

Innovating the Educational Landscape by Assessing the Challenges and Needs of Micro-Credential Developers

*Fauziah Saadah Abdul Halim

Universiti Teknologi MARA

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ABSTRACT

As the rapid pace of the 4th IR continues to reshape the global economy, micro-credentials have emerged as vital tools for closing the skills gap between academic curricula and industry demands. This study aims to address the critical empirical void in the Malaysian landscape by conducting a comprehensive needs assessment of micro-credential developers. The problem is characterised by the relatively slow adoption of micro-credentials in Malaysian Higher Education Institutions (HEIs) due to the movement's novelty and a lack of evidence-based strategies to streamline market-ready modules. Employing a mixed-method research approach grounded in Design and Development Research (DDR), the study utilised a 57-item likert scale questionnaire administered to 170 developers across 6 public Malaysian HEIs. Data analysis integrated descriptive statistics via SPSS and thematic analysis of qualitative insights. Results indicate that while developers possess a strong conceptual grasp of pedagogical needs; prioritising 'bite-sized' content and industry alignment; they faced significant barriers. Primary challenges involve unacknowledged workloads, a lack of monetary incentives, and technical difficulties relating to the security and portability of platforms. The study concludes that sustainable implementation requires a structural shift in HEIs.

Keywords: higher education, micro-credentials (3 – 5 keywords)

INTRODUCTION

The Fourth Industrial Revolution is moving fast, changing how we learn and work. Because technology evolves so quickly, there is a growing 'skills gap' between what students learn in college and the practical skills they actually need for a job (Hunt et al., 2020; Lockley, Derryberry & West, 2016). In fact, major companies like Google and Ernst & Young have noticed that a traditional degree doesn't always predict how well someone will perform at work (Ehlers, 2018). As a result, many employers are shifting their focus away from diplomas and toward skills-based hiring (Varadarajan et al., 2023; Perkins & Pryor, 2021), where what you can actually do matters more than where you went to school.

To stay relevant in this new landscape, workers must embrace upskilling; a concept where workers are constantly learning new things to keep up with industry shifts (Leopold, Battista, Jativa, Sharma, Li & Grayling, 2025; Moraes et al., 2023; Yanek, 2020; Elliott, Clayton & Iwata, 2014,). Since traditional university programs can be slow to update, more flexible options like micro-credentials and microlearning are becoming essential (Ahsan, Akbar, Kam & Abdulrahman, 2023; Gibson, Coleman & Irving, 2016; MQA, 2020; Oliver, 2019). These methods break down complex subjects into small, manageable bites of information. This allows professionals to fill specific knowledge gaps quickly and gain verifiable proof of their expertise (Wheelahan & Moodie, 2021; Hanafy, 2020; Hunt et al., 2020; Hanafy, 2020; Lewis & Lodge, 2016).

As technology moves faster than ever, the rapid pace of technological change is reshaping the modern economy, making micro-credentials a vital tool for connecting traditional education with the needs of the workforce (Willis, Flintoff & McGraw, 2016; Anderson & Staub, 2015). Today, employers are looking for specific, targeted skills; ranging from technical abilities to soft skills; that are often hard to find on a broad university transcript. Often called 'digital badges' or 'nanodegrees', micro-credentials fill this gap by breaking higher education down into smaller, market-ready pieces (Grant, 2014; MQA, 2020). This allows learners to gain essential skills quickly and affordably without the high cost or time commitment of a full degree (MQA,

2020; Hassan & Ayub, 2018; Fong, Janzow & Peck; 2016). These credentials offer a flexible, just-in-time (JIT) approach to professional development. Instead of spending years in a classroom, workers can master specific areas that align with their immediate career goals. Because micro-credentials are competency-based, learners earn them by proving what they can do through assessments rather than just logging hours in a seat (Berry, Airhart & Byrd, 2016; Duncan, 2011). This provides employers with clear, verified evidence of a candidate's actual capabilities (Clements, West & Hunsaker, 2020; Gibson et al., 2015; Davies, Randall & West, 2015).

Furthermore, the structure of micro-credentials supports personalised learning (MQA, 2020; Hunt, Carter, Zhang & Yang, 2020; Rossiter & Tynan, 2019; Milligan & Kennedy, 2017; Crow & Pipkin, 2017; Hickey & Willis, 2017). Workers can stack these small certificates to build toward a larger qualification or use them individually to show they have up-to-date skills (Ahsan et al., 2023; Kumar, et al., 2021; MQA, 2020; Ralston, 2020; Oliver, 2019). This adaptability makes micro-credentials a critical resource for continuous upskilling, ensuring that the workforce stays agile and prepared for the challenges of automation and the new industrial era (Brown et al., 2021; MQA, 2020; Hunt et al., 2020; Oliver, 2019).

Problem Statement

Although Malaysian Higher Education Institutions (HEIs) are using more technology for online learning, the official use of micro-credentials has been slow to gain momentum (Ahmat et al., 2021; Kumar et al., 2022). The delay is largely attributed to the fact that the micro-credentials movement is relatively new in Malaysia, with official accreditation strategies by the Malaysian Qualification Agency (MQA) only formally implemented in 2019 (Kumar et al., 2022). Consequently, the landscape remains in an early stage of development, characterised by limited applications for regional education and training (Orman, Şimşek, and Çakır, 2022; Brown et al., 2021; Selvaratnam & Sankey, 2021; Oliver, 2019; Ghasia, Machumu & DeSmet, 2019; Fong, Janzow, & Peck, 2016).

This systemic infancy has resulted in a critical empirical void. Kumar et al., (2022) state that the novelty of these movements has led to the "limited studies on its implementation", leaving a documented need to investigate how these credentials are accepted and understood when introduced locally (Lim et al., 2018). Furthermore, Ahmet et al. (2021) emphasised that not much empirical research is found' regarding Malaysian micro-credentials experiences, rendering employer acceptance 'unknown'. This lack of local data is compounded by a global absence of literature regarding digital badge adoption rates among human resource professionals and hiring managers (Raish & Rimland, 2016). Without concrete data on adoption rates or the specific obstacles faced by content developers, HEIs lack the necessary evidence-based strategies to streamline the development of high-quality, market-ready modules. This information gap creates a significant barrier to achieving the national development goals outlined in the Malaysia Education Blueprint, as it hinders the effective preparation of a workforce ready for the demands of the 4th Industrial Revolution.

Objective of the Study

The primary objective of this study is to address the empirical void in the Malaysian micro-credential landscape by conducting a comprehensive needs assessment of content developers within HEIs. Specifically, the study aims to investigate the current practices, perceptions, and systemic challenges these developers encounter when designing and implementing microlearning for formal credentialing. To achieve the aforementioned objective, this study seeks to answer the following research questions:

- What are the primary pedagogical, technological, and institutional challenges encountered by content developers in Malaysian HEIs during the design and implementation of micro-credentials?
- What specific design elements and support structures do developers identify as essential for the development and implementation of effective, high-quality micro-credentials that meet both institutional standards and market demands?

This study is part of a boarder multi-phase research but focuses only on Phase 1.1 which is a quantitative needs assessment survey of micro-credential developers in public HEIs. Subsequent phases; specifically the

qualitative stakeholders interviews (Phase 1.2), the systematic literature review (Phase 1.3), the Delphi expert validation (Phase 1), and the practitioner framework evaluation (Phase 3), are part of the overarching research architecture but fall outside of the empirical scope of this study.

LITERATURE REVIEW

Micro-credentials and microlearning have emerged as important developments in higher education, driven by the demands of the Fourth Industrial Revolution and the growing needs for flexible, lifelong learning (World Economic Forum, 2025; Moraes et al., 2022; Kiiskilä et al., 2023; Rossiter & Tynan, 2019; Oliver, 2019; Karachalios & Papadakis, 2023; Brown et al., 2021). Initially introduced as digital badges that recognised participation, micro-credentials have evolved into verifiable certifications that equip learners with specific, industry-relevant knowledge and skills (Malaysian Qualifications Agency, 2019; Malaysian Qualifications Agency, 2020). Despite this progress, the micro-credentials landscape remains fragmented. Previous studies report limited standardisation, inconsistent terminology, and ongoing challenges related to stackability, making it difficult to ensure quality, recognition, and transferability across institutions and industries (Bideau & Kearns, 2022; Rossiter & Tynan, 2019; Lim et al., 2018; Halls-Ellis, 2016; Tierney & Westcott, 2021). To support the effective delivery of micro-credentials, HEIs increasingly adopt microlearning, which breaks complex content into short, focused learning units that promote quick understanding and immediate application (Kohler et al., 2021). Its adaptability to just-in-time and on-demand learning makes microlearning particularly suitable for aligning academic programmes with rapidly changing workforce needs.

The pedagogical foundation of micro-credentials and microlearning is closely linked to andragogy, which views adult learners as self-directed individuals who build on prior experiences and are motivated by learning that is relevant to real-life problems (Alam, 2021; Loeng, 2020; Caruth, 2013; Knowles, 1984; 1993). These principles are particularly relevant to Generation Y learners, who prefer technology-supported, interactive and personalised learning experiences (Erickson, 2008; Conde-Caballero et al., 2023). Extending these ideas, heutagogy places greater responsibility on learners by allowing them to determine their own learning goals, content, and assessment methods, thereby promoting greater autonomy and lifelong learning capabilities (Vinayan & Harikirishanan, 2021; Kenyon & Hase, 2010; Barnett, 2011; Parslow, 2010).

Together, andragogy and heutagogy provide the theoretical foundation for Self-Directed Learning (SDL) and Self-Regulated Learning (SRL) within micro-credentialing (Blaschke, 2012; Aberdour, 2016; Buchem, 2016; Cucchiara et al., 2015). These approaches encourage learners to take ownership of their learning by planning, monitoring, and evaluating their own progress while developing competencies that are relevant to their personal and professional goals (Flynn et al., 2023; Bhaskar et al., 2021). This learner-centred approach is further supported by Personal Learning Environments (PLEs), which provide flexible access to learning resources, and digital badges, which offer immediate recognition of achievement and strengthen learner motivation (Dabbagh & Castañeda, 2020; Attwell, 2019; Gibson et al., 2016; Corbeil et al., 2021; Wills & Xie, 2016; Blaschke & Hase, 2019; Hadwin et al., 2016). Collectively, these elements create a flexible learning ecosystem that supports continuous upskilling and lifelong learning.

To ensure that microlearning content is instructionally effective, researchers commonly draw on Cognitive Load Theory (CTL) and the Cognitive Theory of Multimedia Learning (CTML) (Clark & Mayer, 2016). CLT argues that instructional materials should be designed to match the limited capacity of human working memory by reducing unnecessary cognitive demands (extraneous load) while promoting meaningful learning (germane load) (Sweller et al., 1998; Anmarkrud et al., 2019; Skulmowski & Xu, 2022). In practice, this means presenting information in short, manageable segments supported by relevant multimedia, enabling learners to process, retain, and apply new knowledge more effectively (Alias & Razak, 2023; De Jong, 2010; Emory, 2019; Clark & Mayer, 2016). These instructional principles are further reinforced by Vygotsky's Zone of Proximal Development (ZPD), which proposed that learners achieve better outcomes when appropriate support is provided during the learning process. Through scaffolding, this support is gradually reduced as learners become more competent and independent (Vygotsky, 1978; Paas et al., 2016; Emory, 2019; Wills & Xie, 2016). Together, these theories guide the design of microlearning activities that progressively move learners from novice understanding to mastery within a micro-credentialing ecosystem (Skalka & Drlik, 2018;

Wills & Xie, 2016)

Beyond instructional design, the wider implementation of microlearning and micro0credentials is supported by Connectivism and Competency-Based Learning (CBL). Connectivism recognises that learning in the digital age occurs through networks, where learners access, evaluate, and connect information from multiple sources while using technology to share knowledge across communities (Siemens, 2004; Bates, 2015). This perspective aligns with the Community of Inquiry (CoI) framework, which emphasises the interaction of cognitive, social and teaching presence in creating meaningful online learning experiences. At the same time, CBL ensures that learning outcomes remain closely aligned with workplace expectations by requiring learners to demonstrate mastery of specific competencies before progressing to the next stage (Oliver, 2019; Rothwell & Garber, 2010).

METHODOLOGY

Research Design

This study is situated within a broader multi-phased sequential Mixed Method Research (MMR) approach grounded in Design and Development Research (DDR) Type 2 methodology. This specific study focuses exclusively on Phase 1.1 utilising a quantitative 57-item, 5-point Likert-scale questionnaire administered to micro-credential content developers (N=170). This survey instrument was theoretically grounded in established frameworks, adapting dimensions from Khan's eLearning framework (2010) and works by Corbeil et al (2021) and Ashcroft et al. (2021) to comprehensively measure elements such as pedagogy, technology, management, resource support and institutional factors (Halim et al., 2025).

To provide conceptual concept for the overall research architecture, the overarching study is structured across three phases:

- Phase 1 (Needs Assessment & Framework Conceptualisation), comprises Phase 1.1 (the micro-credential content developer survey reported in this paper), Phase 1.2 (qualitative multi-stakeholder interviews), and Phase 1.3 (a systematic literature review).
- Phase 2 (Framework Validation) utilises a two-round Delphi technique with subject matter expert to achieve consensus on the proposed framework and its accompanying blueprint.
- Phase 3 (Framework Evaluation) evaluates the practical utility of the validated framework and its accompanying blueprint through structured practitioner interviews.

Throughout the overarching research, the ADDIE instructional design framework guides instrument construction and model synthesis. However, the empirical findings presented in the subsequent sections of this study pertain solely to the quantitative micro-credential developer survey (Phase 1.1)

Participants

The participants for this quantitative survey were selected using a homogeneous sampling method to ensure a focused examination of individuals with direct, practical experience in the subject matter. The final sample consisted of 170 content developers (N=170) drawn from six Malaysian public HEIs; University Malaya (UM), University Islam Antarabangsa Malaysia (UIAM), Universiti Teknologi MARA (UiTM), Universiti Malaysia Pahang (UMP), Universiti Utara Malaysia (UUM) and Universiti Malaysia Terengganu (UMT). The specific inclusion criteria required that these developers had successfully designed and completed their micro-credential modules, and currently accessible on their respective university platforms. The respondents represented a diverse spectrum of academic ranks and institutional responsibilities, with the vast majority being senior lecturers and lecturers alongside associate professors and professors actively engaged in digital course transformation.

Procedure

The data collection procedure began with a rigorous process of securing administrative and ethical approvals to ensure compliance with regulatory standards. Initially, an ethical approval letter was obtained from the

university's research ethics committee, followed by a formal support letter from the Ministry of Higher Education (KPT in May 2023). The researcher the applied for and received specific operational consent from the higher authorities of each of the six targeted universities between June and July 2023. Upon receiving these approvals, the researcher collaborated with the designated Person in Charge (PIC) at each institution to accurately identify eligible micro-credential content developers.

Following participant identification, the survey was administered electronically. A total of 285 emails, which included a link to the online questionnaire, were distributed to the micro-credential content developers identified by their respective universities. The questionnaire instrument included a welcome page detailing the study's background, objectives, strict confidentiality measures, and the voluntary nature of participation, ensuring that respondents provided informed consent before proceeding. The active data collection phase took place over a period of four months, spanning from June to September 2023.

Data Collection

The data analysis for the survey incorporated both quantitative and qualitative techniques to yield a comprehensive understanding of developer needs. Quantitatively, the Likert-scale responses were processed using SPSS. Descriptive analysis, including frequencies, percentages, mean scores, and standard deviations, were calculated for all sub-dimensions. Low mean scores and high standard deviations ($SD > 1.00$) were examined to identify key challenges and operational issues or unmet needs in the micro-credential ecosystem. Qualitative, an optional open-ended section inviting developers to share their 'best practices' underwent thematic analysis, allowing the researcher to capture nuanced, tactical insights to enrich the development of the proposed educational framework.

FINDINGS

Operational challenges of significant development effort

Participants highlighted a critical deficiency in institutional support and incentives, which represents a primary barrier to the widespread implementation of micro-credentials. Quantitative data from Table 1, Institutional Challenges reveals that only 37.1% of respondents agree that developers of micro-learning courses are financially rewarded. This item yielded the highest standard deviation ($SD1.41$), showing significant inconsistency and debate regarding compensation practices across institutions.

This lack of financial incentives is worsened by limited professional recognition, with fewer than half of the participants (49.4%) agreeing that micro-credential development is currently linked to professional advancement or recognition. When these findings are synthesised with data from 1.2 Management Considerations, which shows that 78.8% of content developers agree that developing microlearning lessons require a 'significant investment in time and effort', a major operational challenge becomes clear. Educators are expected to undertake high-effort, complex development tasks without adequate institutional backing or reward systems.

Table 1 Descriptive Statistics for Primary Institutional, Management, and Technological Challenges Faced by Micro-Credential Developers (N = 170)

No	Items	Agree	Disagree	Mean	SD
Institutional Challenges					
#43	Microlearning courses should be developed in partnership with employers, professionals, statutory or regulatory bodies, or other colleges and higher institutions.	48.82	7.65	3.78	0.97
#47	Developers of microlearning courses are financially rewarded.	37.06	28.24	2.91	1.41

#48	Micro-credential development comes with professional recognition for contributors who create and transform microlearning lessons into courses.	49.41	14.71	3.52	1.17
#55	Micro-credentials should be recognised by other higher education providers (HEPs).	47.06	1.76	3.77	0.88
#56	Micro-credentials should be recognised by employers and industries.	44.12	3.53	3.60	0.87
Management Challenges					
#27	Developing microlearning lessons requires a significant investment of time and effort.	78.82	2.35	4.65	0.68
#46	Micro-credentials should include details that could be used to confirm the date, location, and recipient of issuance.	54.71	5.88	3.85	0.94
Technological Challenges					
#20	The microlearning lessons should be exclusively delivered online.	65.88	6.47	4.15	1.05
#45	Micro-credentials should be shareable on any platform.	39.41	15.29	3.41	1.21

Furthermore, participants identified substantial challenges regarding external collaboration and market acceptance. Only 48.8% of respondents agreed that microlearning courses should be, or currently are, developed in partnership with employers and regulatory bodies, suggesting a disconnect between academic and external stakeholders. This lack of integration is reflected in the low perceived recognition of micro-credentials; agreement that these credentials are recognised by other higher education providers (HEPs) stood at only 47.1%, while recognition by employers and industry was even lower at 44.1%. This creates a 'value gap' where content developers are hesitant to invest resources into credentials that may not be widely accepted in the labour market. Technological barriers were also rated low, particularly regarding interoperability and standardisation. A notable challenge is the lack of platform portability, as only 39.4% of content developers agreed that micro-credentials should be shareable across any platform, including a massive challenge for learner mobility and credential verification. Additionally, only 54.7% of participants agreed on the inclusion of standardised metadata; such as date, location, and recipient; to secure and verify issuance, with a standard deviation of 0.94 suggesting a lack of consensus on security protocols. Another item highly debated was over delivery modes; which shows a standard deviation of 1.05 regarding whether lessons should be exclusively online, revealing a persistent challenge in determining the most effective delivery strategies for a diverse learner base.

Bite-size and industry-centric pedagogical design

Participants overwhelmingly identified 'bite-sized' content as the most critical pedagogical design element for microlearning within a micro-credentialing framework., reaching 94.12% agreement with a high mean score of 4.51 (SD0.66). This statistical consensus is strongly reinforced by qualitative findings which indicate that for micro-credentials (MCs) to be market-ready, they must adopt a "bite-sized" formatting that concentrates on specific skills through concise, digestible modules. Beyond mere brevity, developers highlighted that this pedagogical approach is most effective when paired with interactive learning elements; such as simulations and hands-on activities, and outcome-based assessments that reflect real-world applications like case studies or practical exercises. Consequently, the duration of content, there was a strong consensus on the necessity of industry-centric design; 78.24% of respondents agree that considering industry needs is crucial while 75.29% emphasised that microlearning should be customised to meet specific industry demands. To ensure these modules effectively represent professional competencies, 74.12% of participants noted that content must accurately reflect current, industry-relevant skills and knowledge. Qualitative data showed to guarantee authenticity, participants insisted that content creation be led by individuals with direct industry experience, ensuring that materials are derived from actual professional training demands.

From an interface and technological perspective, content developers expressed a clear preference for delivery in rich-media formats (78.24% agreement) and platforms specifically designed to enhance learning opportunities (81.18%) and support individualised instructional plans (75.29%). Furthermore, ensuring cross platform accessibility access to multiple devices and operating systems was identified as a key technical requirement by 67.06% of those surveyed.

Table 2 Descriptive Statistics for Essential Design Elements and Support Structures Identified by Developers (N = 170)

No	Items	Agree	Disagree	Mean	SD
Pedagogical Considerations					
#2	Microlearning in micro-credential should be bite-sized.	94.12	1.76	4.51	0.66
#3	Considering industry needs is crucial when designing microlearning lessons for successful micro-credentials.	78.24	2.94	4.45	0.76
#10	Microlearning should be customised to meet industry demands.	75.29	0.59	4.31	0.69
#11	Microlearning should accurately represent specific skills, competencies, or knowledge relevant to the current industry.	74.12	0.00	4.31	0.68
Technological and Interface Design Considerations					
#15	The microlearning lessons for micro-credentials offered should be available across multiple devices and operating systems.	67.06	3.53	4.16	0.89
#16	The microlearning lessons for micro-credentials should be delivered in a media-rich format.	78.24	2.35	4.38	0.71
#17	The microlearning platform should be designed to support individualised instructional plans.	75.29	1.76	4.31	0.72
#19	The microlearning platform should be designed to enhance learning opportunities.	81.18	1.18	4.49	0.62
Resource Support Consideration					
#34	Microlearning offered should be available anytime.	77.65	2.35	4.51	0.77
#35	Microlearning should be delivered on a just-in-time basis.	72.94	2.35	4.31	0.82
#36	Microlearning should be delivered on-demand.	67.65	4.12	4.15	0.87
Management Considerations					
#30	The faculty are responsible for overseeing quality control measures in the microlearning lessons used in its micro-credentials.	75.29	2.35	4.34	0.78
#31	A micro-credential unit/ department should be responsible for updating and upkeep of the microlearning lessons used in its micro-credentials.	72.35	2.94	4.29	0.83
#32	A micro-credential unit/ department should oversee the security aspects (recognitions, achievement records, personal information) of the microlearning lessons used in its micro-credentials.	74.12	2.94	4.34	0.84

#33	A micro-credential unit/ department should be responsible for managing the quality control of the microlearning lessons used in its micro-credentials.	71.76	5.29	4.32	0.9
Institutional Consideration					
#41	Micro-credentials offered can be stacked (combined) to form macro credentials.	68.24	2.35	4.19	0.85
#42	Microlearning courses should be aligned with the standards, instructions and assessment outlined by Malaysian Qualification Agency (MQA) for it to be formally issued.	70.59	1.18	4.39	0.81

Regarding resources support and delivery, participants indicated a strong preference for highly flexible, learner-centric models that accommodate the needs of the modern workforce. The highest level of agreement in this category was for ‘anytime’ availability at 77.65% followed by ‘just-in-time’ delivery at 72.94% and on-demand access at 67.65%. Specific management and institutional structures were identified as important for ensuring the long-term viability, quality and recognition of micro-credentials. Participants advocated for formal institutional oversight, with 71.76% agreeing that a dedicated micro-credential unit or department should be responsible for managing quality control.

This unit’s responsibilities would ideally extend to overseeing security aspects, such as achievement records and personal information (74.12%) as well as the continuous updating and upkeep of microlearning modules (72.35%). Faculty-level responsibility for quality control measures was similarly supported by 75.25% of respondents. To ensure these credentials hold systemic value, participants emphasised the importance of stackability, with 68.24% agreeing they should be stackable into macro-credentials, and 70.59% insisting on alignment with MQA standards for formal issuance. Finally, the data suggests that for MCs to gain traction, institutions must engage in ‘aggressive marketing’ and branding efforts, utilizing success stories and social media to promote offerings in a concerted manner across all faculties.

Qualitative Responses

The qualitative findings (Table 3) offer a detailed outlook on the main institutional and technological obstacles. faced by content developers, illustrating a clear gap between technical requirements of micro-credentialing and the current support structures in Malaysian HEIs. Technologically, developers expressed significant concern regarding the lack of robust security infrastructure, with one participant explicitly noting that strong support for the security system is lacking (developer S154). Beyond security, usability and interface design were identified as major pain points; the same developer highlighted that existing platforms, such as future, require updates to be more ‘user friendly’ and visually engaging for learners. This is compounded by a gap in technical proficiency, where instructors; acting as subject matter experts - feel they lack the specialised skills for ‘recording and uploading the materials’ and require dedicated technical assistance (developer S111).

Table 3 Qualitative Insights: Primary Pedagogical, Technological, and Institutional Challenges Identified by Developers

Challenges	Developer Code	Segment
Technology	S154	Strong support for the security system is lacking. The interphase of ufuture needs to be updated and made more interesting for learners to use and user friendly

	S111	Good technological support is extremely crucial in developing suitable content for the MC as instructors are the content experts, but they may need help in recording and uploading the material.
Institutional	S133	If can give the monetary reward to the instructors/MC developer is better to motivate them in maintaining the learning process via technology
	S56	The development of ML materials requires time, skill and knowledge itself. Faculty/University shall count this as part of teaching hours as the material is for the microcredential purposes
	S73	Para pembangun MC perlu mempunyai satu masa yang kursus [khusus] bagi menyiapkan modul-modul yang ditetapkan

Institutionally, the results reveal a systemic lack of recognition and compensation for the labor-intensive nature of micro-learning development. A primary demotivator is the absence of financial incentives, with participants suggesting that 'monetary reward' is essential to motivate instructors to maintain the learning process via technology (Developer S1333). This issue is exacerbated by an 'unrecognised workload', where developers argue that the 'time, skill and knowledge' required for these modules should be formally integrated into their teaching hours rather than treated as an additional, uncompensated task (developer S56). Furthermore, the need for 'dedicated time' was highlighted as a critical requirement for completing modules, as current institutional structures do not provide the necessary focus period needed to handle the complexities of micro-credential design (developer S73).

Table 4 Qualitative Insights: Essential Design and Support Elements Identified by Developers

Elements	Developer Code	Segment
Pedagogical & Technological	S22	MCs should have well-defined learning outcomes" and must incorporate assessments that align with the learning outcome. These assessments can include projects, case studies, simulations, or practical exercise Incorporating interactive elements, multimedia, and engaging learning materials within MCs can enhance learner engagement"
	S40	Clearly articulate what you want your students to achieve
	S73	tutorial penerangan dan roleplay bagi meningkatkan kefahaman silibus
	S69	tracking system to track student engagement
	S52	Certification Badge is very important for online learners as a Motivation/Reward to complete the MC providing learners with discussion forums, mentors, or feedback loops can further enhance the learning experience
	S99	Contents were developed from real trainings given to and/or demanded by the industry
	S164	The content creators who have experience with the industry need to lead the team. So that everything will look rea
	S22	Additionally, collaborating with industry experts in the design of MCs can provide valuable insights and ensure the relevance of the content
	S127	Perlu melibatkan industri di dalam penyediaan modul

	S65	Pertama, pihak pengurusan memberikan galakan dan sokongan yang kuat kepada pembangun untuk menghasilkan lebih banyak MC di peringkat universiti
	S111	Good technological support is extremely crucial in developing suitable content for the MC

The findings for research question 2 show a strong consensus among developers that high-quality micro-credential must be built upon a foundation of clearly articulated learning outcomes and strictly aligned assessments. Participants emphasise that for these credentials to be effective, assessments should transcend traditional methods and instead incorporate projects, case studies, simulations or practical exercises that directly measure the stated outcomes. Furthermore, the delivery of these models must be interactive and engaging, utilising multimedia materials and methods such as explanatory tutorials and roleplay to enhance syllabus comprehension. To sustain learner momentum, developers identified the necessity of integrated tracking systems to monitor student engagement and the issuance of digital badges or certification as important motivation and reward mechanisms. These pedagogical elements are further enriched by the inclusion of feedback such as discussions forums and mentorship, which are perceived as essential for deepening the overall learning experience.

Regarding the support structures necessary to meet market demands and institutional standards, the data highlights that industry collaboration is beneficial and a necessity for ensuring content relevance. High-quality micro-credentials are viewed as those derived from 'real training' demanded by the industry, ideally led by content creators with actual industry experience to ensure the material is grounded in professional reality. Beyond market alignment, developers stressed the importance of robust internal management, calling for a strong encouragement and backing from university leaders to incentivise the development of micro-credentials at the institutional level. Finally, a critical requirement for successful implementation is the provision of dedicated technological support. This support is very important for bridging the gap between the subject matter expertise of the instructor and the technical execution needed for recording and uploading these digital materials.

Key Design Principles Informed by Developer Insights

The synthesis of developer insights shows that for a micro-credential ecosystem to be effective, it requires a formally-governed framework that is both modularised and aligned with industry needs. This framework must achieve a balance between practical flexibility and pedagogical rigor. A central consideration is the prioritisation of 'bite-sized' formatting to minimise learner cognitive load. This content is delivered via media-rich, mobile-responsive platforms, enabling anytime and on-demand access. To ensure market relevance and institutional integrity, design principles must mandate active industry collaboration in content leadership and maintain strict alignment with MQA standards for stackability and formal recognition. Ultimately, the transition from development to implementation is only sustainable if supported by structural shifts in institutional policy; one that formally recognises the significant labour of digital content creation through dedicated time, specialised assistance, and integrated reward systems.

Table 5 Summary of Primary Institutional, Technological, and Pedagogical Challenges Identified by Micro-Credential Developers

Challenge Category	Specific Challenges Identified	Survey Items / Developer References (S)
Institutional	Lack of Financial Incentives	Item 47; S133 , S1333
	Unrecognized Workload	Item 27; S56 , S73
	Limited Recognition	Items 48, 55, 56; S65
	Stakeholder Disconnect	Item 43
Technological	Interoperability Issues	Item 45

	Security & Standardisation	Item 46; S154
	Usability & Proficiency	Item 20; S154 , S111
Pedagogical	Cognitive & Subject Complexity	S14 , S66
	Professional Isolation	S47

Table 6 Summary of Essential Design and Institutional Support Structures for Micro-Credentials

Category	Essential Design & Support Elements	Survey Items / Developer References
Design Elements	Bite-sized Formatting	Item 2; S102
	Industry Alignment	Items 3, 10, 11; S99 , S164 , S22 , S127
	Aligned Assessments	S22 , S40
	Interactive Media	Item 16; S73 , S102
	Tracking & Feedback	S69 , S22
Support Structures	Flexible Delivery	Items 34, 35, 36; Developer S102
	Dedicated Oversight	Items 30, 31, 32, 33; Developer S104, S111
	Credentialing Value	Items 41, 42
	Motivation Systems	Developer S52 , S92
	Strategic Branding	Developer S34 , S65

DISCUSSION

The study revealed that Malaysian HEIs share many of the systemic tensions observed globally, particularly the friction between traditional academic structures and the rapid, skill-based demands for the Fourth Industrial Revolution. Internationally, literature suggests that traditional university programs are often perceived as being too slow to update their curricula to match market needs (Brown et al. (2021; Brown et al., 2021; McNamara & Sun, 2021; Resei et al., 2019; Gallagher, 2019). In the Malaysian context, this is manifested as a significant operational challenge where the high investment of time and effort required (Ahmat et al., 2021; Eager & Cook, 2020; Stefaniak & Carey, 2019; Davies, Randall & West, 2015) to bridge the skill gap is not yet met with adequate institutional backing (McGreal & Olcott, 2022; Brown et al., 2021; Stefaniak & Carey, 2019; Ghasia, et al., 2019; Jeantet, 2018). While global firms have begun de-emphasising traditional degrees in favour of verifiable skill sets (Varadarajan et al., 2023; Brown et al., 2021; Ralston, 2021; Oliver, 2019), Malaysian developers still perceive a value gap, noting that external industry recognition (Abdul Halim et al., 2024; Phelan and Glackin, 2020; Perkins & Pryor, 2021; Gallagher, 2018) and inter-institutional acceptance remain underdeveloped (McGreal & Olcott, 2022; Resei et al., 2019). This suggests that while the global necessity for micro-credentials is established, the local infrastructure for rewarding the labor involved in their development is still in its infancy.

Regarding design elements, the local preference for bite-sized and industry-centric formatting reflects international best practices that emphasise breaking down complex information into manageable, verifiable modules (Ralston, 2021; Davies et al., 2015; Olneck, 2015). This alignment confirms that Malaysian developers are conceptually in sync with the global shift towards 'just-in-time' learning (Phelan & Glackin, 2021). However, local developers raise a unique pedagogical concern: the significant difficulty of deconstructing rigorous academic subjects; such as mathematical principles, into these smaller units without sacrificing academic integrity. This highlights a specific need for technical assistance to help subject matter experts transition into digital content creators (Abdul Halim et al., 2024; Ahmat et al., 2021, Stefaniak & Carey, 2019; Brooks, 2010) a challenge that is often underestimated in border literature. Finally, the insistence

on anytime and on-demand delivery reflect the global move toward highly flexible, learner-centric models that accommodate the modern workforce. To overcome the limited studies on implementation (Ahsan et al., 2023; Kumar et al., 2022; Young et al., 2019), Malaysian developers advocate for dedicated institutional units to oversee quality control and security.

Considerations

Successful implementation of the micro-credential ecosystem in Malaysian HEIs requires careful attention to institutional support, pedagogical design, and technological infrastructure. Institutional policies need to evolve beyond traditional frameworks by offering formal professional recognition and financial incentives, helping to offset the considerable time and effort educators invest in developing these modules. Pedagogically, content should be strictly bite-sized and industry-aligned to manage learner cognitive load while ensuring that skills remain relevant to the modern workforce. Moreover, to ensure on-demand and anytime availability, technical strategies should prioritise mobile-friendly experience, platform interoperability, and the implementation of stringent security measures for verifying credentials. Ultimately, the sustainability of these programs depends on dedicated management that oversee quality control and ensure that micro-credentials remain stackable and fully aligned with Malaysian Qualifications Agency (MQA) standards.

CONCLUSION

The study concludes that Malaysian HEI content developers possess a strong conceptual understanding of the pedagogical needs for micro-credentials, specifically identifying bite-sized content and industry-centric design as essential elements for successful implementation. However, significant systematic barriers persist, mainly due to a lack of financial incentives and formal professional recognition for those transforming lessons into micro-credential courses. Beyond these institutional hurdles, developers face a major operational strain, as the development of digital content requires a heavy investment of time and energy. The lack of scheduled focus periods makes this workload even worse or sufficient technical assistance specifically for digital production. Furthermore, technological constraints such as a lack of platform interoperability and security is still a concern, limiting learner mobility and credential verification. Ultimately, HEIs must transition toward evidence-based strategies that provide structured institutional backing, ensure strict alignment with MQA standards, and foster the deep industry partnership required to produce high-quality, market-ready micro-credential modules.

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