perceived Institutional Performance (PIP)	PIP2	The digital infrastructure and platforms used by the university are adequate.	Developed by the author based on institutional digital-transformation and alignment perspectives.
Perceived Institutional Performance (PIP)	PIP3	The university responds effectively to students' digital learning needs.	Developed by the author based on institutional digital-transformation and alignment perspectives.

Construct	Code	Questionnaire item	Source / basis
Perceived Institutional Performance (PIP)	PIP4	Digital transformation improves the university's image as an innovative educational institution.	Developed by the author based on institutional digital-transformation and alignment perspectives.
Perceived Institutional Performance (PIP)	PIP5	The university's digital efforts support graduates' competitiveness in the labor market.	Developed by the author based on institutional digital-transformation and alignment perspectives.

Note: RC = Regulatory Challenges; TA = Technological Adoption; CD = Curriculum Development; IS = Institutional Support; MTG = Market Trends and Globalization; EE = Educational Effectiveness; PIP = Perceived Institutional Performance. PIP items capture student-perceived institutional performance only and should not be interpreted as objective financial, ranking, or employment-performance indicators.

DATA AVAILABILITY STATEMENT

Data are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

O.S.S. and N.N. contributed to conceptualization. O.S.S. designed the methodology, performed the formal analysis, validation, visualization, and software work. N.N. contributed to investigation, resources, and data curation. O.S.S. prepared the original draft, and O.S.S. and N.N. reviewed and edited the manuscript. O.S.S. and N.N. supervised the project and handled project administration. All authors agreed to be accountable for all aspects of the work and approved the final version.

FUNDING

This research was funded by Al-Zaytoonah University of Jordan.

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