DIGITAL ECOSYSTEM CULTIVATION AND RESEARCH CULTURE IN INSTRUCTIONAL LEADERSHIP: A DESCRIPTIVE STUDY OF PRIMARY SCHOOL ASSISTANT HEADTEACHERS IN SABAH

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Abstract

Digital transformation in primary schools calls for leadership practices that promote the purposeful use of educational technologies alongside systematic inquiry into teaching and learning. This study describes digital ecosystem cultivation and research culture cultivation as two dimensions of instructional competency among primary school assistant headteachers in Sabah, Malaysia. A focused descriptive analysis was undertaken using reported results from a quantitative, cross-sectional doctoral survey involving 423 assistant headteachers. The adapted instrument drew on the instructional domain of the Malaysian School Leaders Competency Standard 2.0 (KOMPAS 2.0), and descriptive statistics were obtained from the original study. Both domains recorded high self-reported ratings: digital ecosystem cultivation (M = 4.2228, SD = 0.39472) and research culture cultivation (M = 3.9665, SD = 0.40403). Among the four instructional competency dimensions, digital ecosystem cultivation ranked second, whereas research culture cultivation ranked fourth. The difference of 0.2563 scale points is descriptive and was not tested for statistical significance. The pattern suggests a useful professional learning priority: complementing encouragement of digital technology with structured teacher inquiry, reflective evaluation, and evidence-informed improvement. However, the data do not establish a relationship or causal mechanism between the two domains. This study contributes a focused empirical profile of middle-leadership competencies and discusses implications for school-based professional learning and sustainable e-learning practice in geographically diverse educational settings.

Keyword(s): *Digital Ecosystem Cultivation; Research Culture; Instructional Leadership; Primary Schools; e-Learning*

INTRODUCTION

Technology-supported instruction has become an integral part of school improvement agendas. Digital devices, platforms and learning resources can expand access to instructional material, but their presence does not guarantee educationally meaningful use. Sustainable change requires school leaders to coordinate the pedagogical purpose of technology, the development of teachers' professional capabilities and routines for examining the consequences of new practices. McCarthy

et al. (2023) argue that educational digital transformation should be understood through interconnected processes of system change rather than technical substitution alone. Recent reviews of digital school leadership similarly highlight the importance of organisational, professional and instructional dimensions (Wollscheid et al., 2025).

Within primary schools, assistant headteachers serve as middle leaders who translate school-level priorities into actionable practices for teachers and departments. Their position is significant because they are close to classroom processes while also carrying responsibilities for coordination and monitoring. Bush (2023) emphasises the importance of middle leadership for school improvement. An account of digital transformation focused only on principals or ICT infrastructure therefore risks overlooking the contribution of assistant headteachers who provide practical guidance, encourage professional participation and sustain improvement routines.

The Malaysian School Leaders Competency Standard 2.0 (KOMPAS 2.0) identifies four competencies within its instructional domain: curriculum-focused instruction, research culture cultivation, comprehensive monitoring and digital ecosystem cultivation (Institut Aminuddin Baki, 2020). The latter two competencies have distinct but potentially complementary functions. Digital ecosystem cultivation includes leading the uptake of educational technology and supporting teachers' digital practice. Research culture cultivation concerns encouraging school personnel to identify problems, use information systematically, undertake inquiry and communicate results. These competencies need not develop at identical rates, even though both are relevant to evidence-informed e-learning.

The educational contexts of Sabah provide a pertinent setting for examining these competencies. Primary schools span urban, rural and remote settings, and research in Sandakan has documented the range of self-related, resource, system and environmental challenges associated with instructional leadership (Qusayla Abd Razak et al., 2021). Research in nearby Sarawak has also connected school digital maturity with leadership competencies concerning vision, school culture and professional development (Nubun et al., 2024). Such literature establishes the relevance of context, but geographical location alone should not be assumed to determine the competencies of an individual assistant headteacher.

The broader doctoral project from which the present statistics were drawn investigated several organisational and individual correlates of instructional competency. This article instead reports a deliberately bounded descriptive profile of two specific domains. Its contribution is not a new causal model or an inferential comparison: it is an empirically grounded discussion of whether school-based professional learning may need to connect the cultivation of digital practice more deliberately with research-oriented reflection. The aim of this article is to describe digital ecosystem cultivation and research culture cultivation among primary school assistant headteachers in Sabah and to discuss the implications of these findings for evidence-informed e-learning leadership. Specifically, the study addresses two research questions: (1) What are the reported levels of digital ecosystem cultivation and research culture cultivation among primary school assistant headteachers in Sabah? (2) How are the two domains positioned within the wider instructional competency profile?

LITERATURE REVIEW

Digital Ecosystem Cultivation and the Work of Middle Leaders

Digital ecosystem cultivation concerns sustained organisational support for digital learning, not merely the acquisition of equipment. In the operational instrument used in the original survey,

relevant practices include raising awareness of digital technologies in teaching, encouraging optimal use of digital resources, supporting ICT equipment, inspiring diversified technology-supported pedagogies, enabling digital training and guiding colleagues who need assistance. Such leadership practices address the organisational conditions under which teachers may use technology in purposeful ways. They represent reported actions of middle leaders rather than a direct measurement of the quality of online lessons or of student learning outcomes.

Evidence from Malaysian educational settings underscores the organisational character of digital change. Nubun et al. (2024) identify vision, digital culture, professional development and safety as important aspects of school digital maturity. Ibrahim et al. (2024) discuss digital transformation and innovation in relation to primary school performance. On a broader scale, McCarthy et al. (2023) describe digital transformation as a coordinated process involving leadership, human capacity and institutional conditions. Together these studies support an interpretation of digital ecosystem cultivation as an instructional leadership competency with pedagogical, professional and managerial dimensions.

Digital leadership also involves a willingness to review and refine practice. Witthöft et al. (2025) draw attention to an open innovation mindset in school digital innovation. Such work suggests that leaders should not stop at communicating enthusiasm about technology; they should create structures through which teachers can exchange experiences, identify difficulties and test improvements. However, this literature is not evidence that any particular digital practice caused improvement in the present sample; it provides a basis for discussing the educational meaning of the descriptive results.

Research Culture as an Instructional Competency

Research culture cultivation is understood here as leadership that creates opportunities for school personnel to seek evidence and learn from systematic inquiry. The corresponding survey domain encompasses identifying school problems through relevant data, supporting colleagues who wish to undertake research, communicating the importance of inquiry, recognising staff participation and sharing findings. This is a school improvement conception of research culture. It need not imply that all teachers are expected to publish journal articles, but it places value on reasoned investigation, documentation and continuous learning.

The concept of research culture has multiple dimensions, including shared values, expectations, working practices and institutional support (Callard, 2024; Tikhonova & Raitskaya, 2024). Luo et al. (2025) show how a school's research culture can be relevant to primary teachers' engagement in inquiry-based working. Practitioner inquiry can provide a route from identified teaching problems to new practices, but organisational support and opportunities for collaboration are important to its continuity (Marsh & Deacon, 2025). Lynch et al. (2025) further describe action research communities as a whole-school improvement initiative. These perspectives help explain why research culture may demand different organisational routines from those involved in simply promoting digital resource use.

Data literacy also matters. Mandinach and Schildkamp (2021) caution against simplistic understandings of data-based decision-making; schools need to interpret information within appropriate instructional questions and contextual constraints. Datnow et al. (2021) describe capacity building that connects evidence on student thinking with instructional improvement. Consequently, an inquiry-oriented school culture is not synonymous with collecting large amounts of digital data. It involves selecting defensible evidence, reflecting collaboratively and revising practice in response to what is learned.

Conceptual Complementarity without Assuming an Empirical Relationship

Digital ecosystem cultivation and research culture cultivation may reinforce different parts of an improvement cycle. Digital resources broaden the means through which teachers design, communicate and monitor learning, whereas inquiry-oriented practices can help educators ask whether the chosen digital approach is meeting its stated purpose. For example, a leadership team may introduce an online assessment strategy, identify a specific problem in learners' responses, gather suitable evidence, make a limited instructional adjustment and discuss the outcome with colleagues. This illustration is a proposed pathway for practice, not an intervention measured by the study.

The distinction is important for interpreting the results. Means for two domains cannot reveal a correlation between them, and an observed ranking cannot establish that one competency is causally responsible for the other. The relevant theoretical contribution of the present paper is therefore an interpretive proposition: sustainable e-learning leadership may benefit from bringing technology facilitation and evidence-informed professional inquiry into the same improvement conversation. Further research would be needed to test this proposed connection at individual and organisational levels.

METHODOLOGY

Research Design and Source of Data

This article presents a focused descriptive analysis of data obtained from a broader quantitative, non-experimental, cross-sectional doctoral survey involving 423 primary school assistant headteachers in Sabah, Malaysia (Suwardi, 2026). While the original doctoral research examined instructional competency within a broader research framework, the present article focuses specifically on two dimensions: digital ecosystem cultivation and research culture cultivation. The findings were derived from the original survey data, with no additional data collection or inferential statistical analysis conducted for this article.

Population, Sampling and Participants

The original study identified a target population of 2,943 assistant headteachers across 981 government-aided primary schools in Sabah, representing administrative, student affairs and co-curricular leadership roles. Its sampling procedure combined stratified, cluster and simple random selection, with a final sample of 423 assistant headteachers from 12 selected district education offices across six regional groupings. Of the respondents, 215 were male (50.8%) and 208 female (49.2%); 120 served in urban schools (28.4%) and 303 in rural schools (71.6%). The original study also reported 228 participants with fewer than ten years in their assistant headteacher role, 116 with ten to twenty years and 79 with more than twenty years. The present analysis does not compare these subgroups, and the descriptive means should not be interpreted as location-specific estimates.

Instrument and Operational Definitions

Instructional competency was measured using an adapted questionnaire aligned with the instructional domain of KOMPAS 2.0 (Institut Aminuddin Baki, 2020). A pilot study involving 100 respondents was conducted to assess the instrument's suitability and reliability prior to the main survey. Following exploratory factor analysis during the pilot phase, 30 items were retained across four domains: curriculum-focused instruction (eight items), research culture cultivation (six items), comprehensive monitoring (eight items) and digital ecosystem cultivation (eight items). Respondents rated their reported practices on a five-point agreement scale from 1 (strongly disagree) to 5 (strongly agree). Negatively worded items were reverse-coded prior to data analysis to ensure consistency in the direction of scoring.

The pilot study yielded a Cronbach's alpha of .917 for the overall instructional competency instrument (N = 100). The main study reported an overall Cronbach's alpha of .968 (N = 423). Separate reliability coefficients for digital ecosystem cultivation and research culture cultivation were not reported in the source thesis. The questionnaire items represent self-assessed leadership practices. They do not directly quantify school connectivity, teachers' observed performance, the quality of e-learning materials or improvements in pupil achievement.

Descriptive Analysis and Reporting Decisions

The present report uses means and standard deviations taken from the original thesis rather than recalculating scores. Following Levin and Rubin (1998) and Mohd Yusof Abdullah (2006), mean scores above 3.67 were classified as high. The four-domain profile is provided for context, but discussion centres on the two preselected domains. The arithmetic gap between the two focal means is reported only as a descriptive contrast. A paired-sample difference test and domain-to-domain correlation were not conducted because this article was designed to report the descriptive findings documented in the source thesis. No statistical significance or causal relationship is inferred from the reported means.

FINDINGS & DISCUSSION

Respondent and Instructional Competency Profile

The sample included 423 assistant headteachers serving diverse school contexts. The distribution of participants by school location is relevant to the scope of the research but is not used here to claim any measured urban-rural contrast in digital ecosystem or research culture scores. Table 1 summarises the sample structure and Table 2 presents all four instructional competency domains so that the two focal domains can be interpreted within the measurement framework from which they were drawn.

Table 1. Characteristics of the original survey sample (N = 423)

Characteristic	Category	n	%
Gender	Male	215	50.8
	Female	208	49.2
School location	Urban	120	28.4
	Rural	303	71.6
Experience as assistant headteacher	Below 10 years	228	53.9
	10–20 years	116	27.4
	More than 20 years	79	18.7

Note. Data were obtained from Suwardi (2026), Table 4.2. Each demographic characteristic accounts for a total of 423 respondents.

Table 2. Descriptive profile of the four instructional competency domains (N = 423)

Instructional competency domain	Mean	SD	Rank
Curriculum-focused instruction	4.2618	0.37982	1
Digital ecosystem cultivation	4.2228	0.39472	2
Comprehensive monitoring	4.1729	0.38724	3
Research culture cultivation	3.9665	0.40403	4
Overall instructional competency	4.1560	0.33350	—

Note. Data were obtained from Suwardi (2026), Table 4.5 and Appendix I. All four instructional competency domains were classified as high. The ranking is descriptive and does not indicate statistically significant differences.

Reported Digital Ecosystem Cultivation

Digital ecosystem cultivation obtained a mean of 4.2228 (SD = 0.39472), ranking second among the four domains of instructional competency. This suggests that, on average, respondents endorsed statements describing their own role in facilitating digital practices at a relatively high level. Because the scale is based on agreement with descriptions of leadership practice, the result should not be interpreted as an objective assessment of each school's e-learning infrastructure or a direct estimate of technology-induced learning gains.

The instrument's digital domain foregrounds organisational mobilisation, including building awareness of digital technologies, encouraging the use of electronic resources, providing opportunities for ICT-related development and guiding colleagues who need support. These practices resonate with research emphasising the professional and cultural conditions of digital transformation (McCarthy et al., 2023; Nubun et al., 2024). They also show why a single digital competency mean should be interpreted as a broad self-reported leadership construct rather than as a measure of specific digital platforms, instructional software or student outcomes.

The mean also needs to be situated within the wider instructional profile. Curriculum-focused instruction ranked first (M = 4.2618) and comprehensive monitoring ranked third (M = 4.1729). The digital domain therefore appears neither isolated nor marginal in respondents' reported instructional competency. Nevertheless, these aggregate values do not disclose variation at the level of individual digital practices or the distribution of technological resources across schools. Qualitative or item-level evidence would be needed to understand which forms of digital support are most consistently enacted.

Reported Research Culture Cultivation

Research culture cultivation registered a mean of 3.9665 (SD = 0.40403). Although this was the lowest of the four instructional competency means, it remained in the high category used by the original research. It would consequently be inaccurate to conclude that surveyed assistant headteachers lacked research-oriented leadership. A more defensible reading is that research culture cultivation may warrant closer professional attention relative to the other self-reported instructional competencies.

The research domain includes practices that are demanding in different ways from the promotion of technology. Leaders may need to allocate time for inquiry, encourage colleagues to formulate investigable problems, arrange opportunities to discuss methods and findings and support the use of relevant evidence for instructional decisions. The literature suggests that such practices depend on more than individual enthusiasm. Luo et al. (2025) link research culture with teachers' inquiry-oriented working, while Marsh and Deacon (2025) discuss practitioner enquiry as a structured process for professional learning. Similarly, research on whole-school action research communities points to the importance of support and collaborative arrangements (Lynch et al., 2025).

The observed rating does not reveal the reasons for its relatively lower position. Time pressure, access to methodological guidance, differences in leadership responsibilities and the opportunity to share inquiry work are plausible matters for investigation, but none was tested as an explanation of the present result. The contribution of this descriptive observation is therefore to identify a topic for improvement-oriented questioning, not to diagnose a verified deficit in the schools surveyed.

Interpreting the Contrast Between the Two Domains

The numerical difference between the digital ecosystem mean (4.2228) and the research culture mean (3.9665) is 0.2563 points on the five-point response scale. This is a descriptive comparison based on two reported aggregate scores. No inferential test of a within-respondent difference has been performed in this paper, and no relationship between the two domain scores can be derived from their means. The ranking should not be described as evidence of a statistically significant gap.

Even with that limitation, the contrast offers a useful interpretive question for school leadership. Promoting digital resources may be more visible in routine school administration than establishing ongoing cycles of professional inquiry. Yet digital teaching practices would plausibly be more sustainable when teachers can explain why a chosen digital approach fits a learning need and assess whether the intended outcomes were realised. Mandinach and Schildkamp (2021) warn that the use of data can be misunderstood when interpretation and decision-making processes are neglected. Datnow et al. (2021) similarly stress the importance of linking evidence to improvements in instruction. These ideas indicate why digital facilitation and research culture should be considered together in professional development planning, without implying that their connection has already been statistically demonstrated in the Sabah sample.

Practical Implications for Sustainable e-Learning Leadership

One implication is to make inquiry part of digital professional development rather than treating training as a one-off introduction to software. School teams could identify a specific teaching or assessment issue, state the intended contribution of a digital tool, gather appropriately chosen information and review outcomes in a professional learning community. The emphasis should be on a feasible, repeatable improvement process rather than requiring teachers to produce lengthy formal reports. The collaborative inquiry literature provides a rationale for this approach (Luo et al., 2025; Lynch et al., 2025).

A second implication is for assistant headteachers to connect instructional monitoring with evidence-informed digital practice. For example, a teacher team might review whether an online feedback tool helps pupils identify misconceptions, using work samples and moderated professional discussion rather than merely counting platform logins. Such a routine could align the objectives of curriculum leadership, digital resource facilitation and research culture. It is a proposed application of the literature and the survey's competency framework, not an observed practice established by the dataset.

A third implication is the need for context-sensitive support. School resource conditions vary across Sabah, and research on instructional leadership in Sandakan points to multiple context-related challenges (Qusayla Abd Razak et al., 2021). Professional inquiry can be scaled to available resources: modest classroom questions, simple data logs and collegial reflection may be possible even where more advanced digital infrastructure is constrained. At the same time, the study's overall means must not be used to infer that rural and urban schools perform equally, differently or have identical technology access, because those propositions require separate evidence.

Table 3. Interpretation-to-action guide for the two focal competencies

Domain	What the survey measures	Possible professional learning emphasis
Digital ecosystem cultivation	Self-reported support for digital resources, ICT development and colleague guidance	Pedagogical integration, coaching and purposeful use of digital tools
Research culture cultivation	Self-reported encouragement of inquiry, use of data and sharing of findings	Small inquiry cycles, reflective evaluation and evidence-informed decisions

Note. The third column provides literature-informed recommendations; these activities were not evaluated as interventions in the current study.

Methodological Limitations and Directions for Further Inquiry

The present paper is a secondary descriptive account of a broader doctoral survey. It uses aggregate results and therefore cannot examine the covariance of the two focal domains, estimate a paired difference or account for subgroup variation. The original self-report design may be affected by social desirability and common method bias. Its overall reliability coefficient does not provide separate evidence of reliability for the two focal subscales.

Future research could obtain the original respondent-level data and test the correlation between digital ecosystem cultivation and research culture cultivation, the paired mean difference and the reliability of each subscale. Researchers could then investigate whether the proposed connection between inquiry routines and sustainable digital pedagogy survives controls for professional experience, school resources or locality. School observations, teaching artefacts, interviews and documented inquiry cycles would be particularly useful for investigating how leadership practices are enacted and how they relate to classroom learning. These are future research proposals rather than findings from the present data.

CONCLUSION

This article presented a focused empirical description of digital ecosystem cultivation and research culture cultivation among 423 primary school assistant headteachers in Sabah. Both dimensions were rated highly in the original survey, although digital ecosystem cultivation (M = 4.2228) ranked second and research culture cultivation (M = 3.9665) ranked fourth among four instructional competency domains. The descriptive pattern provides a rationale for examining how school leaders might better integrate support for educational technology with ongoing professional inquiry. It does not establish that the two domains differ significantly, influence one another or produce specific improvements in learner outcomes.

For school leadership practice, the argument is that digital sustainability should be pursued through purposeful technology use accompanied by evaluation, collaborative reflection and evidence-informed instructional decisions. Assistant headteachers may be well positioned to facilitate such routines because they connect institutional priorities with teachers' daily work. The central contribution is a bounded empirical profile and a practical agenda for future testing, while the broader regression and moderation findings of the original doctoral project lie outside this paper's objectives.

Conflict of Interest

The authors declare no known competing interests in relation to this manuscript.

Author Contribution

Erna Suwardi was responsible for the research conceptualisation, data collection, data analysis, interpretation of findings, and manuscript preparation. Muhamad Suhaimi Taat contributed to data verification, methodological review, and manuscript formatting. Roslee Talip assisted with language review and manuscript refinement. Mohd Sobrye Paimin contributed to the critical review of the manuscript, particularly the discussion and overall presentation. All authors reviewed and approved the final version of the manuscript.

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Ethics Statement

Permission to conduct the original doctoral research was obtained from the Malaysian Ministry of Education (reference: KPM.600-3/2/3-eras(23539), dated 13 March 2025) and the

Sabah State Education Department (reference: JPNSBH.SPS.600-1/1/1 JLD. 33 (32), dated 29 April 2025). The study purpose and confidentiality of questionnaire responses were explained to participants. Only aggregated findings are reported in this article to protect respondent confidentiality.

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