JOURNAL OF TECHNOLOGY MANAGEMENT AND TECHNOPRENEURSHIP

# Digital Literacy and Behavioural Intention to Use Digital Technologies among Administrative Staff in Malaysian Public Universities: A UTAUT-Based Conceptual Framework

Laila Zahidah A. Rahman[a,*], Mohamad Idham Md Razak[a], Nor Shahrulnizam Muhamad Nor[a]

[a]*Faculty of Business and Management, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*

**Abstract**

Digital literacy has become a critical determinant of institutional effectiveness as Malaysian public universities accelerate their digital transformation agendas under the Malaysia Digital Economy Blueprint and the Public Sector Digitalisation Strategic Plan 2021–2025. Although the Unified Theory of Acceptance and Use of Technology (UTAUT) remains the dominant lens for explaining technology adoption, it implicitly assumes that users possess uniform capability to act upon their intentions, has historically been applied to bounded, single-system contexts, and has left voluntariness of use largely unexamined; it therefore cannot explain why documented competency deficits translate into weak adoption motivation among administrative staff. This paper addresses these theoretical shortcomings by proposing a UTAUT-based conceptual framework in which digital literacy, conceptualised as a multidimensional competency rather than a technology, is positioned as an antecedent that influences behavioural intention to use digital technologies both directly and indirectly through Effort Expectancy as a partial mediator, a pathway grounded in Social Cognitive Theory and self-efficacy. Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions are modelled as direct predictors of behavioural intention, while voluntariness of use, together with gender, age, and experience, is incorporated as a moderator to capture the semi-mandatory nature of technology use in Malaysian public universities. A quantitative, cross-sectional survey of 384 administrative staff across eight public universities is proposed, with data to be analysed using covariance-based Structural Equation Modelling. The framework contributes theoretically by repositioning individual competency within UTAUT's nomological network, contextually by examining a systematically overlooked institutional workforce, and practically by generating evidence to calibrate digital upskilling policy under the MyDIGITAL agenda.

Keywords: *Digital literacy; UTAUT; behavioural intention; effort expectancy; voluntariness of use; administrative staff; public universities*

## 1. Introduction

Digital transformation has emerged as a defining characteristic of contemporary organisational ecosystems, fundamentally reshaping how organisations operate, manage information, and pursue strategic objectives. As digital technologies become increasingly embedded in administrative functions, the roles of administrative

* Corresponding author.
*E-mail address: lailautem@gmail.com*

personnel have evolved from routine clerical responsibilities to complex, technology-mediated tasks that demand a higher order of specialised competency (Spante et al., 2018). Digital literacy, broadly defined as the capacity to effectively utilise digital tools, platforms, and technologies to accomplish work-related objectives, has consequently become a critical determinant of organisational effectiveness and institutional resilience (Spante et al., 2018; Carretero et al., 2017).

In Malaysia, national digitalisation efforts are institutionally anchored within the Malaysia Digital Economy Blueprint (MyDIGITAL) and operationalised through the Public Sector Digitalisation Strategic Plan 2021–2025, which collectively aim to establish a sustainable, resilient, and digitally capable public administration (MAMPU, 2020). Within the higher education sector, Malaysian public universities have substantially accelerated their digital adoption trajectories, particularly following the COVID-19 pandemic, which necessitated rapid transitions to remote administration and online service delivery (Hashim et al., 2021). Administrative personnel are now routinely expected to manage learning management systems, student information systems, digital financial platforms, and a range of institutional e-platforms. Nevertheless, disparities in digital preparedness persist across staff groups and functional roles, attributable to a confluence of age, educational attainment, access to training, institutional support, and individual motivational orientation.

Malaysia's civil service comprises 1,305,976 employees, of whom 97,046 are employed across 20 public universities, including 65,163 administrative personnel whose digital competency directly determines the quality of academic administration, student services, and institutional governance (Zaliha Mustafa, 2025). Despite the policy emphasis on digital competency under the 11th Malaysia Plan and the National Fourth Industrial Revolution (4IR) Policy, a significant digital literacy deficit persists among this workforce, manifesting in delays in student verification, examination documentation processing, and digital file transfers, alongside an over-reliance on a minority of staff perceived as more IT-proficient.

Beyond these empirical observations, however, the more fundamental gap addressed by this study is theoretical. Three interrelated shortcomings limit the explanatory capacity of the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003) in this context. First, UTAUT models users' perceptions of technology, namely Performance Expectancy (PE) and Effort Expectancy (EE), yet treats the individual capability underlying those perceptions as exogenous: the theory contains no construct capturing whether users actually possess the competencies that their intentions presuppose. This omission is consequential in workforces with documented literacy deficits, because UTAUT cannot explain why two employees facing identical systems, incentives, and support form markedly different effort perceptions and intentions (Blut et al., 2022; Kabakuş et al., 2023). Second, UTAUT's dependent variable has historically been bounded to intention to use a single, specific information system, whereas contemporary administrative work demands transferable engagement across an evolving ecosystem of platforms; the theory is therefore silent on how a general competency shapes intention towards digital technologies in general rather than towards one system in particular (Nikou & Aavakare, 2021). Third, although voluntariness of use was specified as a moderator in the original formulation, it has been operationalised in only a small fraction of subsequent applications, leaving UTAUT under-specified for semi-mandatory public sector environments in which adoption is neither fully discretionary nor fully compelled (Blut et al., 2022). Addressing what UTAUT fails to explain therefore requires extending the model by integrating digital literacy as a competency-based antecedent, redefining the outcome as behavioural intention to use digital technologies, and explicitly activating voluntariness of use as a moderator.

Administrative staff constitute the appropriate population for this theoretical extension for three reasons. First, at 65,163 personnel they represent the single largest workforce segment in Malaysian public universities, yet remain systematically marginalised in technology acceptance research relative to academics and students. Second, they occupy a structurally distinctive position: unlike academics, who exercise

considerable pedagogical autonomy in selecting digital tools, and unlike students, who adopt technologies largely as voluntary consumers, administrative staff operate integrated enterprise systems, covering student records, finance, procurement, and governance, under semi-mandatory institutional directives. This places them precisely at the boundary condition, voluntariness of use, that remains untested in UTAUT. Third, unlike general government officers in ministries, university administrative staff work at the intersection of public sector digitalisation mandates and academic service ecosystems, making their adoption behaviour uniquely informative for both higher education management and national digital policy. Their competency deficits, moreover, propagate directly into institutional performance, as they mediate between digital infrastructure and every category of end user.

Guided by these gaps, this study pursues four objectives: to examine the influence of UTAUT constructs on behavioural intention to use digital technologies among administrative staff in Malaysian public universities; to assess the moderating effect of voluntariness of use on the relationship between Social Influence and behavioural intention; to assess the mediating role of Effort Expectancy in transmitting the effect of digital literacy on behavioural intention; and to validate the proposed conceptual framework through Structural Equation Modelling (SEM). Correspondingly, the study is guided by four research questions concerning which UTAUT constructs significantly predict behavioural intention to use digital technologies, whether voluntariness of use moderates the Social Influence–behavioural intention pathway, whether Effort Expectancy mediates the digital literacy–behavioural intention relationship, and whether the proposed framework can be empirically validated.

## 2. Digital Literacy

### *2.1 Conceptual Distinctions: Digital Skills, Digital Competence, Digital Literacy, and Digital Capability*

Before reviewing the empirical literature, it is necessary to clarify four terms that are frequently, and erroneously, used interchangeably. Digital skills represent the narrowest construct, denoting operational, tool-specific proficiencies such as navigating software interfaces or managing files (van Deursen & van Dijk, 2015). Digital competence is broader, encompassing the knowledge, skills, and attitudes required for confident, critical, and responsible use of digital technologies, and is the term institutionalised in European policy through the DigComp framework (Carretero et al., 2017; Spante et al., 2018). Digital literacy, the construct adopted in this study, extends further into the cognitive and socio-cultural domain: it denotes an individual's integrated capacity to locate, evaluate, synthesise, create, and communicate information through digital media in a manner that is critical, safe, and ethically responsible (Buchan et al., 2024; Ng, 2012). Digital capability, by contrast, is typically an organisational-level construct describing an institution's strategic capacity to deploy digital resources towards its objectives, and is therefore not an individual attribute at all. In their systematic review, Spante et al. (2018) demonstrate that the inconsistent use of these terms has fragmented the higher education literature and impeded cumulative theory-building. Accordingly, this manuscript uses digital literacy (DL) exclusively and consistently to denote the individual-level, multidimensional competency defined above; digital skills and digital competence are referenced only when reporting studies that explicitly measured those narrower or adjacent constructs.

### *2.2 Digital Literacy in Organisational and Public Sector Contexts*

Across the organisational literature, three points of convergence emerge. First, digital literacy is consistently conceptualised as multidimensional, spanning technical, cognitive, informational, social, and ethical competencies rather than basic operational skill (Buchan et al., 2024; Spante et al., 2018; Nikou et al.,

2022). Second, it is increasingly treated as a strategic human capital resource: productivity, decision-making quality, and service delivery are shaped less by access to technology than by individuals' capacity to translate digital skills into purposeful work outcomes (van Deursen & van Dijk, 2015). Third, its consequences are amplified in the public sector, where the shift towards e-government and integrated administrative systems demands documentation accuracy, digital financial reporting, and regulatory compliance from an administratively literate workforce (Kabakuş et al., 2023). For administrative staff specifically, digital literacy has transitioned from a supplementary competency to a prerequisite for professional effectiveness and organisational resilience (Carretero et al., 2017).

Where the literature diverges, however, is in its adequacy for the present context, and three limitations warrant explicit critical evaluation rather than the generic observation that prior studies are "limited". First, the foundational frameworks are contextually bounded: the DigComp framework, for instance, was developed and validated within European institutional settings that presuppose ubiquitous infrastructure and standardised training provision, assumptions that do not hold across unevenly resourced Malaysian public university campuses (Carretero et al., 2017). Second, the empirical base is population-skewed: van Deursen and van Dijk's (2015) influential longitudinal analysis, while methodologically rigorous, examined the general Dutch population and measured internet skills rather than workplace digital literacy, limiting its transferability to administrative workforces. Third, the study most proximate to the present one, Kabakuş et al.'s (2023) examination of digital literacy and technology acceptance among Turkish higher education administrative staff, established the DL–acceptance link but modelled acceptance towards technology in general terms without accounting for the mandatory-leaning institutional context or testing voluntariness as a boundary condition, precisely the theoretical extensions this study undertakes. Collectively, these limitations indicate that existing findings cannot simply be imported into the Malaysian public university setting; they must be re-specified within a theory that accommodates competency, context, and compulsion simultaneously.

### *2.3 Digital Literacy in Malaysian Public Universities*

In Malaysia, digital literacy development is closely tied to the national digital transformation agenda articulated through MyDIGITAL and operationalised via the Public Sector Digitalisation Strategic Plan 2021–2025, complemented by an explicit government target for all public officials to attain digital literacy by 2025 (JPM, 2021; MAMPU, 2020; Khan et al., 2022). Despite this policy ambition, digital literacy deficits remain documented across Malaysian public sector organisations, including administrative personnel in higher education institutions, attributable to the absence of standardised training, uneven ICT infrastructure distribution, and wide variance in baseline proficiency. Within public universities, administrative staff are increasingly required to manage learning management systems, student information systems, and institutional governance portals, yet disparities in age, educational attainment, and training access generate intra-institutional skill divides that impede service delivery and constrain digital innovation (Hashim et al., 2021). The Malaysian literature, however, exhibits two compounding weaknesses: it has concentrated overwhelmingly on academic staff and students, leaving administrative personnel largely unexamined despite their critical mediating role between institutional digital infrastructure and end users; and it remains predominantly descriptive, documenting competency gaps without disentangling their behavioural, motivational, and organisational determinants through any explanatory theory. This dual gap, an overlooked population studied without theoretical structure, justifies the adoption of UTAUT as an explanatory framework capable of moving beyond demographic profiling towards actionable insight for institutional policy and training design.

## 3. UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

### *3.1 Overview of the Theory*

UTAUT, proposed by Venkatesh et al. (2003), synthesises eight prominent technology acceptance models, including the Theory of Reasoned Action, the Theory of Planned Behaviour, the Technology Acceptance Model, and Social Cognitive Theory, into a unified and parsimonious framework. The model specifies four core determinants of Behavioural Intention (BI): Performance Expectancy (PE), the degree to which an individual believes the technology will enhance job performance; Effort Expectancy (EE), the perceived ease of learning and using the technology; Social Influence (SI), the degree to which important others are perceived to expect its use; and Facilitating Conditions (FC), the perceived availability of organisational and technical resources supporting use. These relationships are moderated by gender, age, experience, and voluntariness of use, and the model has demonstrated explanatory power accounting for up to 70% of variance in behavioural intention, rendering it well-suited to institutional and public service contexts (Venkatesh et al., 2003).

Despite this robust explanatory record, critical examination reveals recurring limitations that constrain its direct applicability here: the overwhelming majority of UTAUT studies have been conducted among student populations or urban professionals in developed-country settings; most applications examine bounded, single information systems rather than multidimensional competency constructs; and voluntariness of use, although specified as a key moderator, remains considerably less examined than demographic moderators (Blut et al., 2022; Kabakuş et al., 2023). Empirically, PE is consistently among the strongest predictors of BI, particularly where personal and institutional performance goals align (Kabakuş et al., 2023); EE is closely tied to digital literacy, as more competent individuals navigate new systems with reduced cognitive burden, although its influence tends to diminish with experience (Venkatesh et al., 2003); SI operates through compliance, internalisation, and identification, and is particularly salient in hierarchical public sector organisations, although findings on its strength remain inconsistent across studies (Cabrera-Sánchez et al., 2021); and FC has been identified as a significant enabler of digital adoption in institutional settings (Venkatesh et al., 2003; Dwivedi et al., 2019). BI itself remains the most proximal, well-validated predictor of actual use, although its predictive strength attenuates as habits form, a dynamic cross-sectional designs cannot capture (Venkatesh et al., 2003; Nikou et al., 2022).

### *3.2 Justification for Modifying UTAUT*

Because any modification of an established theory must be theory-driven rather than ad hoc (Venkatesh et al., 2012), the three modifications introduced in this study are each justified explicitly. First, digital literacy is integrated as an antecedent of Effort Expectancy. This extension is grounded in Social Cognitive Theory (Bandura, 1986): mastery experiences with digital tools build self-efficacy, and self-efficacy in turn anchors perceptions of how effortful new technology will be. The logic parallels Venkatesh's (2000) own antecedent model, in which computer self-efficacy is a primary anchor of perceived ease of use; positioning DL upstream of EE therefore extends UTAUT in a manner consistent with the theory's internal architecture rather than departing from it (Nikou & Aavakare, 2021; Kabakuş et al., 2023).

Second, the dependent variable is specified as behavioural intention to use digital technologies rather than intention "towards digital literacy". Digital literacy is a competency, capability, or skill, not a technology, and an individual cannot meaningfully form an adoption intention towards a competency they either possess or develop. Treating literacy as the object of adoption would constitute a category error that conflates the capability to act with the behaviour itself. The respecified model therefore positions DL as the capability-based antecedent and intention to use digital technologies, the transferable ecosystem of workplace systems and platforms, as the behavioural outcome, consistent with how Nikou and Aavakare (2021) model literacy as a driver of intention to use digital technology. This reconceptualisation is applied consistently throughout the title, abstract, hypotheses, and conceptual framework of this manuscript.

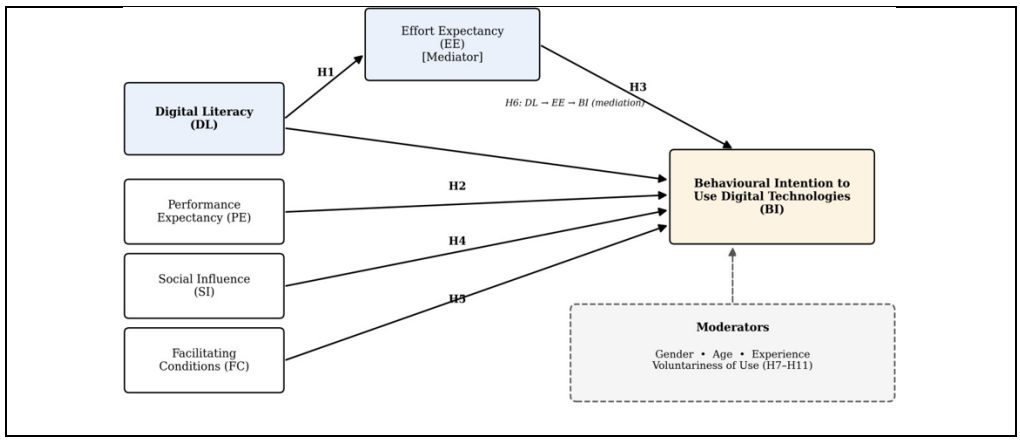
Third, Facilitating Conditions is respecified as a predictor of behavioural intention rather than of use behaviour. In the original UTAUT, FC predicts use behaviour directly, with its effect on intention argued to be captured by EE (Venkatesh et al., 2003). Three considerations justify the departure. Theoretically, in a pre-implementation, conceptual context where use behaviour is not yet observable, perceived availability of infrastructure, training, and support shapes motivational readiness before any use can occur; resource assurance functions as a precondition of intention formation, particularly in mandatory-leaning public settings where staff weigh institutional support before committing effort (Bervell et al., 2021; Armansyah, 2021). Empirically, the meta-analytic re-examination of UTAUT by Dwivedi et al. (2019) demonstrates a significant direct FC→BI path across pooled studies and formally incorporates it in their revised theoretical model. Structurally, the present study models intention as its terminal endogenous variable; omitting FC entirely would discard a construct of clear policy relevance in Malaysian universities. The FC→BI specification is therefore the theoretically appropriate one for this model, not a residual inconsistency.

## 4. CONCEPTUAL FRAMEWORK

The conceptual framework operationalises the modified UTAUT model within the institutional context of administrative staff in Malaysian public universities. Digital literacy is positioned as an antecedent variable exerting both direct and indirect influences on behavioural intention to use digital technologies. The indirect pathway operates through Effort Expectancy as a mediating variable, reflecting the theoretically grounded premise that existing digital competency shapes perceptions of the ease with which digital tools can be adopted, which in turn influences motivational readiness (Kabakuş et al., 2023; Nikou & Aavakare, 2021). The direct pathway acknowledges that digital literacy may also exert an independent effect on intention, consistent with findings that higher competency is associated with greater intrinsic motivation to engage with digital platforms beyond effort perceptions alone (Aavakare & Nikou, 2020).

The specification of partial rather than full mediation is deliberate and theoretically justified. Full mediation would imply that digital literacy influences intention exclusively by lowering perceived effort, a proposition Social Cognitive Theory renders untenable: competency raises not only efficacy beliefs about ease but also outcome expectations and intrinsic engagement, motivational routes that operate independently of effort perceptions (Bandura, 1986). Empirically, Aavakare and Nikou (2020) report direct literacy-to-intention effects that persist alongside indirect pathways, indicating that effort reduction does not exhaust the mechanism. Partial mediation is therefore specified a priori, while the bootstrapped indirect-effect procedure described in Section 6 permits empirical adjudication: should the direct path prove non-significant, the data would indicate full mediation, and the framework accommodates either outcome without re-specification.

The four core UTAUT constructs, PE, EE, SI, and FC, are positioned as direct predictors of BI, jointly operationalising the motivational, social, and organisational dimensions of adoption within the Malaysian public university administrative environment (Venkatesh et al., 2003). Gender, age, experience, and voluntariness of use are incorporated as moderators, but deliberately not across all pathways. This selective specification follows the original UTAUT, which itself does not hypothesise every moderator on every path: Venkatesh et al. (2003) specify gender and age as moderators of PE; gender, age, and experience as moderators of EE; and all four moderators, including voluntariness, only on SI. The FC pathway is left unmoderated for three reasons. First, the original moderation of FC (by age and experience) applies to the FC →use behaviour path, which lies outside this intention-focused model. Second, no theoretical rationale exists in the Malaysian administrative context for expecting the support – intention link to vary systematically by demographic group: institutional infrastructure, training, and helpdesk provision are supplied uniformly under standardised public service schemes. Third, Blut et al.'s (2022) meta-analysis shows moderator effects on FC to be the weakest and least consistent in the UTAUT nomological network; imposing blanket moderation




would inflate model complexity and the multi-group testing burden without theoretical warrant, violating the parsimony that motivated UTAUT's original synthesis.

Figure 1: Proposed conceptual framework linking Digital Literacy, UTAUT constructs, Effort Expectancy as mediator, and the moderating variables (grouped in dashed box) to Behavioural Intention to Use Digital Technologies

Voluntariness of use warrants particular emphasis because technology use among Malaysian public university administrative staff exists on a continuum shaped by policy directives, departmental expectations, and individual agency rather than being uniformly mandatory or discretionary (Blut et al., 2022). The framework will be tested through SEM, selected for its capacity to estimate direct, mediated, and moderated relationships while accounting for measurement error (Hair et al., 2019; Byrne, 2016). Figure 1 presents the framework, redesigned for clarity: the four moderators are grouped within a single dashed box with one conditioning arrow directed at the PE→BI, EE→BI, and SI→BI pathways, replacing the multiple crossing moderation lines of the earlier version. A limitation of the framework lies in its reliance on cross-sectional data, which precludes examining how these relationships evolve as digital experience and institutional

digitalisation mature; future research may incorporate longitudinal designs or the habit and hedonic motivation constructs of UTAUT2 (Venkatesh et al., 2012).

## 5. HYPOTHESIS DEVELOPMENT

### *5.1 Digital Literacy and Effort Expectancy*

Social Cognitive Theory holds that mastery experiences are the most powerful source of self-efficacy, and that efficacy beliefs govern how demanding individuals judge prospective tasks to be (Bandura, 1986). Because digitally literate staff have accumulated mastery experiences across digital tools, they possess higher technology-related self-efficacy; because self-efficacy anchors judgements of prospective effort, such staff will therefore appraise new digital systems as less cognitively demanding. Empirical evidence is consistent with this mechanism: digital competency reduces the perceived effort of engaging with new platforms (Kabakuş et al., 2023; van Deursen & van Dijk, 2015), prior platform experience builds adaptive competency that renders new skill acquisition more manageable (Nikou & Aavakare, 2021), and competency deficits amplify perceptual barriers to the point of hindering adoption entirely. For administrative staff in Malaysian public universities, it follows that investment in digital literacy programmes should mitigate perceived difficulty with new systems and create a more receptive environment for technology integration. It is therefore hypothesised that Digital Literacy (DL) has a significant and direct influence on Effort Expectancy (EE) (H1).

### *5.2 UTAUT Constructs and Behavioural Intention*

Performance Expectancy operates through outcome expectations: individuals form intentions when they anticipate that behaviour will yield valued results. Because administrative work is evaluated against processing speed, accuracy, and service quality, staff who believe digital tools will improve these outcomes have a direct motivational reason to intend their use; therefore, perceived performance gains should translate into stronger intention. This mechanism is corroborated across public sector accounting, university administration, and e-government services, where PE is consistently a significant, and often dominant, predictor of intention (Venkatesh et al., 2003; Blut et al., 2022). It is hypothesised that Performance Expectancy (PE) has a significant and direct influence on Behavioural Intention to use digital technologies (BI) (H2).

Effort Expectancy influences intention because anticipated cognitive cost enters directly into the cost–benefit appraisal underlying volitional behaviour: when a system is perceived as intuitive, the psychological cost of engagement falls and intention strengthens accordingly (Kabakuş et al., 2023; Nikou & Aavakare, 2021). Conversely, high perceived effort introduces cognitive barriers that even digitally proficient individuals cannot fully offset, particularly where systems are poorly designed or inadequately supported. It is hypothesised that Effort Expectancy (EE) has a significant and direct influence on Behavioural Intention (BI) (H3).

Social Influence shapes intention through three distinct psychological mechanisms: compliance with authority, internalisation of institutional norms, and identification with valued reference groups (Cabrera-Sánchez et al., 2021). Because Malaysian public university administration is hierarchical and directive-driven, supervisory expectations and institutional mandates carry normative force that informal peer networks alone cannot explain; because administrative workflows are interdependent and collaborative, colleagues' expectations further raise the perceived probability of use (Maruping et al., 2017). It is hypothesised that Social Influence (SI) has a significant and direct influence on Behavioural Intention (BI) (H4).

Facilitating Conditions encompass ICT infrastructure, training provision, technical support, and institutional policy directives perceived as enabling technology use (Venkatesh et al., 2003). As justified in

Section 3.2, in an intention-focused, pre-implementation model, perceived resource assurance operates as a precondition of motivational readiness: staff who perceive adequate support are more confident in their prospective ability to use digital tools and therefore form stronger intentions, an effect especially pronounced when Performance Expectancy is low (Bervell et al., 2021; Armansyah, 2021; Dwivedi et al., 2019). It is hypothesised that Facilitating Conditions (FC) have a significant and direct influence on Behavioural Intention (BI) (H5).

### *5.3 The Mediating Role of Effort Expectancy*

The mediation hypothesis is grounded in the causal chain that Social Cognitive Theory and self-efficacy theory jointly specify. Digital literacy constitutes accumulated mastery experience; mastery experience builds technology self-efficacy; self-efficacy lowers appraisals of prospective effort; and lower perceived effort strengthens behavioural intention (Bandura, 1986; Venkatesh, 2000). Effort Expectancy therefore functions as the psychological transmission mechanism through which capability becomes motivation: competency does not automatically produce intention, it does so to the extent that it reshapes the individual's appraisal of how demanding engagement will be (Aavakare & Nikou, 2020; van Deursen & van Dijk, 2015). From a capability perspective, literacy converts environmental resources into feasible action, and perceived feasibility is precisely what EE captures within UTAUT. This pathway is expected to be most consequential for less digitally experienced staff, for whom effort represents the primary psychological barrier, and to attenuate among highly proficient users whose competency reduces sensitivity to effort perceptions (Venkatesh et al., 2003). Consistent with the partial mediation specification justified in Section 4, it is hypothesised that Effort Expectancy mediates the relationship between Digital Literacy and Behavioural Intention (H6).

### *5.4 Moderating Variables*

The moderators are retained from the original UTAUT specification, but their inclusion is justified for the Malaysian public university context rather than transplanted mechanically. Gender is expected to moderate the PE→BI and EE→BI relationships because administrative role allocation in the Malaysian public service remains partially gendered, producing differential technology exposure and confidence profiles; consistent with socialisation accounts, PE effects tend to be stronger among male staff oriented towards task accomplishment, while EE effects are more pronounced among female staff for whom perceived ease offsets lower prior exposure (Venkatesh et al., 2003; Hamakhan, 2020). Age is expected to operate similarly because the seniority-based grade structure of the Malaysian civil service concentrates older staff in supervisory positions with less direct system-facing work, while cognitive ageing research indicates greater weight on effort considerations among older users. It is hypothesised that gender and age moderate the PE→BI relationship (H7) and the EE→BI relationship (H8).

Experience is expected to moderate the PE→BI and SI→BI relationships because habituation changes the basis of intention formation: seasoned users have internalised institutional norms, weakening the marginal force of social pressure, and evaluate performance benefits against accumulated first-hand evidence rather than expectation (Venkatesh et al., 2003; Blut et al., 2022). It is hypothesised that experience moderates the PE→BI relationship (H9) and the SI→BI relationship (H10).

Voluntariness of use is specified as a moderator of the SI→BI relationship only, and this restriction is itself theoretical. Voluntariness conditions the compliance mechanism specifically: when use is perceived as mandated, normative pressure from supervisors and institutional leadership bears directly on intention, whereas under discretionary conditions social expectations lose coercive force and intention rests on internal cost–benefit reasoning through PE and EE, mechanisms that voluntariness does not touch (Venkatesh et al., 2003). Because adoption among Malaysian public university administrative staff sits on a continuum between full mandation and complete discretion, shaped by circulars, departmental culture, and personal agency, and

because voluntariness remains the least examined of UTAUT's original moderators (Blut et al., 2022), its explicit operationalisation here addresses both a contextual necessity and a documented gap (Dwivedi et al., 2019). It is hypothesised that voluntariness of use moderates the SI→BI relationship (H11).

Table 1: Summary of Proposed Hypotheses (BI denotes Behavioural Intention to use digital technologies)

| Hypothesis | Hypothesised Path | Relationship Type |
|---|---|---|
| H1 | Digital Literacy (DL) → Effort Expectancy (EE) | Direct |
| H2 | Performance Expectancy (PE) → Behavioural Intention (BI) | Direct |
| H3 | Effort Expectancy (EE) → Behavioural Intention (BI) | Direct |
| H4 | Social Influence (SI) → Behavioural Intention (BI) | Direct |
| H5 | Facilitating Conditions (FC) → Behavioural Intention (BI) | Direct |
| H6 | Digital Literacy (DL) → Effort Expectancy (EE) → Behavioural Intention (BI) | Mediation |
| H7 | Gender and age moderate PE → BI | Moderation |
| H8 | Gender and age moderate EE → BI | Moderation |
| H9 | Experience moderates PE → BI | Moderation |
| H10 | Experience moderates SI → BI | Moderation |
| H11 | Voluntariness of use moderates SI → BI | Moderation |

This study advances three dimensions of novelty relative to the existing UTAUT literature. Contextually, prior UTAUT applications in the Malaysian public sector have predominantly addressed citizen-facing e-government services, student technology adoption, and academic staff engagement with digital learning platforms, leaving administrative staff, the largest workforce segment in public universities, systematically overlooked (HRMIS, 2025). Conceptually, whereas most UTAUT studies operationalise the dependent variable as intention to use a specific information system, this study models intention to use digital technologies as a transferable outcome and integrates digital literacy as a competency-based antecedent of Effort Expectancy, a theoretically grounded causal pathway that has received limited empirical attention (Kabakuş et al., 2023; Nikou & Aavakare, 2021). Methodologically, the study operationalises voluntariness of use, the least examined of UTAUT's original moderators, within a mandatory-leaning developing-country institutional setting through multi-group SEM, a combination of analytical approach and population not previously examined in the Malaysian public higher education literature (Blut et al., 2022).

## 6. Research Methodology

This study adopts a positivist research paradigm and a quantitative, deductive design, employing a cross-sectional, self-administered survey distributed through both manual drop-off and web-based methods to maximise response rate (Creswell & Creswell, 2018; Bhattacherjee, 2012). The target population comprises 65,163 administrative staff across 20 Malaysian public universities, with eight institutions purposively selected to represent the research, comprehensive, and technical university categories across Peninsular

Malaysia, Sabah, and Sarawak (Ministry of Higher Education, 2025; HRMIS, 2025). A two-stage stratified random sampling technique is employed, stratifying first by institutional category and second by job classification, to ensure proportionate representation across administrative grades (Sekaran & Bougie, 2010). The target sample size of 384 respondents, determined with reference to the Krejcie and Morgan (1970) table and exceeding the 10:1 item-to-response rule (Hair et al., 2010), substantially surpasses the minimum of 170 derived from an a priori SEM power analysis (Soper, 2020; Cohen, 1988), providing a margin for response attrition and stronger generalisability.

A pilot study of 100 respondents will precede the field study. Although 30–50 respondents are conventionally sufficient for feasibility-oriented piloting, the pilot in this study serves a psychometric rather than merely logistical purpose: the 34-item instrument combines items adapted from UTAUT, UTAUT2, and digital literacy scales into a new institutional context, and the pilot will therefore include preliminary exploratory factor analysis and reliability estimation prior to the main confirmatory analysis. A sample of 100 satisfies the minimum subject-to-item ratio of approximately 3:1 required for stable factor extraction on a 34-item instrument (Hair et al., 2010), whereas a pilot of 30–50 would render factor analysis unstable. The larger pilot is thus a methodological safeguard for instrument validity rather than an arbitrary inflation.

The survey instrument comprises 34 items measuring six constructs, namely Digital Literacy, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Behavioural Intention to use digital technologies, adapted from the original UTAUT and UTAUT2 measurements (Venkatesh et al., 2003, 2012) and established digital literacy scales (Ng, 2012; Nikou & Aavakare, 2021). Items are measured on a 10-point interval scale. Although 5- and 7-point scales are more common in UTAUT research, the 10-point format is selected on estimator-driven grounds: covariance-based SEM with maximum likelihood estimation assumes approximately continuous, multivariate normal indicators, and wider response formats improve approximation to interval-level data and distributional normality (Leung, 2011), yield greater response variance supporting discriminant validity (Awang, 2016), and have been shown empirically to produce comparable psychometric properties to 5- and 7-point formats without distortion (Dawes, 2008). Internal consistency will be assessed via Cronbach's Alpha (Tavakol & Dennick, 2011).

Data will be analysed using covariance-based SEM (CB-SEM) in IBM AMOS. The choice of CB-SEM over PLS-SEM is deliberate and follows the selection criteria articulated by Hair et al. (2019). The study is confirmatory rather than exploratory: the structural model derives from an established, extensively validated theory, and the research objective is theory testing, the condition under which CB-SEM is the recommended estimator. All constructs are reflectively specified using established scales, satisfying CB-SEM measurement assumptions. The hypothesised model requires multi-group invariance testing for categorical moderators (gender, age, experience, voluntariness), a procedure that is fully developed within the AMOS multi-group framework, including configural, metric, and scalar invariance assessment (Byrne, 2016). Finally, the target sample of 384 comfortably exceeds the requirements of maximum likelihood estimation for a model of this size. PLS-SEM would be preferable for prediction-oriented, exploratory research with complex formative models or small samples, none of which characterises this study.

Common method bias (CMB) will be addressed through both procedural and statistical remedies, following Podsakoff et al. (2003). Procedurally, respondent anonymity and confidentiality will be assured to reduce evaluation apprehension; predictor and criterion measures will be psychologically separated within the questionnaire; item wording will be refined during the pilot to remove ambiguity; and scale formats will be varied where feasible. Statistically, Harman's single-factor test will be conducted as an initial diagnostic, a full collinearity variance inflation factor (VIF) assessment will be applied with a threshold of 3.3 (Kock, 2015), and a theoretically unrelated marker variable will be embedded in the instrument to partial out method variance (Lindell & Whitney, 2001). Analysis will proceed through data screening and CMB assessment, followed by Confirmatory Factor Analysis and structural model estimation evaluated against established fit

indices (Hair et al., 2017). The mediating role of Effort Expectancy will be tested using the bootstrapped indirect-effect procedure with 5,000 resamples and bias-corrected confidence intervals (Hair et al., 2017; Byrne, 2016), while moderation analysis will employ multi-group SEM and interaction-term testing to examine the conditioning effects of gender, age, experience, and voluntariness of use on the hypothesised pathways.

## 7. Expected Findings And Discussion

Based on the theoretical propositions of UTAUT and the empirical evidence reviewed, Performance Expectancy and Effort Expectancy are expected to emerge as significant direct predictors of behavioural intention to use digital technologies, which would be consistent with their established dominance in prior UTAUT validations across public sector and higher education settings (Venkatesh et al., 2003; Kabakuş et al., 2023). Digital Literacy is expected to exert a significant indirect effect on behavioural intention through Effort Expectancy; such a result may indicate that digital competency operates partly by reducing perceived adoption effort, supporting its reconceptualisation as a capability-based antecedent (Nikou & Aavakare, 2021). Given the semi-discretionary nature of technology use within Malaysian public university administration, voluntariness of use is expected to moderate the Social Influence–behavioural intention relationship, and the influence of institutional and supervisory expectations may prove more pronounced among staff who perceive their digital engagement as institutionally compelled rather than self-determined (Blut et al., 2022).

Should these relationships be empirically supported, the findings would carry direct implications for university management and national policymakers. At the institutional level, evidence that Effort Expectancy mediates the digital literacy–behavioural intention relationship would suggest that training interventions targeting perceived ease of use, rather than digital literacy content alone, may yield disproportionate gains in adoption motivation. At the policy level, support for the moderating role of voluntariness of use would assist the Ministry of Higher Education, MAMPU, and the Economic

Planning Unit in calibrating digital upskilling strategies according to the degree of discretion afforded to staff across institutional contexts, thereby strengthening implementation of the Public Sector Digitalisation Strategic Plan 2021–2025 and the MyDIGITAL Blueprint. These anticipated patterns remain propositions to be tested, and the eventual empirical results may depart from them in ways that would themselves be theoretically informative, particularly regarding the boundary conditions of UTAUT in semi-mandatory settings.

## 8. Conclusion

This paper has presented a UTAUT-based conceptual framework and corresponding research methodology for examining the determinants of behavioural intention to use digital technologies among administrative staff in Malaysian public universities, a population that remains markedly underexamined in the technology acceptance literature despite its centrality to national digitalisation objectives. The study's anticipated contributions are threefold.

Theoretically, the framework repositions digital literacy within UTAUT's nomological network as a competency-based antecedent rather than an object of adoption, resolving the category error inherent in modelling intention "towards" a competency; it grounds the Digital Literacy–Effort Expectancy–Behavioural Intention pathway in Social Cognitive Theory and self-efficacy; it provides a justified respecification of Facilitating Conditions as a predictor of intention in pre-implementation contexts; and it activates voluntariness of use, the least examined of UTAUT's original moderators, within a semi-mandatory institutional setting.

Practically, the framework is expected to generate actionable evidence for institutional and national stakeholders: for university management, identification of the mediating role of Effort Expectancy would redirect training design towards ease-of-use perceptions rather than content coverage alone; for national policymakers, evidence on voluntariness would support the calibration of digital upskilling mandates under the MyDIGITAL agenda and the Public Sector Digitalisation Strategic Plan 2021–2025.

Methodologically, the study contributes a justified application of covariance-based SEM with multi-group invariance testing for four moderators, a psychometrically motivated pilot design, a 10-point interval measurement format aligned with maximum likelihood estimation assumptions, and a combined procedural–statistical protocol for common method bias.

The study's reliance on cross-sectional data constitutes its principal limitation, precluding examination of how these relationships evolve as staff gain digital experience and institutional digitalisation matures; future research may therefore benefit from longitudinal designs or the incorporation of habit and hedonic motivation constructs from UTAUT2 (Venkatesh et al., 2012). Subject to empirical validation through Structural Equation Modelling, the proposed framework is expected to provide a theoretically grounded and practically actionable basis for designing targeted digital literacy interventions within Malaysian public higher education and comparable institutional settings.

**Acknowledgements**

I would like to express my sincere gratitude to all those who contributed to the completion of this article. First and foremost, I am grateful to my supervisor for the valuable guidance, helpful feedback, and continuous encouragement provided throughout the study. I also appreciate my colleagues and peers for the meaningful discussions that strengthened this work. Finally, I sincerely thank and acknowledge my husband and my family for their understanding and support at every stage in completing this article. This article would not have reached completion without their contribution.

**References**

Aavakare, M., & Nikou, S. (2020). University staffs' everyday engagement with digital technology – Exploring the role of information literacy and digital literacy. In Proceedings of the 23rd Biennial Conference of the International Telecommunications Society (ITS), Online Conference, 21–23 June 2020. International Telecommunications Society.

Armansyah, R. F. (2021). Herd behavior in using mobile payment with Unified Theory of Acceptance and Use of Technology (UTAUT2). Jurnal Manajemen dan Kewirausahaan, 23(2), 111–128. https://doi.org/10.9744/jmk.23.2.111-128

Awang, Z. (2016). SEM made simple: A gentle approach to learning Structural Equation Modelling. MPWS Rich Resources.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall.

Bervell, B., Kumar, J. A., Arkorful, V., Agyapong, E. M., & Osman, S. (2021). Remodelling the role of facilitating conditions for Google Classroom acceptance: A revision of UTAUT2. Australasian Journal of Educational Technology, 38(1), 115–135. https://doi.org/10.14742/ajet.7178

Bhattacherjee, A. (2012). Social science research: Principles, methods, and practices (2nd ed.). University of South Florida.

Blut, M., Chong, A. Y. L., Tsigna, Z., & Venkatesh, V. (2022). Meta-analysis of the Unified Theory of Acceptance and Use of Technology (UTAUT): Challenging its validity and charting a research agenda in the red ocean. Journal of the Association for Information Systems, 23(1), 13–95. https://doi.org/10.17705/1jais.00719

Buchan, M. C., Bhawra, J., & Katapally, T. R. (2024). Navigating the digital world: Development of an evidence-based digital literacy program and assessment tool for youth. Smart Learning Environments, 11, Article 8. https://doi.org/10.1186/s40561-024-00293-x

Byrne, B. M. (2016). Structural equation modeling with AMOS: Basic concepts, applications, and programming (3rd ed.). Routledge.

Cabrera-Sánchez, J.-P., Villarejo-Ramos, Á. F., Liébana-Cabanillas, F., & Shaikh, A. A. (2021). Identifying relevant segments of AI applications adopters – Expanding the UTAUT2's variables. Telematics and Informatics, 58, 101529. https://doi.org/10.1016/j.tele.2020.101529

Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use (EUR 28558 EN). Publications Office of the European Union. https://doi.org/10.2760/38842

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). Sage.

Dawes, J. (2008). Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7-point and 10-point scales. International Journal of Market Research, 50(1), 61–104. https://doi.org/10.1177/147078530805000106

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a revised theoretical model. Information Systems Frontiers, 21(3), 719–734. https://doi.org/10.1007/s10796-017-9774-y

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis: A global perspective (7th ed.). Pearson Education.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2017). Multivariate data analysis (8th ed.). Cengage Learning.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hamakhan, Y. T. M. (2020). The effect of individual factors on user behaviour and the moderating role of trust: An empirical investigation of consumers' acceptance of electronic banking in the Kurdistan Region of Iraq. Financial Innovation, 6, Article 43. https://doi.org/10.1186/s40854-020-00206-0

Hashim, M. A. M., Tlemsani, I., & Matthews, R. (2021). Higher education strategy in digital transformation.
Education and Information Technologies, 27, 3171–3195. https://doi.org/10.1007/s10639-021-10739-1

HRMIS. (2025). Human Resource Management Information System staffing data. Public Service Department of Malaysia.

JPM. (2021). Malaysia Digital Economy Blueprint (MyDIGITAL). Economic Planning Unit, Prime Minister's Department, Malaysia.

Kabakuş, A. K., Bahçekapılı, E., & Ayaz, A. (2023). The effect of digital literacy on technology acceptance: An evaluation on administrative staff in higher education. Journal of Information Science, 51(4), 930–941. https://doi.org/10.1177/01655515231160028

Khan, N., Sarwar, A., Tan, B. C., & Khan, S. (2022). Connecting digital literacy in higher education to the 21st century workforce. Knowledge Management & E-Learning: An International Journal, 14(1), 46–61. https://doi.org/10.34105/j.kmel.2022.14.004

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. International Journal of e-Collaboration, 11(4), 1–10. https://doi.org/10.4018/ijec.2015100101

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30(3), 607–610. https://doi.org/10.1177/001316447003000308

Leung, S. O. (2011). A comparison of psychometric properties and normality in 4-, 5-, 6-, and 11-point Likert scales. Journal of Social Service Research, 37(4), 412–421. https://doi.org/10.1080/01488376.2011.580697

Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. Journal of Applied Psychology, 86(1), 114–121. https://doi.org/10.1037/0021-9010.86.1.114

MAMPU. (2020). Public Sector Digitalisation Strategic Plan 2021–2025. Malaysian Administrative Modernisation and Management Planning Unit.

Maruping, L. M., Bala, H., Venkatesh, V., & Brown, S. A. (2017). Going beyond intention: Integrating behavioral expectation into the Unified Theory of Acceptance and Use of Technology. Journal of the Association for Information Science and Technology, 68(3), 623–637. https://doi.org/10.1002/asi.23699

Ministry of Higher Education. (2025). Statistics on Malaysian public universities. Ministry of Higher Education Malaysia.

Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065–1078. https://doi.org/10.1016/j.compedu.2012.04.016

Nikou, S., & Aavakare, M. (2021). An assessment of the interplay between literacy and digital technology in higher education. Education and Information Technologies, 26(4), 3893–3915. https://doi.org/10.1007/s10639-021-10451-0

Nikou, S., De Reuver, M., & Mahboob Kanafi, M. (2022). Workplace literacy skills – How information and digital literacy affect adoption of digital technology. Journal of Documentation, 78(7), 371–391. https://doi.org/10.1108/JD-12-2021-0241

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Sekaran, U., & Bougie, R. (2010). Research methods for business: A skill building approach (5th ed.). John Wiley & Sons.

Soper, D. S. (2020). A-priori sample size calculator for Structural Equation Models [Software]. https://www.danielsoper.com/statcalc

Spante, M., Sofkova Hashemi, S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. Cogent Education, 5(1), 1519143. https://doi.org/10.1080/2331186X.2018.1519143

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2015). Internet skill levels increase, but gaps widen: A longitudinal cross-sectional analysis (2010–2013) among the Dutch population. Information, Communication & Society, 18(7), 782–797. https://doi.org/10.1080/1369118X.2014.994544

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research, 11(4), 342–365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the Unified Theory of Acceptance and Use of Technology. MIS Quarterly, 36(1), 157–178. https://doi.org/10.2307/41410412

Zaliha Mustafa. (2025). Human Resource Management Information System data on Malaysia's civil service. Public Service Department of Malaysia.