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RESEARCH ARTICLE

SHAPING DIGITAL SCIENTIFIC CULTURE: PLATFORM ENGAGEMENT AND DIGITAL LITERACY AS DRIVERS OF TECHNOLOGY ADOPTION IN INDONESIAN HIGHER EDUCATION (Arial 14 Bold, maksimum 20 Words)

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Abstract *(The abstract must be between 200 and 300 words)*

The digital transformation of higher education demands more than infrastructure it requires cultivating a digital scientific culture in which students engage critically with knowledge through technology. This study examines Platform Engagement (PE) and Digital Literacy (DL) as co-determinants of Technology Adoption (TA) among Indonesian university students (N = 1,083). Data from open-ended surveys were coded through content analysis, then analysed using Spearman rank correlation and bootstrapped mediation analysis (5,000 iterations, 95% CI). All bivariate associations were significant: PE–DL ($r_s = 0.178$, $p < .001$), PE–TA ($r_s = 0.130$, $p < .001$), and DL–TA ($r_s = 0.138$, $p < .001$). Path analysis confirmed significant direct effects of PE on DL ($\beta = 0.167$, $p < .001$) and on TA ($\beta = 0.090$, $p = .001$), and of DL on TA ($\beta = 0.129$, $p < .001$). Bootstrapped mediation revealed a significant indirect effect ($\beta = 0.021$, 95% CI [0.010, 0.035]), confirming DL as a partial mediator accounting for 19.3% of the total PE–TA effect. Platform engagement alone does not sustain technology adoption; digital literacy is the necessary bridge. These findings contribute to the technopedagogy framework by demonstrating that critical literacy development must be embedded within digital engagement strategies to cultivate durable academic technology adoption in Indonesian higher education.

Keywords: *Impact of Physical Education, Innovation, Teach Universal Development, and Health Contasta (Up to 8 comma-separated keywords)*

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1. Introduction

Talk to any lecturer at an Indonesian university today and the story tends to go the same way. Classrooms are equipped, students carry smartphones, and institutional platforms are in place yet meaningful digital learning remains uneven (Lei et al., 2023; Mhlongo et al., 2023; Sibghatullah Shah, 2024). Behind this paradox lies something that policy documents rarely address: the difference between having access to digital tools and knowing what to do with them. Following the rollout of the Merdeka Belajar-Kampus Merdeka (MBKM) policy and the disruptions of the COVID-19 pandemic, Indonesian higher education has invested heavily in digital infrastructure (Kurniawan, 2025; Makmun et al., 2025; Teguh Akbari et al., 2022). What has received far less attention is whether students have developed the competencies to engage with that infrastructure in ways that support genuine academic work (Dirckinck-Holmfeld et al., 2023; Goodyear, 2021).

At stake is what scholars have called digital scientific culture the set of practices and dispositions that orient a learning community toward using digital tools for critical inquiry and knowledge construction, rather than passive consumption (Hali, 2025; Mugnaini et al., 2023). Building such a culture requires that students engage actively and purposefully with digital environments and, through that engagement, develop the evaluative and synthetic competencies that constitute digital literacy (Georgopoulou et al., 2025). Platform Engagement the breadth and purposiveness of students' involvement with digital platforms is widely considered a precondition for literacy development. Digital Literacy, in turn, is increasingly identified as the cognitive mechanism through which platform use translates into academic technology adoption (Arangurí et al., 2025; Rusman et al., 2025).

This theoretical chain engagement feeding literacy, literacy enabling adoption forms the basis of the technopedagogy framework, which holds that digital competency development is a prerequisite for meaningful technology use in education, not a by-product of it. Yet despite growing attention to these questions in the broader educational technology literature, studies that empirically test the mediating role of digital literacy between platform engagement and technology adoption in Indonesia remain scarce. Most existing Indonesian work has focused either on adoption barriers at the system level or has treated digital literacy as an outcome variable rather than a mediating mechanism (Cahyadi et al., 2021; Setiawardani et al., 2026; Suparman et al., 2025). This study fills that gap.

Using open-ended survey data from 1,083 students across Indonesian higher education institutions, subjected to AI-assisted content analysis coding and analysed through bootstrapped mediation analysis, this study tests three hypotheses: (H1) Platform Engagement significantly predicts Digital Literacy; (H2) Digital Literacy significantly predicts Technology Adoption; and (H3) Digital Literacy partially mediates the relationship between Platform Engagement and Technology Adoption. The results are framed within the broader discourse on digital scientific culture formation in Indonesian universities and carry direct implications for curriculum design under the MBKM framework.

2. Methods

This section describes how the research was conducted, including the design, population and sample, instruments, and data analysis procedures. The study employed a quantitative approach with an [specify design, e.g., correlational or explanatory] design. The population consisted of [briefly describe population], and the sample included [number] participants selected through [sampling technique]. Data were collected using [instrument name] and a **Physical Activity Quiz**, which measured [brief description of what was measured]. Descriptive statistics and [name of test, e.g., correlation or t-test] were used to analyze the data with the help of [software name], adopting a significance level of $p < .05$.

3. Results

This section outlines the findings from initial or ongoing research that need to be shared promptly. It also includes an analysis of these results, ensuring they align with the objectives of the study. Tables and figures may be used to clearly present and support the data.

3.1. Descriptive Statistics

Table 3 presents descriptive statistics for the three construct composites. Platform Engagement (M = 1.83, SD = 0.525) and Technology Adoption (M = 1.80, SD = 0.476) both clustered near the lower end of the 1–3 scale, with medians of 2.00. Digital Literacy scored somewhat higher (M = 2.37, SD = 0.459, Median = 2.50), suggesting that students reported more developed critical information practices relative to their platform engagement behaviours a gap worth investigating.

Individual indicators revealed notable distributional asymmetries. DL2 (critical reading) showed a pronounced ceiling effect: 86.8% of respondents scored at level 3, meaning the vast majority claimed to actively seek multiple sources when evaluating information. Yet PE2 (knowledge-platform use) showed the opposite pattern, with 67.0% scoring at level 1 indicating they rarely used academic digital tools such as e-journals or databases. The contrast between high self-reported critical reading intent and low engagement with the very platforms that would support that intent points to a practised gap that curriculum designers should take seriously. These distributional asymmetries confirm the appropriateness of non-parametric analysis.

Table 3. Descriptive statistics for construct composite scores

Descriptives	PE	DL	TA
N	1083	1083	1083
Missing	0	0	0
Mean	1.83	2.37	1.80
Median	2.00	2.50	2.00
Standard deviation	0.525	0.459	0.476
Minimum	1.00	1.00	1.00
Maximum	3.00	3.00	3.00

https://doi.org/

3.2. Spearman Rank Correlations

All three pairwise Spearman correlations were statistically significant at p < .001 (Table 4). PE was positively associated with DL (rs = 0.178, df = 1,081) and with TA (rs = 0.130, df = 1,081). DL was also significantly associated with TA (rs = 0.138, df = 1,081). Effect magnitudes are modest an expected consequence of the constrained variance in a 1–3 ordinal scale yet the directional coherence of all three associations aligns precisely with the hypothesised mediation model. All null hypotheses of zero association are rejected.

3.3. Mediation Analysis

Table 5 and Figure 1 present the bootstrapped mediation results. Path a (PE → DL) was positive and significant (β = 0.167, t = 6.387, p < .001), confirming H1. Path b (DL → TA | PE) was significant (β = 0.129, t = 4.060, p < .001). The direct effect of PE on TA controlling for DL (path c') remained significant (β = 0.090, t = 3.238, p = .001), as did the total effect (β = 0.111, t = 4.058, p < .001). H2 and the direct-path component of H3 are thus supported.

The indirect effect the quantity at the heart of H3 was 0.0214 (SE = 0.00623), with a 95% bootstrap CI of [0.0102, 0.0347]. This interval excludes zero, confirming statistical significance. With path c' also remaining significant, the pattern qualifies as partial mediation (Baron and Kenny, 1986; Hayes, 2018): Digital Literacy mediates the PE–TA relationship without fully accounting for it. The proportion of the total effect mediated through DL was 19.3% roughly one-fifth. H3 is supported. Variance explained was $R^2 = 0.036$ for the DL equation and $R^2 = 0.030$ for the TA equation. These figures reflect the measurement constraint of the ordinal 1–3 scale rather than weak substantive effects: at constrained variance, even genuinely meaningful relationships produce low R^2 (Cohen, 1988), and the consistent statistical significance of all path coefficients speaks to the robustness of the findings.

Table 5. Mediation Estimates

			95% Confidence Interval			
Effect	**Estimate**	**SE**	**Lower**	**Upper**	**Z**	**p**
Indirect	0.0214	0.00623	0.0102	0.0347	3.44	<.001
Direct	0.0896	0.02850	0.0350	0.1469	3.14	0.002
Total	0.1110	0.02840	0.0568	0.1676	3.91	<.001

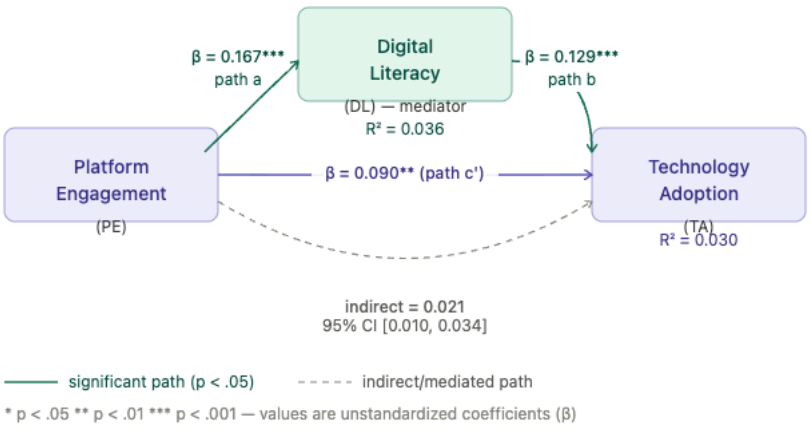


Figure 1. Mediation model: Digital Literacy as partial mediator between platform engagement and technology adoption

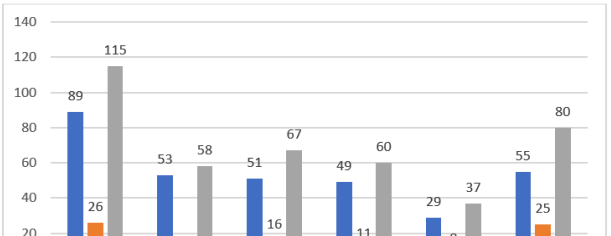


Figure 2. Representation of visibility and gender fitness in grade 1 physical education textbooks.

4. Discussion

This section interprets and contextualizes the main findings of the study in relation to the research questions and existing literature. The Discussion should explain how the results confirm, extend, or contradict previous work, highlighting the theoretical and practical implications of the findings. It is also important to address any unexpected outcomes, limitations of the study, and possible sources of bias, while suggesting directions for future research. The discussion should be structured logically, moving from specific observations to broader implications, and should avoid simply repeating the results already presented in the Findings or Results section.

5. Conclusion

The Conclusion presents a concise summary of the main findings and explicitly addresses the research questions or objectives set at the beginning of the study. This section should indicate the extent to which the results support or reject the initial hypotheses, and highlight their practical or policy implications. Rather than merely repeating the results, the Conclusion emphasizes the contribution of the study to the broader field of knowledge and suggests potential topics or research designs for future studies that other researchers may explore.

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References

The **References** section lists all sources that are directly cited in the article, arranged according to the **APA (American Psychological Association)** style. Each entry should include the author's name, year of publication, title of the work, journal or book title, and relevant publication details (volume, issue, page range, DOI, or URL) in accordance with the latest APA guidelines. Authors are encouraged to use a reference manager such as **Mendeley**, **Zotero**, or **EndNote** to facilitate the automatic generation of in-text citations and the reference list, reduce formatting errors, and speed up the manuscript preparation process.

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