

Workforce Transformation: Factors Influencing Learner Continuation in a Workplace Data Literacy Programme at the National University of Singapore

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Abstract

As organisations adapt to rapid digital transformation, workforce upskilling has become increasingly important. While many studies examine participation in voluntary or mandatory training, far less is known about learner progression in hybrid structures that combine both, particularly within workplace professional development programmes. This study investigates factors influencing continuation beyond the mandatory foundational course within the National University of Singapore's (NUS) Data Literacy Programme (DLP), a modular, stackable pathway designed for executive and administrative staff. Using a mixed-methods design, the study analyses demographic data, course performance, progression patterns across intermediate and advanced courses, and semi-structured interviews. Quantitative findings show that educational background and foundational course performance are statistically significant predictors of progression, with learners holding STEM or postgraduate qualifications more likely to continue. However, strong performance in the foundational course also enables non-STEM learners to progress, highlighting the role of early mastery in building self-efficacy. While demographic variables such as gender and age showed statistically significant differences, they were not substantive determinants of continuation. Qualitative insights reveal that intrinsic motivation, perceived workplace relevance, and confidence in handling technical content are central drivers of sustained engagement, while barriers stem from low self-efficacy, uncertainty about course difficulty, and limited clarity about progression pathways. Overall, the findings suggest that learner continuation is shaped not only by demographic traits and but also by modifiable factors such as perceived competence and relevancy. The study offers recommendations for strengthening learner confidence and supporting progression in workplace upskilling pathways.

Keywords: data science, adult learning, lifelong learning, workforce transformation, motivation

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Introduction

In Singapore, workforce transformation and lifelong learning have become national priorities under initiatives such as the SkillsFuture movement, which promotes stackable, skills-based, and industry-aligned upskilling (Fung, 2020; SkillsFuture Singapore, n.d.). Considering this national agenda, it is important to understand what motivates adult learners to continue learning, especially beyond mandatory training. Given that roughly 70% of working adult learners have reported improvements in job performance following training (SkillsFuture Singapore, 2024), investigating the motivational, behavioural, and institutional factors that sustain learners' engagement beyond mandatory programmes becomes increasingly important.

According to the World Economic Forum's *Future of Jobs Report* (World Economic Forum [WEF], 2025), nearly 60% of employers expect major business transformation by 2030, driven primarily by digital transformation, artificial intelligence, and automation. These shifts are significantly reshaping the demand for skills in the workforce. Similarly, findings from the Society for Human Resource Management (SHRM, 2025) indicate that in 2025, 28% of organisations reported needing new skills for full-time roles, while 47% noted that existing roles were being redefined to incorporate new skill requirements. Together, these trends suggest that skills which are adequate today may not remain sufficient in the near future. Consequently, organisations must proactively anticipate emerging skill needs and invest in developing employees who are genuinely "future-ready" and "future-capable."

Building on this need for future-ready skills, Li (2024) highlights that lifelong learning should be embedded within organisational strategic priorities. Both employees and employers must commit to ongoing reskilling and upskilling, with career development treated as an essential element of ensuring workforce readiness for Industry 4.0. Li further emphasises that learning opportunities must be accessible, available, and affordable if organisations hope to build a workforce capable of adapting to rapid technological change (Li, 2024).

The importance of creating the right learning environment is also reinforced by Wijga et al. (2025), who found that a supportive learning climate is a foundational condition for effective workplace learning. Their study indicates that organisations prioritising continuous development and providing structured learning opportunities significantly enhance employee learning. In addition, they note that social support from peers and supervisors plays a critical role. Workplace friendships, team encouragement, and positive manager–employee interactions are all strongly associated with greater engagement in learning activities.

Building on Singapore's national agenda for continuous lifelong learning and digital capability development, together with the National University of Singapore's (NUS) vision to be a leading global university shaping the future, the NUS Data Literacy Programme (DLP) exemplifies how institutional initiatives can translate national priorities into targeted workforce upskilling. The DLP is a strategic initiative launched through the NUS Learning and Development Academy to address emerging skills gaps in data literacy across the executive and administrative (E&A) workforce, enabling staff to remain future-ready and relevant amid rapid technological change. In alignment with Singapore's broader effort to retrain mid-career workers through continuous and lifelong learning, NUS has additionally developed the Master of Science in Applied Data Science (MSc ADS). This programme is specifically designed to reskill and upskill E&A staff, equipping them with practical data science capabilities to solve real workplace challenges and strengthening internal talent pipelines for data-driven decision making (Tan et al., 2025).

The NUS Learning and Development Academy supports these efforts by providing the structure and academic rigour of a traditional institutional teaching unit while equipping the E&A workforce with essential and emerging 21st-century competencies such as data literacy, artificial intelligence, sustainability, and design agility. By leveraging forward-looking andragogical approaches such as workplace-integrated project-based learning, communities of practice, and skills recognition through micro-credentials, the Academy fosters a culture of lifelong learning and a dynamic learning ecosystem. These initiatives collectively empower staff to build skills mastery and future readiness, enabling them to contribute meaningfully to NUS's strategic priorities and long-term institutional vision.

This study investigates learner motivation and progression within a modular, stackable data literacy programme at NUS, contributing to broader understandings of adult learning in professional contexts. The NUS DLP is offered to all E&A staff within the university and has also been adapted for external organisations through customised versions tailored to their specific operational and learning needs.

The DLP structure comprises the foundational course (DLP Basic) followed by two elective tiers: DLP Intermediate (DLPI 2A through 2D) and DLP Advanced (DLPA 3A through 3D), covering areas such as data visualisation, predictive modelling, and optimisation (see Table 1). Learners have the flexibility to select and complete the intermediate courses in any sequence according to their interests and professional needs, enabling progressive skill development whilst minimising disruption to work responsibilities. They may enrol in any advanced-level course upon completing at least one intermediate course. The voluntary nature of progression beyond the foundational level offers a valuable context for examining how workplace learners decide whether, and how, to pursue further upskilling.

Table 1

The Data Literacy Programme (DLP) Progression From the Basic to Advanced Courses

Tier	Course Code	Course Title	Description
Basic	DLPB	Introduction to Data Science and Data-Driven Decision-Making	Mandatory course introducing essential data concepts, descriptive statistics, and workplace data interpretation.
Intermediate (DLPI)	2A	Data Visualisation with R	Creating and interpreting data visualisations for communication.
	2B	Applied Regression for Predictive Analytics using R	Building and interpreting regression models for practical insights.
	2C	Simulation Modelling in R	Applying discrete event simulation to analyse and optimise operational performance
	2D	Customer Analytics with R	Applying data-driven methods to understand customer behaviour.
Advanced (DLPA)	3A	Unsupervised Learning	Exploring clustering and dimensionality reduction techniques.
	3B	Supervised Learning	Applying classification and regression models using machine learning.
	3C	Survey Analytics	Analysing survey data for evidence-based decision-making.
	3D	Optimisation for Decision-Making	Employing optimisation techniques for resource allocation and decision-making.

Note. The DLPB course runs across 11 weeks, comprising seven 3-hour face-to-face workshops, while each DLPI and DLPA course runs across 10 weeks with five 3-hour face-to-face workshops.

While much of the existing literature on adult learning focuses either on self-enrolled learners in voluntary courses or on participants in fully mandatory training, limited attention has been given to hybrid models that blend mandatory and elective components. The NUS DLP represents such a hybrid structure, combining a required foundational course with optional higher-level courses. The courses are designed to equip learners with essential competencies for handling data effectively. Delivered through a blended-learning format, combining bite-sized e-learning videos, face-to-face workshops, and workplace projects, the course supports immediate application of skills in authentic work settings. This design provides a distinctive opportunity to examine learner motivation, barriers to continued participation, and institutional strategies that encourage ongoing engagement within an authentic workplace learning environment.

Prior research on the mandatory foundational (Basic) course showed that feedback from participants reflects strong perceived value; nearly 79% of those who completed the basic course perceived its positive utility, and among this group, approximately 60% reported applying the skills acquired in their workplace within two months of completion (Kurnianingsih et al., 2023). The present study expands on this work by further exploring progression and achievement through the voluntary tiers of the NUS DLP.

This study adopts a mixed-methods approach that triangulates demographic data, enrolment data, academic performance, and in-depth interviews to build a comprehensive understanding of the factors influencing learner progression and sustained participation. To date, no study has specifically examined adult learners' continuation within a stackable data literacy programme, in which progression from a mandatory foundational course to optional advanced courses occurs within the workplace. The NUS DLP, which blends structured institutional requirements with learner-driven choice, offers a unique opportunity to investigate how motivation, self-efficacy, and contextual support interact to sustain participation in ongoing digital upskilling.

Literature Review

Adult learners' decision to continue or discontinue participation in upskilling programmes can be understood through several established theories in educational psychology and andragogy. Bandura's (1977) concept of self-efficacy is foundational; individuals' beliefs in their ability to succeed strongly influence their persistence and performance. Learners who doubt their technical abilities (e.g. coding and data analysis competencies) are more likely to experience low self-efficacy, increasing the risk of disengagement. Complementing this, Knowles' (1984) principles of andragogy emphasise that adult learners are motivated when learning is immediately relevant and applicable to their personal and professional lives. When the connection between course content and workplace tasks is unclear, motivation can diminish even among otherwise capable learners.

Building on these perspectives, Self-Determination Theory (SDT) (Deci & Ryan, 1985) offers further insight into why some adult learners persist in upskilling programmes. SDT posits that sustained engagement depends on the satisfaction of three basic psychological needs: competence, autonomy, and relatedness. When learners feel capable of mastering course content, perceive a sense of control over their learning, and experience meaningful support from peers or supervisors, their motivation becomes more self-determined. This internalisation process strengthens persistence, enabling learners to continue despite challenges.

Goal orientation theory similarly highlights the importance of learners' underlying goals. Those who adopt mastery-oriented goals (i.e., seeking to deepen understanding and develop skills) tend to display greater persistence than learners motivated primarily by performance goals such as outperforming others (Dweck & Leggett, 1988; Eccles & Wigfield, 2002). For working adults, intrinsic and extrinsic motivations frequently coexist (Rothes et al., 2014). Intrinsic motivation may arise from genuine interest or enjoyment in skill development, while extrinsic motivation may stem from managerial encouragement, organisational recognition, career advancement opportunities, or other external benefits. Crucially, extrinsic motivators can still enhance persistence when they are experienced as autonomy-supportive rather than controlling (Deci et al., 1999; Pelletier et al., 2001).

Learners' perceived competence also plays a central role in sustaining engagement. When learners experience measurable progress or receive positive feedback, their perceived competence increases, reinforcing their motivation and confidence to progress to higher-level courses. Conversely, negative experiences or weak prior performance may diminish perceived competence and increase the likelihood of discontinuation (Deci & Ryan, 2000; Gorges & Kandler, 2012). Research on younger student populations shows that prior academic success predicts stronger expectations of future success and greater persistence (Robbins et al., 2004). However, studies in adult learning settings reveal more nuanced patterns. For example, Greenberg et al. (2013) found that persistence in adult education was influenced by factors such as English as a second language (ESL) status, age, reading-related skills, and previous adult education experience, suggesting that demographic and contextual factors interact with motivational constructs to shape learning trajectories.

Beyond individual psychological factors, broader learning environments also influence adult learner engagement. Through an extensive analysis of the literature, Zamiri and Esmaeili (2024) identified eleven strategies and supports—including collaborative projects, mentorship programmes, workshops, online platforms, peer learning, problem-based approaches, cross-collaboration initiatives, leadership development, inclusive learning environments, gamified activities, and social networking—that play pivotal roles in cultivating diverse skills. Their findings emphasise the value of collaborative, interactive learning communities in fostering shared knowledge, personal growth, and sustained engagement. These communities not only enhance learners' educational experiences but also strengthen collective learning within the broader organisational or social context.

Methodology

Research Design

This study adopts a mixed-methods design that integrates quantitative and qualitative analyses to examine learner continuation beyond the DLP mandatory foundational course at the NUS.

The approach is structured around three key analytical objectives:

1. Identifying demographic and performance-related patterns in learner progression,
2. Examining motivational and contextual factors influencing continuation decisions, and,
3. Understanding learners' perceptions of programme usefulness and relevance.

Data Sources

Data were drawn from multiple components of the DLP ecosystem to ensure comprehensive coverage and triangulation across the mandatory DLP Basic (DLPB), and the optional Intermediate (DLPI) and Advanced (DLPA) courses.

The data sources include:

1. Course performance data: DLPB, DLPI and DLPA records, capturing learner achievement across five academic performance bands (Bands 1–5),
2. Enrolment data: Tracking learner progression from DLPB to DLPI and DLPA courses, allowing classification into continuers and non-continuers,
3. Demographic information: Age, gender, marital status, education level, and job category, and,
4. Learner interviews: Semi-structured interviews with a subset of learners to explore deeper motivational drivers, perceived challenges, and recommendations for programme enhancement.

Quantitative Analysis

Quantitative analysis was conducted to identify patterns and associations between learner characteristics and continuation decisions.

1. Demographic comparisons were conducted between continuers and non-continuers using chi-square tests for categorical variables (e.g., gender, education level) and t-tests for continuous variables (e.g., age, course scores),
2. Performance analysis examined whether achievement in DLPB (performance bands) predicted progression into DLPI and DLPA, and,
3. Pathway analysis was performed to compare learners, revealing potential differences in continuation likelihood and performance outcomes.

Qualitative Analysis

Qualitative data from learner interviews were analysed using thematic analysis. Emergent themes progressed to iterative coding and review. Recurring patterns emerged for the following four dominant themes:

1. Motivational factors: including intrinsic interest in topic area, managerial support in influencing continuation, and external incentives,
2. Perceived usefulness: potential for direct application of learnt skills into workplace contexts,
3. Impact of incentives: perceptions of recognition or rewards on workplace and career, and,
4. Programme critique: course structure, content delivery, and learner support mechanisms.

Triangulation and Synthesis

Findings from the quantitative and qualitative domains were synthesised to produce a comprehensive overview of the factors deemed to be influencing learner continuation. Quantitative results provided evidence of demographic and performance-related trends, while qualitative insights illuminated motivational, contextual, and relational dimensions underlying these patterns. Together, the synthesis informed insights and recommendations aimed at

designing learner personas, improving course design, and enhancing support mechanisms to foster a more sustained and meaningful data literacy learning journey.

Ethical Considerations

All procedures involving human participants were reviewed and approved by the NUS Institutional Review Board (NUS-IRB Reference Code: NUS-IRB-2025-572). Course performance and feedback data were collected as part of regular teaching activities and used in anonymised form for research purposes. Informed consent was obtained from participants who took part in interviews, and all data were anonymised prior to analysis.

Results

Learner Continuation Patterns

Across 4,354 participants who completed the DLPB course, 6.8% progressed into any non-mandatory DLPI course. Of those, 16.8% continued further into at least one DLPA course. This reflects a natural self-selection mechanism, where learners who perceive strong alignment with course content or relevance to their work are more likely to continue. The progression data also suggest that the first non-mandatory course may act as a *threshold course*, helping learners determine the perceived value and personal fit of further upskilling opportunities.

Demographic Factors

Although certain demographic variables (such as gender, age, and years of service) were found to significantly predict progression (see Table 2, $p < .05$), these factors represent relatively stable characteristics that are unlikely to change. Therefore, our emphasis should be placed on psychological and motivational factors, which may be more amenable to intervention and play a more dynamic role in determining learners' continuation, rather than on fixed demographic constraints.

Influence of Educational Background

Statistical comparisons revealed that educational qualification and disciplinary background were significant predictors of continuation beyond the DLPB level ($p < .05$). Examining the demographics of those continuing learners indicated that the proportion of learners holding a Master's degree or PhD was 56.7% higher, and the proportion from STEM fields was 39.1% higher, compared to the DLPB only cohort. This suggests that learners with higher qualifications and prior exposure to quantitative disciplines were more confident in navigating the technical demands of subsequent courses.

Table 2
Demographic and Educational Characteristics Associated With Course Continuation

	Course Continuation		p-value
	Basic Only N (%)	Continued N (%)	
N (%)	4056 (93.2)	298 (6.8)	
Gender (%)			< 0.001
F	2691 (66.3)	168 (56.4)	
M	1365 (33.7)	130 (43.6)	
Age			< 0.001
Mean (SD)	40.55 (9.3)	38.01 (8.9)	
Marital Status			0.075
Single	1409 (34.7)	125 (41.9)	
Married	2529 (62.4)	169 (56.7)	
Separated	6 (0.1)	0 (0.0)	
Divorced	93 (2.3)	4 (1.3)	
Widowed	19 (0.5)	0 (0.0)	
Highest Educational Level (%)			< 0.001
Doctorate/PhD	137 (3.4)	20 (6.7)	
Master's	810 (20.0)	89 (29.9)	
Bachelor's	1547 (38.1)	109 (36.6)	
Diploma	373 (9.2)	8 (2.7)	
Others	1189 (29.3)	72 (24.2)	
STEM (%)			< 0.001
Non-STEM	2598 (64.1)	149 (50.0)	
STEM	1458 (35.9)	149 (50.0)	
Years of Service			0.003
Mean (SD)	6.98 (7.66)	5.65 (6.28)	
Job Category			0.806
Admin	1505 (37.1)	107 (35.9)	
Executive	1720 (42.4)	128 (43.0)	
Lab	241 (5.9)	15 (5.0)	
Others	590 (14.5)	48 (16.1)	

Note. “Basic Only” refers to learners who completed only the foundational DLPB course(s). “Continued” refers to learners who progressed to at least one non-mandatory course (DLPI and/or DLPA). p-values represent the significance of group differences, calculated using the χ^2 test for categorical variables and the t-test for continuous variables. STEM = Science, Technology, Engineering, and Mathematics disciplines. Percentages are calculated within *each outcome group* (i.e., “Basic Only” and “Continued”) and may not sum to one hundred due to rounding.

Influence of Past DLPB Performance

Course performance played an important role in predicting learners’ continuation (see Table 3). Learners who achieved higher performance bands in DLPB were significantly more likely

to continue, even among those without a STEM background. This finding suggests that perceived competence and self-efficacy developed during the foundational course can offset the lack of disciplinary familiarity. Conversely, learners with lower scores often cited technical difficulty and lack of immediate workplace relevance as reasons for discontinuing.

Table 3*DLP Basic Course Performance Associated With Course Continuation*

	Mark Definition (max.100)	Course Continuation		p-value
		Basic Only N (%)	Continued N (%)	
All		4056 (93.2)	298 (6.8)	< 0.001
Band 1	85-100	339 (8.4)	56 (18.8)	
Band 2	75-85	1754 (43.2)	142 (47.7)	
Band 3	65-75	1363 (33.6)	79 (26.5)	
Band 4	55-65	572 (11.6)	15 (5.0)	
Band 5	< 55	128 (3.2)	6 (2.0)	
STEM		1458 (35.9)	149 (50.0)	< 0.001
Band 1	85-100	142 (9.7)	29 (19.5)	
Band 2	75-85	662 (45.4)	75 (50.3)	
Band 3	65-75	473 (32.4)	36 (24.2)	
Band 4	55-65	148 (10.2)	7 (4.7)	
Band 5	< 55	33 (2.3)	2 (1.3)	
Non-STEM		2598 (64.1)	149 (50.0)	< 0.001
Band 1	85-100	197 (8.4)	27 (18.1)	
Band 2	75-85	1092 (43.2)	67 (45.0)	
Band 3	65-75	890 (33.6)	43 (28.8)	
Band 4	55-65	324 (11.6)	8 (5.4)	
Band 5	< 55	95	4 (2.7)	

Note. "Basic Only" refers to learners who completed only the DLPB course. "Continued" refers to learners who progressed to at least one non-mandatory course. p-value represents the significance of group differences, calculated using the χ^2 test.

Pathway and Sequencing Patterns

Among those who continued into intermediate courses, the most common entry pathway was through DLPI 2A: Data Visualisation with R, which served as an accessible and broadly relevant introduction to data visualisation techniques. Learners described it as "practical," "immediately useful," and "less intimidating." In contrast, those who chose technically demanding courses first (e.g., DLPI 2B Applied Regression for Predictive Analytics using R or DLPI 2D Customer Analytics with R) were more likely to be learners with STEM backgrounds or better foundational course performance. Course sequencing thus appeared influenced by both educational background and foundational course performance ($p < .05$), indicating a relationship between prior achievement, perceived readiness, and elective choice.

Motivations and Barriers

Interview findings revealed that intrinsic motivators, particularly *personal interest* and *perceived workplace relevance*, were the dominant factors influencing continuation from DLPB to DLPI. Learners often framed their decision to progress as part of a broader professional growth narrative rather than an institutional expectation. Extrinsic motivators, such as *recognition* or *encouragement from reporting officers*, played a secondary but reinforcing role when they aligned with learners' intrinsic goals.

Barriers to continuation were primarily self-efficacy-related—for example, *anxiety about programming*, *time constraints*, and *uncertainty about the difficulty of higher-level courses*. Several participants indicated that despite strong interest, they were hesitant to commit due to perceived technical challenges (“I’m not sure I can handle the coding part”) or a lack of clarity about next steps (“I didn’t know what came after [DLPI] 2A”).

These findings suggest that continuation is shaped less by fixed demographic traits and more by mouldable factors such as perceived competence, motivation, and relevance; factors that can be influenced through programme design and learner support strategies.

Discussion

Taken together, the quantitative and qualitative findings indicate that educational background and foundational course performance influence whether learners take the next step into non-mandatory courses, while self-efficacy, and perceived value of learning determine whether they sustain participation beyond the initial stages. Learners' progression beyond the foundational course is best understood as a dynamic interplay between prior preparation, motivational orientation, and the availability of institutional support.

Consistency With Prior Studies

The observation that higher educational qualifications and STEM backgrounds predict continued participation aligns with prior literature on academic preparedness and adult learning. Learners with STEM training or advanced degrees may possess well-developed metacognitive and problem-solving strategies that support confidence and persistence, which are skills shown to enhance performance across learning contexts (Ishak et al., 2025). Such familiarity likely translates into stronger learning competencies (Downing et al., 2009; for review see Dawson, 2008), allowing these learners to navigate analytically demanding materials and progress more readily beyond the foundational level.

However, our results also demonstrate that strong performance in the foundational course (DLPB) promotes continuation even among non-STEM learners, underscoring both *self-efficacy* and *perceived competence* as critical mediators. Consistent with Bandura's (1977) assertion that mastery experiences (such as early success in DLPB) are the most powerful source of self-efficacy, such success provides non-STEM learners with confidence to attempt more technical intermediate courses. Moreover, as suggested by Deci and Ryan (2000), positive achievement enhances learners' perceived competence, reinforcing motivation and engagement. Thus, good past performance supports both the belief in one's ability (self-efficacy) and the felt sense of effectiveness (perceived competence), which together strengthen persistence in continued learning.

We found statistically significant differences across gender and age in our dataset; however, the broader pattern aligns with prior research showing that demographic variables exert limited practical influence on continuation decisions. Greenberg et al. (2013) reported that factors such as *age*, *language status*, and *reading-related skills* affected persistence in adult literacy programmes, but these effects appear more pronounced in foundational learning contexts where basic competencies vary widely. In contrast, studies by Park and Choi (2009) and Pickett (2018) demonstrated that, in professional or workplace settings, demographic characteristics are weak predictors of persistence, with perceived relevance and organisational support emerging as stronger determinants. Likewise, Imlach et al. (2017) found that age did not hinder academic success in older learners, suggesting that ongoing cognitive engagement and motivation may be more critical than demographic characteristics. Within the context of workplace-based data literacy, our results indicate that while demographic differences may appear statistically detectable, they are not the primary drivers of progression. More importantly, demographic traits are inherently stable and cannot be modified through programme design. Thus, our focus is placed on factors that are both meaningful and modifiable—such as *educational background* (for example, through further study), *prior achievement*, *self-efficacy*, and *perceived value*—which offer actionable avenues for strengthening learner support. Importantly, this study extends earlier work by examining not only persistence within a single course but continuation across multiple, stackable modules situated within a workplace learning ecosystem.

Educational Background as a Foundation for Continued Learning

The relationship between educational attainment and persistence also underscores how prior education may equip individuals with transferable learning strategies. Higher levels of educational attainment and degree-level exposure to STEM studies appear to cultivate analytical reasoning, problem-solving, and self-regulated learning facilitating adaptation to new data-driven contexts. In this way, we see the positive relationship between these factors and success within the overall DLP. Cognitive load theory and transfer-of-learning research support this interpretation, suggesting that well-developed prior schemas enable learners to assimilate new concepts more efficiently (Tynjälä, 2008).

At the same time, our results demonstrate that the DLP's structured progression, particularly the DLPB course, may serve as a learning equaliser. By providing scaffolded opportunities for early success, the programme can boost confidence even for those without prior disciplinary advantage. This reinforces Knowles' (1980) andragogical principle that adult learners thrive when instruction leverages existing experience while ensuring achievable mastery at each stage. We do note that there may be a self-selecting, or filtering occurring through the advanced stages of the programme as noted by the relatively smaller uptake at the advanced levels. However, it should be noted that the most advanced topics were launched some years after the programme initiated and so do experience a natural lag in uptake.

We believe that through building intellectual and academic confidence (particularly in those from a non-STEM background), the likelihood of further engagement in formal and informal workplace learning and development opportunities is enhanced. We note that this study did not directly address this concept, however the broader context of the findings and discussions appear to support this notion. Within the context of NUS, further research can investigate whether increased learner engagement transfers to the wider portfolio of voluntary training opportunities offered to staff.

Recommendations

Several observations have been made regarding learners' progression patterns, and it is noted that progression through the pathway of the DLP is influenced by several key factors. Educational qualifications and disciplinary background play a significant role in progressing from the DLPB level to the DLPI and DLPA levels, with learners from STEM or data-related fields more likely to progress, while non-STEM learners may hesitate due to perceived difficulty and competence. However, non-STEM learners with higher performance bands were significantly more likely to continue because the foundational course helped build data literacy skills that offset their lack of disciplinary familiarity. Conversely, lack of immediate workplace relevance, perceived technical challenges, and low confidence may also hinder continuation. It is therefore critical to address these factors and reduce deterrents that may impede progression into higher levels of the programme.

To support progression, it is recommended to address misconceptions and uncertainties about course demands and progression pathways, and to leverage early learner success. Through periodic clinics and information roadshows, learners could clarify expectations, intended learning outcomes, and guidance on which course would align best with their immediate job scope or workplace project. These sessions would also allow learners to hear from peers and testimonials about workplace application and their learning journey, which can sustain motivation and engagement. Ultimately, this approach may foster increased interest and reduce motivational barriers, enabling more learners to continue with confidence.

Building on the importance of workplace relevance and practical application, another strategy involves organising structured staff hackathons as a practical means of reinforcing immediate workplace applications and supporting continued progression into modules requiring higher-order analysis and solutioning, such as those in the intermediate and advanced tiers. Hackathons provide an effective environment for acquiring technical knowledge (Miličević et al., 2024) and foster collaborative learning through peer interaction. This approach not only strengthens technical competencies but also encourages innovation and teamwork, creating a dynamic platform for applying and developing new skills in real-world workplace contexts.

A final recommendation concerns the role of the instructor in supporting learner confidence and progression. Given that self-efficacy and perceived relevance emerged as central determinants of continuation (particularly for non-STEM learners), effective instructional practice becomes a key leverage point. Instructors who provide clear explanations, structured walkthroughs, and intentional scaffolding can help reduce perceived technical barriers and strengthen early mastery experiences that build self-efficacy. Additionally, creating an inclusive and psychologically safe learning environment can encourage participation and reduce anxiety around technical content. Strengthening instructional consistency across courses and equipping instructors with strategies that promote clarity, relevance, and confidence-building may therefore enhance learners' readiness and willingness to progress through the DLP pathway.

Conclusion

This study demonstrates that continuation within a workplace data literacy pathway is shaped not only by learners' demographic and educational backgrounds but, more importantly, by foundational course performance, perceived competence, and the relevance of learning to their work. While learners with STEM or advanced qualifications are more likely to progress, strong

performance in the foundational course enables non-STEM learners to build self-efficacy and overcome initial disciplinary gaps. These findings highlight that sustained engagement is less about fixed traits and more about modifiable factors that can be influenced through programme design. Providing clear guidance, strengthening early mastery experiences, and ensuring supportive learning environments can meaningfully encourage progression into higher-level modules. By attending to these areas, organisations can better support adult learners in navigating upskilling pathways and cultivate a workforce that is genuinely prepared for ongoing digital transformation.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, a generative AI language model, was used to assist in proofreading, enhancing clarity, and refining the language of this manuscript. The tool was not used to generate research ideas, conceptual frameworks, analyses, findings, or substantive content, nor to interpret data or draw conclusions. All ideas, study design, procedures, analyses, and arguments presented in the manuscript originate from the author and were developed through systematic and rigorous research. The use of ChatGPT was limited strictly to improving readability, coherence, and grammatical accuracy, comparable to an advanced language-editing tool. No text was generated or included verbatim without the authors' review, modification, and verification.

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