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IT Automation versus Conventional Systems in Private Universities: TAM and JD-R Predictors of Academic Outcomes in Kupang City

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ABSTRACT

A significant gap exists in quantitative comparative research on IT-based automation versus conventional systems in resource-constrained regional universities, particularly in eastern Indonesia. This study addresses this gap by examining comparative associations between IT-based and conventional systems at private universities in Kupang City, East Nusa Tenggara. Guided by the Technology Acceptance Model (TAM) and Job Demands-Resources (JD-R) theory, a quantitative cross-sectional survey was conducted. A two-stage sampling procedure yielded 215 valid respondents (130 students, 55 lecturers, 30 administrative staff). A 36-item Likert-scale questionnaire demonstrated satisfactory internal consistency (Cronbach's α = .81 to .87). Independent samples t-tests and multiple regression (SPSS v.25) revealed that IT-adopting institutions reported significantly higher student engagement ($M = 3.82$ vs. 3.31, $p < .001$), academic productivity ($M = 3.91$ vs. 3.28, $p < .001$), and lecturer effectiveness ($M = 3.75$ vs. 3.29, $p = .003$). Regression showed perceived usefulness ($\beta = .41$, $p < .001$) and perceived ease of use ($\beta = .29$, $p = .002$) as the strongest productivity predictors ($R^2 = .56$). However, IT-adopting institutions also reported higher technostress and reduced face-to-face peer interaction. These findings suggest that a hybrid model may optimize outcomes. This study contributes comparative evidence from an under-researched regional context.

INTRODUCTION

The rapid expansion of information technology (IT) in higher education has fundamentally reshaped how academic institutions operate, teach, and engage with students. Despite the growing body of evidence on educational technology adoption in well-resourced and Western contexts (Selwyn, 2016; Zawacki-Richter et al., 2019), empirical evidence from geographically peripheral, resource-constrained institutions in Southeast Asia remains sparse. Universities worldwide are transitioning from manual,

convention-bound practices to digitally mediated systems that promise efficiency, accessibility, and scalability. Yet this transition is not uniform: institutions in emerging economies and peripheral regions, such as those in East Nusa Tenggara (NTT), Indonesia, face compounded challenges including infrastructural deficits, digital literacy gaps, and socio-cultural resistance to change (Monageng et al., 2025).

Private universities in Kupang City represent a particularly instructive case. Among the 14 active private universities (Perguruan Tinggi Swasta, PTS) registered with L2DIKTI Region XV NTT and collectively serving an estimated 18,000 students, digitalization trajectories vary substantially. While national education policy (e.g., Kampus Merdeka) promotes digitalization, many local institutions operate simultaneously with both IT-based platforms, such as Academic Information Systems (SIA), Learning Management Systems (LMS), and digital administrative portals, and long-established conventional, paper-based, and face-to-face practices. This dual-system reality creates measurable variation in student engagement, academic productivity, and lecturer teaching effectiveness across institutions, making comparative inquiry both feasible and theoretically significant.

Despite a growing body of research on educational technology adoption (Xue et al., 2026; Younas et al., 2025), three research gaps remain under addressed. First, most studies are conducted in well-resourced, urban, or Western contexts; empirical evidence from geographically peripheral, resource-constrained institutions in Southeast Asia is sparse (Monageng et al., 2025). Second, comparative quantitative studies that simultaneously measure the effect of system type (IT-based vs. conventional) on multiple educational outcomes, student engagement, productivity, and lecturer effectiveness are limited. Third, few studies integrate the Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2017), which conceptualizes IT systems as both demands and resources, with Technology Acceptance Model (TAM) constructs (Davis, 1989) to explain productive academic outcomes in the context of automation-driven institutional change.

To address these gaps, this study asks: (1) Are IT-based automation systems associated with significantly higher student engagement and academic productivity than conventional systems at private universities in Kupang City? (2) Which TAM constructs, Perceived Usefulness or Perceived Ease of Use most strongly predict productive

academic outcomes? The findings are expected to provide actionable guidance for institutional policy-makers and contribute to the educational technology literature on technology adoption in developing-country higher education contexts. The study further explores how observed patterns may be understood through the integrated lens of TAM and JD-R, where PU and PEOU function as job resources and technostress as a job demand.

IT-based automation in educational institutions encompasses the deployment of digital tools to manage administrative operations, facilitate instruction, and support student services. Key technologies include Academic Information Systems (AIS), Learning Management Systems (LMS), e-library portals, and automated assessment platforms (Butson & Spronken-Smith, 2024). Empirical studies consistently link LMS adoption with improvements in student flexibility, access to resources, and self-regulated learning (Zawacki-Richter et al., 2019). AI-powered learning tools, though not the focus of the present study, have been shown in other research to personalize learning experiences and reduce administrative burdens on lecturers (Younas et al., 2025).

Nonetheless, automation adoption is not without friction. Research identifies technostress, defined as negative psychological states arising from IT use, as a significant barrier to productive engagement (Bakker et al., 2021). In developing-country contexts, institutional readiness, defined by infrastructure quality, training availability, and leadership support, moderates the relationship between technology adoption and educational outcomes (Monageng et al., 2025; Deacon et al., 2025).

Conventional systems, characterized by face-to-face instruction, paper-based administration, and direct interpersonal communication, retain considerable pedagogical value, particularly in contexts where relational and humanistic dimensions of education are prioritized (Cornelius-White, 2007; Barata, 2024; Song & Mukundan, 2025). Direct lecturer-student interaction has been associated with greater emotional engagement, stronger mentoring relationships, and improved deep learning outcomes (Selwyn, 2016). Social Cognitive Theory underscores that learning is inherently a social process: knowledge is co-constructed through observation, modeling, and reciprocal interaction (Bandura, 1978).

However, conventional systems exhibit significant structural limitations. Manual administrative processes are time-consuming, error-prone, and poorly scalable (Vahdat et al., 2021). As student enrolment grows and regulatory reporting demands intensify, institutions dependent solely on conventional systems face declining operational efficiency and administrative accuracy (Poma, 2024).

Student engagement, encompassing behavioral, cognitive, and emotional dimensions of involvement in academic activities, is a central predictor of retention, achievement, and lifelong learning outcomes (Fredricks et al., 2004; Xue et al., 2026). Academic productivity, operationalized in the higher education context as the volume and quality of completed coursework, research participation, and skill acquisition, is shaped by both systemic factors (availability of resources, institutional support) and individual factors (motivation, self-efficacy) (Bakker et al., 2021). Technology adoption research consistently finds that students who perceive digital tools as useful and easy to use exhibit higher engagement and productivity (Xue et al., 2026). Conversely, excessive cognitive load from poorly designed systems or insufficient training can suppress these outcomes (Bakker et al., 2021).

To address research questions one and two, this study integrates two complementary theoretical frameworks. The Technology Acceptance Model (TAM), originally proposed by (Davis, 1989) and extensively validated in educational technology research (Xue et al., 2026), posits that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the primary determinants of technology adoption intention and actual system use. In the higher education context, PU refers to students' and lecturers' belief that IT systems improve their academic performance; PEOU reflects the degree to which systems are free from difficulty.

The Job Demands-Resources (JD-R) Model (Bakker & Demerouti, 2017) provides a complementary lens for understanding the dual impact of IT adoption on academic actors. In this study, PU and PEOU (TAM constructs) are operationalized as job resources within the JD-R framework, cognitive and motivational assets that help actors achieve their goals, while technostress is operationalized as a job demand that depletes psychological resources. When resources outweigh demands, motivation and well-being are enhanced; when demands predominate, particularly without institutional

support, burnout and disengagement follow (Bakker & de Vries, 2021). Social Cognitive Theory (Bandura, 1978) further contextualizes these dynamics by highlighting the role of interpersonal relationships in sustaining engagement amidst technological transformation.

METHOD

This study employed a quantitative cross-sectional survey design to compare educational outcomes across two groups of private universities in Kupang City: those that have substantially adopted IT-based automation systems (IT group) and those that continue to operate predominantly with conventional systems (Conventional group). This design enables the testing of associations and group differences, not causal effects; temporal precedence between system type and educational outcomes cannot be established. The quantitative approach was selected to enable statistical comparison and generalization within the target population (Creswell & Creswell, 2023). Regression assumptions were tested using residual plots, Durbin-Watson statistic, and variance inflation factor (VIF), all within acceptable thresholds.

The target population comprised all lecturers, undergraduate students, and administrative staff at private universities (Perguruan Tinggi Swasta, PTS) in Kupang City, East Nusa Tenggara, Indonesia. Based on records from L2DIKTI Region XV NTT, there were 14 active private universities. A two-stage purposive sampling strategy was employed. In Stage 1, four universities were selected using a 10-item IT Integration Rubric evaluating LMS deployment, digital gradebooks, online registration, automated reporting, and SIA use. Two independent researchers rated each institution (inter-rater agreement: Cohen's $\kappa = .91$). Two institutions scoring $\geq 8/10$ were classified as "IT-adopting" (fully deployed SIA, LMS, and digital systems for ≥2 years) and two scoring $\leq 3/10$ as "Conventional-dominant" (relying on manual administration and face-to-face-only instruction without an LMS). Conventional-dominant institutions may still use basic communication tools such as email; the classification refers to the absence of integrated academic IT infrastructure.

In Stage 2, participants were selected using stratified convenience sampling. Inclusion criteria were undergraduate students (final-year, ≥2 years enrollment), lecturers

(full-time, ≥2 years service), and administrative staff (full-time, ≥1 year service). Of 280 questionnaires distributed, 215 valid responses were returned (76.8%): 130 students, 55 lecturers, and 30 administrative staff (112 from IT-adopting, 103 from conventional-dominant institutions). Non-response analysis revealed no significant differences in demographic profile between respondents and non-respondents. Sample size was determined using G*Power 3.1 for a medium effect size ($f^2 = 0.15$), $\alpha = .05$, power = .80 for regression, yielding n = 85; for t-tests (d = 0.50), minimum n = 64 per group (Faul, Erdfelder, Lang, & Buchner, 2007). Both requirements were met. Regression analyses were primarily driven by the student sub-sample (n = 130); analyses involving lecturers (n = 55) and staff (n = 30) are descriptive and should be interpreted with caution.

Data were collected using a structured Likert-scale questionnaire. All items were adapted from existing validated scales; no new items were created. Items for Perceived Usefulness followed (Davis, 1989); Student Engagement items were adapted from (Fredricks, Blumenfeld, & Paris, 2004); items for Academic Productivity, PEOU, and Lecturer Effectiveness drew on (Xue et al., 2026). The final instrument comprised 36 items across five constructs: Perceived Usefulness (8 items, $\alpha = .87$), Perceived Ease of Use (8 items, $\alpha = .84$), Student Engagement (8 items, $\alpha = .86$), Academic Productivity (7 items, $\alpha = .83$), and Lecturer Effectiveness (5 items, $\alpha = .81$). Cronbach's α from .81 to .87 indicate satisfactory internal consistency. All items used a 5-point Likert scale. The instrument was validated by three experts and pilot-tested with 30 participants (not included in final analysis). No items were deleted; all corrected item-total correlations exceeded .40.

Data collection was conducted over eight weeks (March to April 2025). Questionnaires were distributed digitally (Google Forms) and in print. Research assistants assisted participants at conventional-dominant institutions unfamiliar with digital forms. A Mann-Whitney test revealed no significant differences between digital and paper respondents ($p > .05$). Less than 2% of data were missing, handled using series mean imputation. Informed consent was obtained, and institutional ethical approval was secured.

Data were analyzed using IBM SPSS Statistics Version 25. The analysis proceeded in four stages: (1) descriptive statistics; (2) normality (Kolmogorov-Smirnov)

and homogeneity of variance (Levene's test); (3) independent samples t-tests comparing IT-adopting and conventional-dominant groups; and (4) multiple linear regression with academic productivity and student engagement as dependent variables, and PU, PEOU, system type (dummy-coded: 0 = conventional, 1 = IT-adopting), and respondent role (dummy-coded: D1 = lecturer, D2 = staff) as predictors. Statistical significance was set at $p < .05$. VIF values below 2.5 indicated no problematic collinearity.

RESULT AND DISCUSSION

Results

Table 1 presents descriptive statistics for all five constructs by system type. Respondents at IT-adopting universities consistently reported higher mean scores across all educational outcome constructs compared to conventional-dominant institutions. All between-group differences were statistically significant ($p < .001$ for four constructs, $p = .003$ for Lecturer Effectiveness).

Table 1
Descriptive Statistics and Group Comparisons

Construct	IT M	IT SD	Conv M	Conv SD	t(213)	p	Cohen's d	95% CI [d]
Perceived Usefulness	3.94	0.61	3.18	0.72	8.17	< .001	1.15	[0.85, 1.45]
Perceived Ease of Use	3.79	0.58	3.22	0.69	6.30	< .001	0.89	[0.61, 1.17]
Student Engagement	3.82	0.57	3.31	0.64	5.93	< .001	0.86	[0.58, 1.13]
Academic Productivity	3.91	0.55	3.28	0.68	7.24	< .001	1.04	[0.75, 1.33]
Lecturer Effectiveness	3.75	0.60	3.29	0.71	4.89	= .003	0.71	[0.44, 0.98]

Note. IT group n = 112; Conventional group n = 103.

Multiple Regression Analysis

Table 2 presents multiple linear regression results predicting student engagement (SE) and academic productivity (AP).

Table 2
Multiple Regression Results

Predictor	SE β	SE t	SE p	AP β	AP t	AP p
Perceived Usefulness (PU)	.38	5.21	< .001	.41	5.89	< .001
Perceived Ease of Use (PEOU)	.27	3.68	< .001	.29	4.02	.002
System Type (IT = 1)	.19	2.91	.004	.22	3.14	.002
Respondent Role: Lecturer (D1)	.08	1.29	.200	.10	1.61	.109
Respondent Role: Staff (D2)	.06	0.97	.334	.08	1.29	.199
Model R^2	.52			.56		
Adjusted R^2	.51			.55		
F-statistic	$F(5,209) = 45.5$, $p < .001$			$F(5,209) = 53.4$, $p < .001$		

Note. β = standardized coefficient. System type dummy-coded: 0 = conventional, 1 = IT-adopting. VIF < 2.5 for all predictors.

Discussion

TAM Constructs as Drivers of Educational Outcomes

The finding that Perceived Usefulness is the dominant predictor of both student engagement (β = .38) and academic productivity (β = .41) is consistent with TAM literature. Davis (1989) originally proposed that PU exerts a stronger influence than PEOU on adoption intention; this hierarchical relationship appears to extend to educational outcome variables in the Indonesian higher education context. Xue et al.'s (2026) systematic review similarly reports PU as the primary determinant of student acceptance, supporting the generalizability of current findings.

Perceived Ease of Use also emerged as a significant independent predictor (β = .27–.29), underscoring the practical importance of interface design and technical support. This finding has particular resonance in Kupang City, where digital literacy levels are heterogeneous. Evidence from comparable contexts suggests targeted digital transformation training can improve PEOU perceptions, particularly when tailored to specific roles (Aquino et al., 2025). Where systems are difficult to navigate, even highly motivated students may fail to convert that motivation into productive academic behavior.

System Type and Educational Outcomes: Beyond Efficiency

The significant between-group differences across all five constructs (Table 2) provide robust empirical evidence that system type is associated with meaningful variation in educational outcomes. Effect sizes (d = 0.71 to 1.15) suggest the practical impact of IT adoption is substantial. Due to the cross-sectional design, these associations should not be interpreted as causal.

However, these aggregate associations should not be interpreted as wholesale endorsement of automation over human interaction. It should be noted that technostress was not formally operationalized as a measured construct in this study. With that caveat, open-ended responses suggested that respondents at IT-adopting universities qualitatively indicated greater adaptation pressures suggestive of technostress, as well as lower perceived quality of peer interaction, consistent with Social Cognitive Theory's emphasis on co-present learning (Bandura, 1978; Xiong & Zhou, 2025). From the JD-R perspective, PU and PEOU function as motivational resources while technostress constitutes a job demand (Bakker & Demerouti, 2017; Bakker & de Vries, 2021). These trade-offs suggest the net educational benefit of IT adoption is contingent on institutions' capacity to manage associated demands.

Conventional Systems: Humanistic Value and Operational Limitations

Conventional-dominant institutions scored lower on all outcome measures, yet respondents there reported higher levels of interpersonal interaction quality and relational trust. This is consistent with Selwyn's (2016) argument that educational technology, while enhancing access and efficiency, can undermine the affective and social dimensions of learning. In NTT's cultural context, where communal values and interpersonal relationships are foundational, the erosion of face-to-face contact carries particular risk (Aluman, 2023).

Open-ended responses from administrative staff at conventional-dominant institutions suggested substantially higher rates of data-related difficulties, pointing to operational challenges that argue for at least partial IT adoption in data management, independent of pedagogical considerations.

The Case for a Hybrid Model

Taken together, the findings suggest a hybrid model is a promising institutional strategy: deploying IT automation for administrative processing, content delivery, and self-directed learning support, while deliberately preserving face-to-face interaction for mentoring, collaborative learning, and socio-emotional development. This proposed strategy is based on observed challenges and trade-offs rather than direct empirical testing of a hybrid condition and remains an important direction for future research. This conclusion aligns with Deacon et al. (2025), who found that resistance to digital change is most effectively addressed through culturally sensitive, phased integration.

Theoretical Contributions

This study makes three theoretical contributions. First, it extends TAM validation to regional Indonesian private universities, demonstrating that PU and PEOU predict educational outcomes beyond mere adoption intention. Second, it integrates TAM with JD-R theory, operationalizing PU and PEOU as job resources and technostress as a job demand, providing a more comprehensive explanatory model. Third, it suggests Social Cognitive Theory (Bandura, 1978) may explain why reduced face-to-face interaction at IT-adopting institutions correlates with lower perceived social engagement, providing a theoretical rationale for the hybrid model.

CONCLUSION

This study provides quantitative evidence that IT-based automation systems are associated with significantly higher student engagement, academic productivity, and lecturer teaching effectiveness compared to conventional systems at private universities in Kupang City, East Nusa Tenggara, Indonesia. Perceived Usefulness ($\beta = .41$) and Perceived Ease of Use ($\beta = .29$) are the strongest predictors of academic productivity, collectively explaining 56% of outcome variance alongside system type and respondent role.

The findings carry important practical implications. First, institutional leaders at conventional-dominant universities should prioritize IT infrastructure investment, particularly administrative digitalization, to reduce operational inefficiencies. Second, IT-adopting institutions should invest in regular training and technical support to reduce technostress and improve PEOU perceptions. Third, all institutions are encouraged to

adopt a hybrid approach, using LMS for content delivery while preserving face-to-face interaction for mentoring to balance efficiency gains with humanistic educational dimensions valued in the local socio-cultural context. However, the proposed hybrid model remains a conceptual implication derived from observed trade-offs rather than an empirically tested condition. Future research should directly compare hybrid, fully IT-based, and conventional configurations to validate this recommendation.

For policymakers at L2DIKTI Region XV NTT, differentiated digital readiness support, providing infrastructure grants and training to conventional-dominant institutions while offering technostress management resources to IT-adopting institutions could be an effective regional strategy.

Limitations. The cross-sectional design precludes causal inference. The sample was drawn from only four institutions in a single city, limiting geographic generalizability. The four selected institutions, while limited in number, represent the contrasting levels of IT integration commonly found among private universities in NTT, ranging from fully digitalized to predominantly conventional operations. The purposive-convenience sampling may have introduced selection bias. The self-report nature of the academic productivity measure may be subject to social desirability bias. Future research should employ multi-institutional, multi-region designs with objective performance data and include covariates such as institutional budget and faculty demographics.

In resource-constrained regional universities, strategic and phased IT adoption, anchored by TAM-informed training that builds perceived usefulness and ease of use, and mitigated by deliberate preservation of human-centered learning interactions, represents a viable pathway toward equitable educational improvement.

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