OPEN ACCESS
Journal of Information & Knowledge Management
Vol. 23, No. 1 (2024) 2350069 (30 pages)

DOI: 10.1142/S0219649223500697

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Streamlining Micro-Credentials Implementation in Higher Education Institutions: Considerations for Effective Implementation and Policy Development

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Received 9 July 2023
Accepted 15 September 2023
Published 2 November 2023

Abstract. The rise of online learning has brought about a close connection between micro-credentials and lifelong learning, employability, and new models of digital education. Micro-credentials are considered instrumental in transforming higher education today. This study aims to examine the extent to which micro-credentials have been adopted in Malaysia, focussing on the viewpoint of Higher Education Providers (HEPs). It seeks to identify the challenges faced by HEPs when offering micro-credentials, encompassing technological, organisational, and people-related obstacles. By analysing empirical data, this research intends to propose a conceptual framework that can guide the successful adoption and implementation of micro-credentials within educational institutions. By addressing these

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recommendations, HEPs in Malaysia can successfully adopt and implement micro-credentials within their institutions. This will not only enhance the learning experience for students but also contribute to the overall transformation of higher education, keeping pace with the demands of the digital age and fostering a culture of continuous learning and skill development.

Keywords: Micro-credentials; adoption readiness; technological management; educational system; higher education providers; quality education.

1. Introduction

Micro-credentials are officially recognised records that demonstrate the completion of learning objectives during shorter, less time-consuming educational or training events. They concentrate on validating competency-based knowledge, outcomes, and/or skills using trustworthy assessments and open standards, which can improve graduates' chances of finding employment. An institution or organisation may accept micro-credential for credit or as an attestation for potential employers. Initially, micro-credentials were first established in online discussion forums and other social media platforms to differentiate average users from advanced users by awarding digital badges to the respondents who completed the necessary assessments and assignments, for the purposes of upskilling, as well as learning new skills (McGreal and Olcott, 2022). Eventually, learners can earn a digital badge and advance to the next selected digital badge once the micro-credentials are completed (Rottmann and Duggan, 2021).

Higher education institutions should focus on formalising the position for micro-credentialing in their programmes by developing policies and associated taxonomies to guide this effort within their institutions. Nevertheless, underlying the factors of these flourishing concepts, it is essential to look at the efforts and policy before further implementation, else, it could become another "white elephant" project, looking giant, but empty in the contents. If that scenario happened, it is not going to be helpful for the industry player to upgrade and upskill their staff, but it would create more chaos for the education system in recognising the micro-credential, and it may take additional efforts to clean up the mess.

2. Problem Statement

Micro-credentials are gaining importance in Malaysia to promote flexible learning. This study aims to assess the readiness of Malaysia in adopting micro-credentials and determine the most suitable adoption model. Higher Education Providers (HEPs) can then implement appropriate support and policies to overcome challenges and ensure successful implementation, providing quality learning experiences.

The current higher education system has limitations in terms of cost and duration, posing a challenge for working adults seeking academic qualifications or new skills. However, the emergence of micro-credentials offers an alternative educational option with shorter completion times. Many institutions have developed micro-credential programmes to retrain and educate the workforce, providing working adults

with opportunities for promotion and skill expansion within a shorter timeframe. These certification programmes can be advantageous for individuals to enhance their academic and personal development before entering the job market. Therefore, this study aims to address the challenges faced by local learners and developers of micro-credentials, bridging the gap in understanding and implementation.

3. Literature Review

3.1. *Background of micro-credentials in Malaysia*

Micro-credentials allow learners to gain specific skills in a shorter time. They outstand from the traditional education due to the trackable information in the badges (Kiiskila *et al.*, 2022). The conventional degrees are claimed in failing to convey a learner's competencies. For instance, the employees can track and verify their skills obtained with the solid digital badges that is transferable between stakeholders (Lim *et al.*, 2018). To this extent, the micro-credential programmes represent as evidence for competence, including the progression level. Besides, micro-credentials have increased the opportunities available in terms of flexibility and competencies to learn in their own space. For example, learners can choose between micro-credentials and conventional degrees according to their situations and preferences. Malaysian government has put effort into micro-credentials and it results in the increase of the programmes in Malaysian higher education system. Malaysian Qualifications Agency (MQA) has introduced a framework, offering a guideline for the implementation and development of micro-credentials in HEPs (MCMC, 2022).

Organisations have played a crucial part in enabling the development and spread of micro-credentials in Malaysian HEPs. Their contribution has been vital in establishing the required infrastructure, including digital platforms and support systems, for efficiently delivering micro-credentials. In addition, institutions have actively worked together with industry partners to ensure that the micro-credentials offered meet the expectations and demands of the industry. The designing process of micro-credential is important for enhancing and revitalising individual skill sets. Therefore, it is crucial to go beyond the methodology and design when considering each specific level of credentialing (Hernandez *et al.*, 2014). To this extent, the key factor is to improve the relationship between the credential products and evaluating whether an organisational structure is in place to assess the quality of the micro-credential course and align with the necessary skills and competencies.

3.2. *Micro-credentials in multimedia communication scope (enhance learners' digital literacy competencies)*

Multimedia and communication encompass different aspects of using communication technology to transfer various types of media data, such as continuous and discrete media. For example, leveraging digital innovation, basic telecommunication infrastructure and 5G technology for the seamless transmission of multimedia content (Duklas, 2020). This is because digital communication involves sensitive

information and data, policy and regulation, network security and others that is a crucial role to ensure the confidentiality and integrity of the communication process (Salloum *et al.*, 2018). The primary goal of the Malaysian Communications and Multimedia Commission (MCMC) is to promote a competitive and efficient multimedia communication industry in Malaysia (MCMC, 2022). By focussing on the development and regulation of multimedia communication, MCMC is important in encouraging innovation and ensuring the communication sector meets the evolving social and economic needs in Malaysia.

Micro-credentials have a significant value as they offer training and guidance that assist students in developing their digital literacy skills. These skills hold great importance for students in academic and employment settings (West and Cheng, 2022). Micro-credential programmes have proven to be effective in supporting learners in fostering their professional identities and using digital badges as motivation. This is because the badges represent learners' efforts and the time devoted to their learning journey, showcasing a range of learning materials, including interactive activities and instructional resources (Koronios *et al.*, 2019). By utilising micro-credentials, learners can enhance their digital literacy competencies and strengthen their overall skill set in a digital landscape. The current landscape is indeed messy and poorly defined, which needs a defined initiative and unstandardised framework.

3.3. *Challenges of micro-credentials from HEPs' perspective (micro-credential providers)*

The content and tracking of information within digital badges are important considerations for learners when deciding which badges to pursue (Lemoine and Richardson, 2015). The specific details carried by the badges and the responsible organisations for updating, storing, and displaying the information are crucial factors (Pollard and Vincent, 2022). Learners often compare digital badges earned to assess their value and credibility. To facilitate this process, it is essential to establish standardised technological infrastructure for verifying and validating badges. This standardisation would simplify decision-making for learners and ensure transparency and consistency in badge assessment.

In the context of this study, organisational readiness refers to the preparedness of institutions or management to adopt micro-credentials effectively. It involves several key elements that contribute to the successful implementation of micro-credentials within an organisation. One important aspect is maintaining the quality of the tasks or assessments required to earn digital badges. This includes ensuring that the staff involved in designing and evaluating these tasks are properly trained and equipped with the necessary knowledge and skills (Pollard and Vincent, 2022). Additionally, organisations need to establish effective process controls to ensure the consistency and reliability of the assessment process. This involves implementing clear guidelines and standards for evaluating and awarding digital badges, as well as conducting regular quality assurance checks to uphold the integrity of the credentials.

Education leaders must be more highly skilled and professional to educate students to navigate society successfully. Educators need to invest in accessible and relevant professional development to advance their skill sets (Darling-Hammond and Hyler, 2020). For example, HEPs need to strengthen the standards of administrators and educators by enhancing their skills and knowledge. In addition, the adult learning theory is largely ignored, as the efforts also ignore the important trend of educators to be competent enough to transfer the relevant skills to the learners (Rubin and Brown, 2019). As technology evolves, educators need to adapt to the trend to push learning experiences based on the latest learning technology methods.

3.4. *Issues identified pertaining to micro-credential implementation*

The private sectors are making an investment in many trainings and learning offers, through a distinctive number of perspectives, one is either as employers to support the process of upskilling/reskilling the workforce or as content developers for micro-credentials to be competitive with regards to response and demand (Bideau and Kearns, 2022). The IR 4.0 revolution has moderated the inception of Massive Open Online Courses (MOOCs) facilitated by many learning institutions, by which there is a collaboration between education, the Industrial workforce, students and HEIs (Ghasia *et al.*, 2019). Hence the unavailability of a global and recognised credentialing system has put forth an opportunity for the industrial sector, professional body, and licensing organisations to offer credentialed services that are recognised globally (Oliver, 2019) as depicted in Fig. 1.

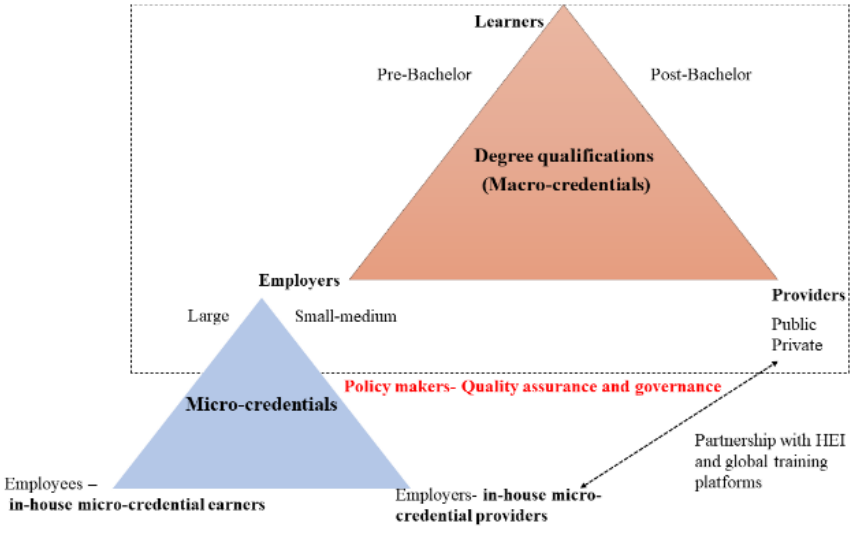

Fig. 1. Evolution of micro-credential ecosystem (Oliver, 2019).

Ensuring global acceptance and usefulness of micro-credentials poses a significant challenge in terms of establishing consistent terminology in course design (Ministry of Communication and Digital, 2023). These micro-credential courses should be tailored to meet the demands of learners seeking specific skill sets and knowledge required for reskilling, upskilling, interpersonal skill development, or Industry 4.0 competencies (Desmarchelier and Cary, 2022). The COVID-19 pandemic has accelerated the need for a digitalised and flexible lifestyle, leading to evolving personal and professional situations. This unprecedented situation presents an opportune moment to reevaluate the education system and prepare society for technological advancements.

3.5. *Identification of critical success factors*

3.5.1. *Technological critical success factors*

Micro-credentials are digital badges or certifications that demonstrate a learner's skills or knowledge in a specific area of interest. The increasing popularity of micro-credentials has led to a need for technological infrastructure readiness to support their delivery and management. (Lockley *et al.*, 2016) emphasise the investment in key infrastructure in technology, in addition to curriculum, policy, processes, and training. The technology ecosystem needs to be robust enough to reduce manual work for both issuers and learners, ensure quality and authenticity, and facilitate visibility and compatibility of needs for employers (Markowitz, 2018). Some successful badges are co-created between the potential employer and the university (Leaser and Gallagher, 2017), thus ensuring the quality for the possible future employer from the beginning.

Recent studies have also focussed on emerging technologies that could enhance the technological competency of micro-credential design and delivery. In addition, due to the wide array of terms and definitions presently being used for micro-credentials, an up-to-date taxonomy is needed. Blockchain hosting of credentials, controlled by the students, is another technology that needs more research (McGreal *et al.*, 2022).

Micro-credentials have gained popularity in recent years as a way for individuals to acquire specific skills and knowledge that are recognised by employers. These issues include data privacy, credential fraud, platform reliability, and cybersecurity. For example, Infante-Moro *et al.* (2020) emphasise the importance of data privacy in the design and delivery of micro-credentials. They suggest that micro-credentialing platforms should use secure data management practices and provide learners with control over their personal information.

3.5.2. *Organisational critical success factors*

Micro-credential is a new education system where performance is under review. To this extent, the HEPs' organisational culture is crucial to shape the belief towards everyone. The perception of every educator and his/her acceptance are important

parts for the courses (Woods and Woods, 2021). The teamwork and networking across the HEPs during micro-credential development need to be ensured to support each other. This means that each stakeholder in HEPs should understand his/her responsibilities and do his/her best to develop a new evolution in learning (Kohl, 2019).

In addition, the management of HEPs is the guideline for the implementation process for micro-credential. Management support is crucial to ensure effective leadership to provide supportive strategies such as financial commitment, policy implementation and investment (Howard and Babb, 2022). Apart from the supportive management team, strategic alignment with micro-credential development is important. Therefore, the management team needs to have a continuous investment in micro-credential practices and procedures (Rossiter and Tynan, 2019). For instance, having a monthly meeting to check on the strategies implemented to ensure the progress is on track.

3.5.3. *People critical success factors*

The motivation of learners is a key element for the success of micro-credentials, as they proved to be more engaged and more likely to complete their course and apply the skills learned (Kizilcec *et al.*, 2013). The support and guidance provided to learners also act as an essential role in the success of micro-credentials (Green and Liem, 2019). For example, learners who received feedback and personalised coaching were more likely to complete their courses. Besides, learners who received support from instructors are more likely to apply the skills in their work. The recognition and validation of micro-credentials by HEPs and other stakeholders can enhance the credibility and reputation of the courses. In short, micro-credentials are claimed to be the factors to affect learners' job aspirations.

4. Micro-credential HEPs readiness theoretical framework

Based on the comprehensive evaluation conducted, a framework has been identified and proposed to assess the readiness of HEPs in implementing micro-credentials, taking into consideration the technological, organisational, and people-related factors.

As discussed in previous sections, the significance of micro-credentials in the educational landscape has been established (Table 1). In order to effectively evaluate the readiness of HEPs for micro-credential implementation, a theoretical framework has been developed from the perspective of these institutions. This framework (Fig. 2) aims to identify and understand the impact of each factor on the successful implementation of micro-credentials within HEPs. By considering the technological advancements, organisational strategies, and the involvement of various stakeholders, the framework provides a comprehensive and holistic approach to assess the readiness of HEPs and guide them in effectively implementing micro-credentials.

Table 1. Summary of factors by literature support.

Challenges faced	Literature support
Technological critical success factors	Infante-Moro *et al.* (2020), Leaser and Gallagher (2017), Lockley *et al.* (2016), Markowitz (2018), McGreal *et al.* (2022)
Organisational critical success factors	Fischer *et al.* (2022), Howard and Babb (2022), Kohl (2019), Rossiter and Tynan (2019), Selvaratnam and Sankey (2019), Shanahan and Organ (2022), Woods and Woods (2021)
People critical success factors	Green and Liem (2019), Kizilcec *et al.* (2013), McGill *et al.* (2020)

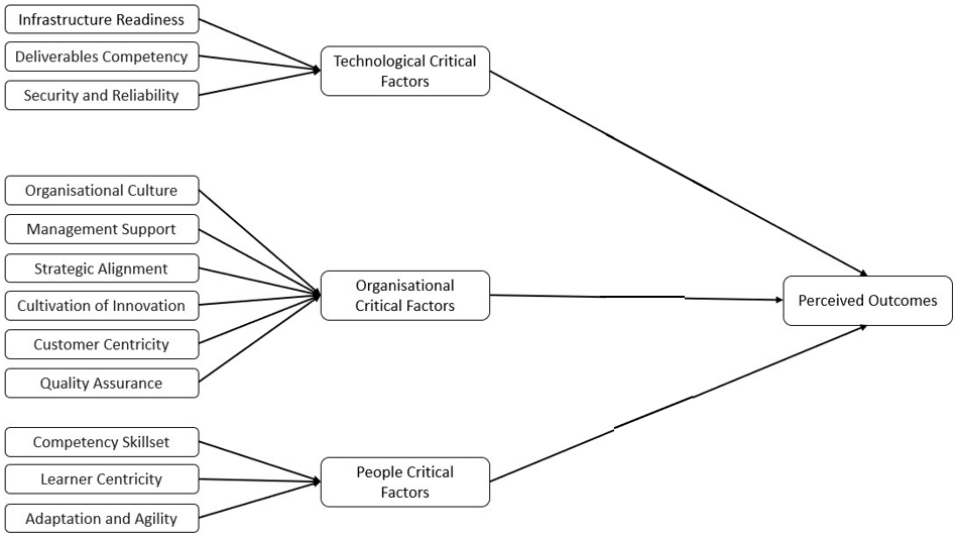

Fig. 2. HEPs readiness theoretical framework.

4.1. *Hypothesis development*

A comprehensive set of hypotheses has been put forward for the purpose of testing and evaluating the readiness of HEPs to successfully implement micro-credentials. These hypotheses are designed to assess various aspects and factors that contribute to the capability of HEPs to adopt and integrate micro-credentials into their existing educational systems. Through rigorous examination and analysis, these hypotheses aim to provide insights into the level of preparedness and potential challenges that HEPs may face when embarking on the implementation of micro-credentials. By systematically testing these hypotheses, valuable information can be gathered to inform decision-making processes and ensure the effective implementation of micro-credentials within the higher education landscape. The hypotheses' relationship between factors and the description of each elements have been concluded in Fig. 3 and Table 2.

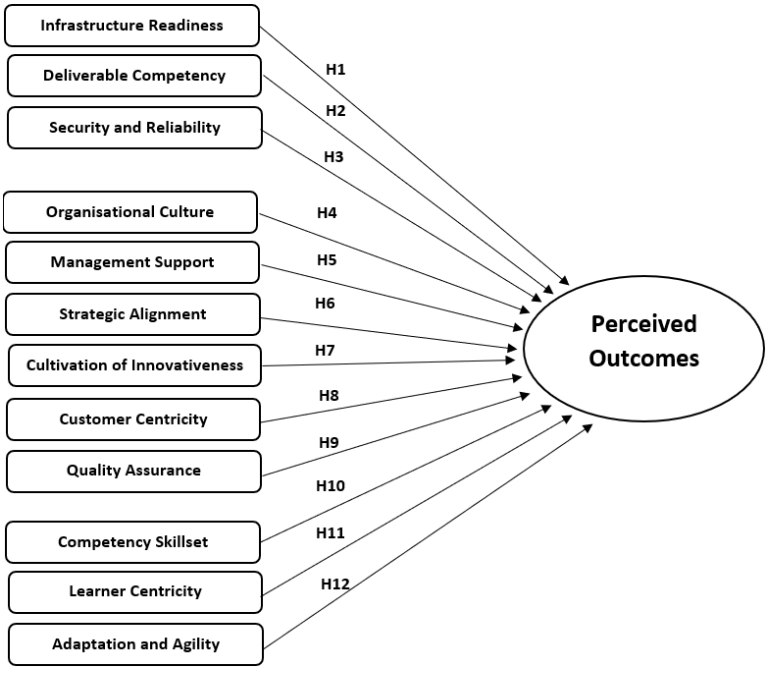

Fig. 3. Hypothesis development.

Table 2. Description of each hypothesis.

Critical factors	Hypothesis	Description
Technological critical factor	H_1	The possession of Infrastructure Readiness set will greatly enhance the perceived outcome when implementing micro-credentials
	H_2	The possession of Deliverable Competency set will greatly enhance the perceived outcome when implementing micro-credentials
	H_3	The possession of Security and Reliability set will greatly enhance the perceived outcome when implementing micro-credentials
Organisational critical factor	H_4	The possession of Organisational Culture set will greatly enhance the perceived outcome when implementing micro-credentials
	H_5	The possession of Management Support set will greatly enhance the perceived outcome when implementing micro-credentials
	H_6	The possession of Strategic Alignment set will greatly enhance the perceived outcome when implementing micro-credentials
	H_7	The possession of Cultivation of Innovativeness set will greatly enhance the perceived outcome when implementing micro-credentials
	H_8	The possession of Customer Centricity set will greatly enhance the perceived outcome when implementing micro-credentials
People critical factor	H_9	The possession of Quality Assurance set will greatly enhance the perceived outcome when implementing micro-credentials
	H_{10}	The possession of Competency Skillset set will greatly enhance the perceived outcome when implementing micro-credentials
	H_{11}	The possession of Learner Centricity set will greatly enhance the perceived outcome when implementing micro-credentials
	H_{12}	The possession of Adaptation and Agility set will greatly enhance the perceived outcome when implementing micro-credentials

4.2. *Aims and objectives*

The research questions of this study focus on assessing the readiness of Malaysia in adopting micro-credentials and determining the most suitable adoption model for implementation. It aims to investigate the challenges faced by HEPs in offering micro-credentials and understand the perspectives of learners and developers in the local context. This research aims to provide valuable insights into the current state of micro-credential adoption in Malaysia, as well as to examine the demand for micro-credentials in the country. Additionally, it seeks to assess the readiness of HEPs to implement micro-credentials from the perspectives of technological, organisational, and people readiness. Furthermore, the research objectives include proposing a best adaptation model or conceptual framework based on empirical evidence for the successful adoption and implementation of micro-credentials within educational institutions. Lastly, the framework will be tested and validated through a set of hypotheses. By addressing these research questions and objectives, this study contributes to enhancing the quality and accessibility of flexible learning options in Malaysia, specifically focussing on the adoption and implementation of micro-credentials within the higher education sector.

5. Research Methodology

5.1. *Introduction*

The adoption and popularity of micro-credentials in Malaysian HEPs are currently low. To gather data on the acceptance and adoption of micro-credentials in Malaysia, a descriptive survey research approach will be utilised. This survey will help identify the challenges faced by Malaysian HEPs in delivering high-quality micro-credential content (El-Farra *et al.*, 2022). Additionally, the descriptive research will provide a comprehensive analysis and description of the current status of micro-credentials by HEPs in Malaysia.

To gain deeper insights into the research questions and explore the main challenges surrounding micro-credentials and their importance in Malaysian HEPs, an exploratory research method will be employed. Exploratory research is particularly useful when investigating a new topic with limited existing research (Swedberg, 2020). The theoretical framework developed with the support of exploratory research will explain the challenges encountered by institutions in providing micro-credentials to learners. The combination of these two research methods will provide a more comprehensive understanding of the implementation status of micro-credentials in Malaysia (Fig. 4).

A cross-sectional study was designed in this study to study and investigate the research objectives at a point of time. A mixed-method approach was designed to integrate both quantitative and qualitative data within a single study. The mixed method study is particularly advantaged in collecting rich and comprehensive data, for example, perception of the micro-credential often integrates quantitative data (scores determining prevalence) with qualitative data by sharing emotions

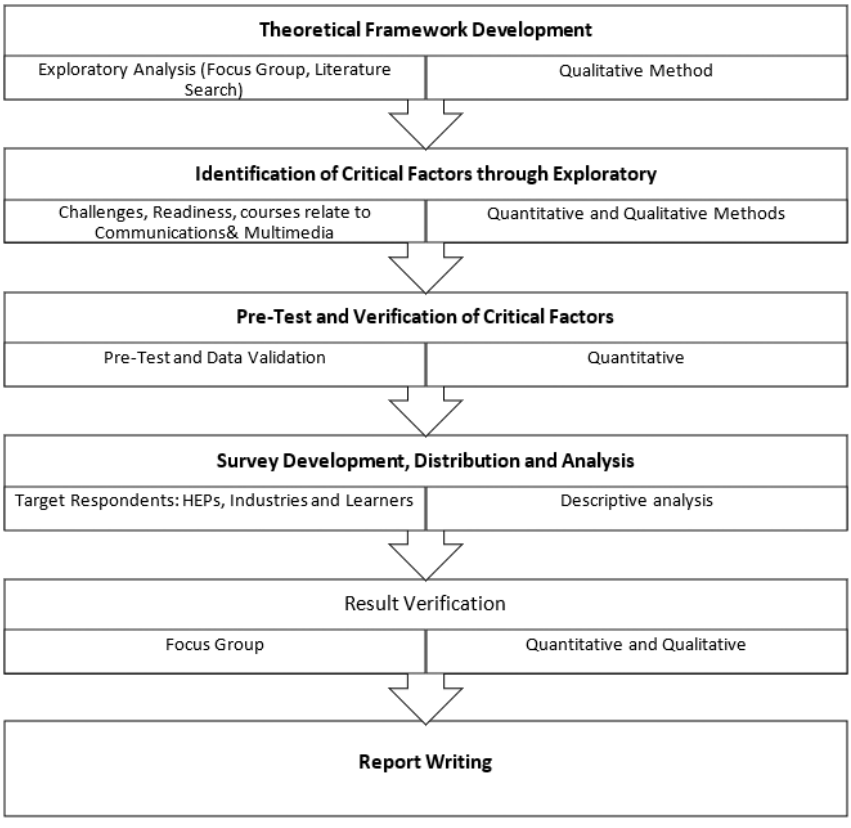

Fig. 4. Research process.

and expression. For quantitative study, a survey questionnaire is adopted in this study, supported by the qualitative study through interviews within focus groups. The main reason behind integrating a mixed method approach in this study is to allow researchers to explore different perspectives and uncover relationships related to the research questions (Shorten and Smith, 2017). The quantitative data from this study help in analysing data regarding the demands of micro-credential in multimedia and communication fields. In addition, the qualitative study provides opportunities for participants to reflect and share feelings and experiences of micro-credentials in multimedia and communication fields. Through this method, qualitative study can help explain quantitative data with enriched evidence and enable research questions to be answered more deeply (Shorten and Smith, 2017).

5.2. *Target sample*

A priori G* power analysis (Lakens and Caldwell, 2021) was used to generate the minimum sample size required to detect medium effect size, with 0.80 desired statistical power level. Given the structural complexity of the model, the minimum

sample size required to detect the effect was 150. A total of 200 participants was targeted for this study, assuming less than 30% incomplete or missing data that may be excluded from the study.

The target groups are those who fulfilled the following:

- HEPs (management and educator).
- Industry relevant to multimedia and communications.
- Individuals aged 18–60 years old.
- Able to provide consent (verbal/written) to participate.
- Understand Bahasa Malaysia or English.

5.3. *Statistical analysis*

Data analysis will be conducted using IBM SPSS Statistics for Windows, version 22 (IBM Corp, Armonk, NY, USA). The analysis will follow a per protocol approach, which means that only participants with valid baseline data and those who have completed at least one of the endpoint assessments according to their assigned groups will be included in the analysis.

6. Findings

6.1. *Descriptive analysis*

6.1.1. *Types of institutions*

558 respondents from public universities, private Universities, vocational colleges, polytechnics, private colleges, community colleges and Institute Kemahiran have participated in the online survey to study the readiness of HEPs to implement micro-credentials from the perspective of Technological, Organisational, and People Readiness. The breakdown of the institutions is in the bar chart in Fig. 5. Based

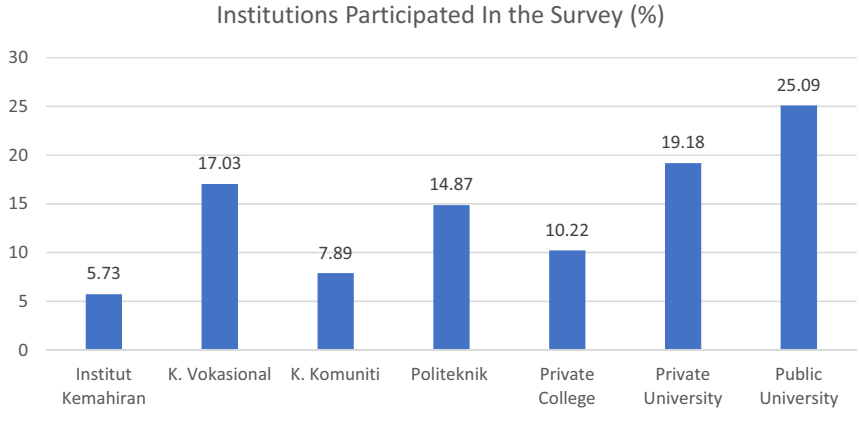

Fig. 5. HEPs participated in the survey.

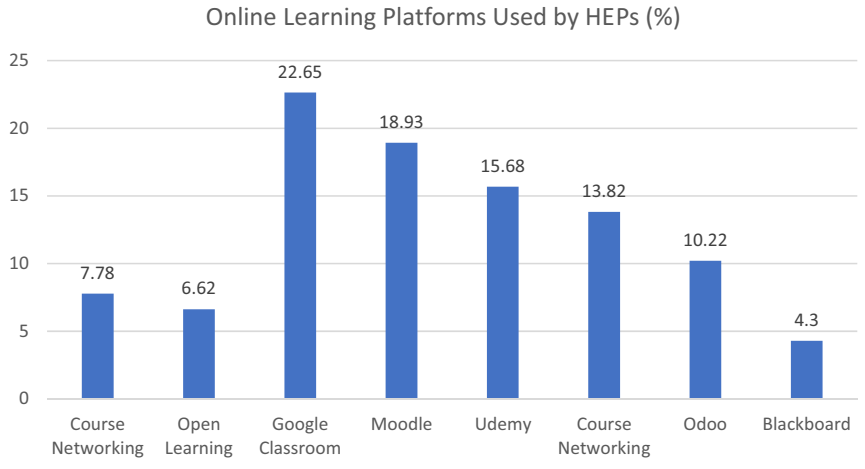

Fig. 6. Online learning platforms used by HEPs.

on the bar chart, most of the respondents were from public universities, private universities, and vocational colleges.

6.1.2. *Types of platforms*

The bar in Fig. 6 shows the online platform which the institutions prefer or intend to use when implementing micro-credentials. Based on the bar chart, most of the institutions prefer or intend to use Google Classroom followed by Moodle, Udemy, and Coursera as online learning platforms when implementing micro-credentials. The bar chart also clearly showed that Blackboard is the least preferred online platform for micro-credential implementations.

6.1.3. *Current status of micro-credentials in institutions*

In this study, the status of micro-credentials adoption rate in Malaysia has been investigated where the institutions were asked to describe the institutional micro-credential status via survey. The respondents were asked to rate between 0 and 4, and the representation of the rating is shown in Fig. 7. 6.99% of the HEPs do not intend to implement micro-credential, while 15.41% of the HEPs are going to implement micro-credential programmes in the next 12 months. On the other hand, 26.88% of HEPs are in the preliminary stage, 14.70% are in the intermediate stage and 36.02% are in the maturity stage.

6.1.4. *Current micro-credentials status by HEPs segment*

From the result generated (Fig. 8), 36.04% of the Institute Kemahiran are planning to implement micro-credentials in the next 12 months. In the case of K. Vokasional, they are mostly in the maturity stage where there are 32.34% of them who have all programmes offered in micro-credentials form. In contrast, there are

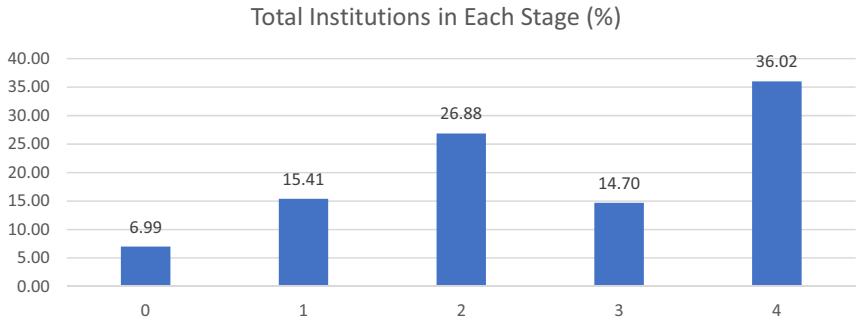

Fig. 7. Total institutions in each stage (%).

Notes: 0 — Our institution does not intend to implement micro-credentials for the time being, 1 — Our institution is planning to implement micro-credentials in the next 12 months, 2 — Preliminary stage (range of 1–30 micro-credentials are offered), 3 — Intermediate stage (range of 31–100 micro-credentials), 4 — Maturity stage (all programmes have micro-credentials courses offered).

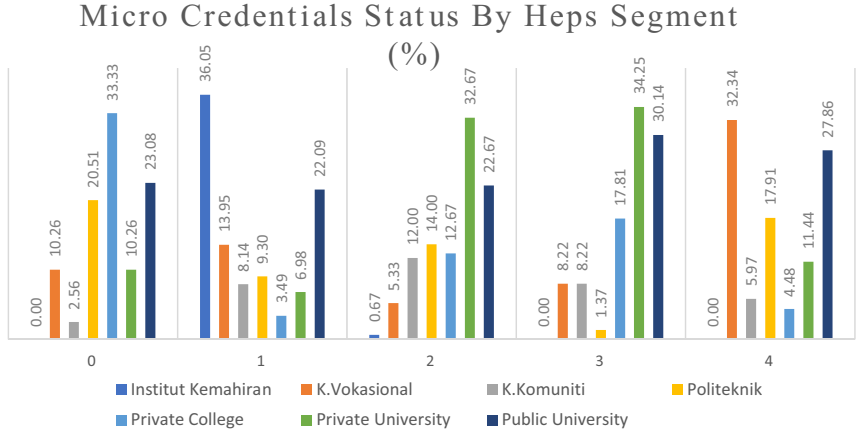

Fig. 8. Micro-credential status by HEPs segment (%).

Notes: 0 — Our institution does not intend to implement micro-credentials for the time being, 1 — our institution is planning to implement micro-credentials in the next 12 months, 2 — Preliminary stage (range of 1 to 30 micro-credentials are offered), 3 — Intermediate stage (range of 31 to 100 micro-credentials), 4 — Maturity stage (all programmes have micro-credentials courses offered).

only 10.26% of the K. Vokasional who have no intent to implement micro-credentials for the time being. Besides, there are 12% of the K. Komuniti who are in the preliminary stage for micro-credential programmes. 17.91% of the Politeknik are having a mature status for the micro-credentials programme. In the case of Private College, 12.67% of them are in the preliminary stage, while only 4.48% are in the maturity stage. Furthermore, nearly half of the Private University (32.67%) are in the preliminary stage, while for Public University, 27.86% of them are in the maturity stage.

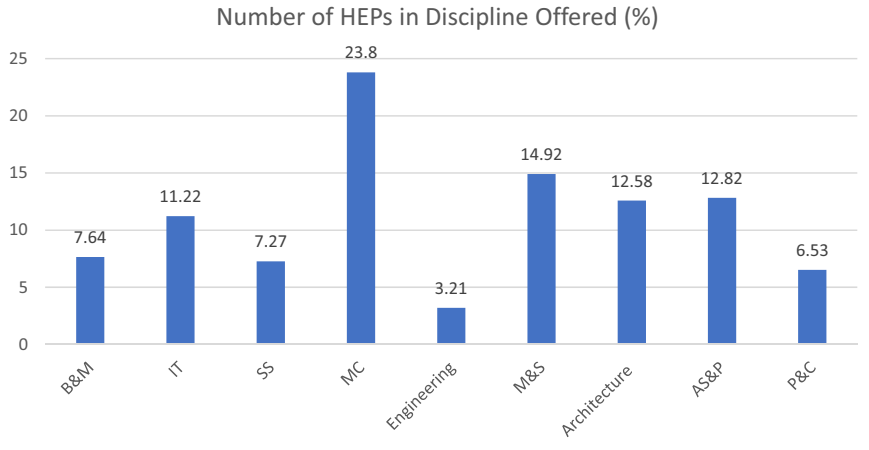

Fig. 9. Number of HEPs in discipline offered.

Notes: Business & Management: B&M; Computing & IT: IT; Social Sciences: SS; Medical Sciences: MS; Mathematics & Statistics: M&S: Applied Science & Pharmacy: AS&P; Psychology & Counselling: P&C.

6.1.5. *Discipline of micro-credentials offered*

The discipline which the institutions prefer to offer micro-credential was investigated through the survey. Figure 9 shows the disciplines that the HEPs wish to offer under micro-credentials. Based on the results obtained, most of the institutions preferred to offer micro-credentials in Medical Sciences followed by Engineering and Mathematics & Statistics. Based on Hernandez *et al.* (2014), professional practice in science, technology, engineering, and mathematics (STEM) fields is expected to build students' conceptual knowledge and understanding of engineering and technology. This indicates that STEM subjects may be suitable for micro-credential implementation, as they require practical skills and knowledge. Hence, most institutions preferred to offer micro-credentials related to STEM.

6.1.6. *Communications and multimedia micro-credentials courses related offered by HEPs*

The institutions were asked on the Multimedia and Communication micro-credentials courses that are or will be offered in their institutions. Nine choices of Communication and Multimedia-related courses, namely Data Communication and Networking, Multimedia-Related Courses, Information Technology and Multimedia, 4G and 5G Standards, Technologies and Architecture, Modulation, Channel Equalisation and Diversity Techniques for Mobile Radio Communication Systems, Data Communications and Networking, Data & Network Security, Advanced Signal Processing, and Multimedia-based Instructional Design were provided in the survey. Figure 10 shows the number of votes received for each of the course choices. Based on the results obtained, most of the institutions mentioned that their institutions are or will be offering Information Technology and Multimedia followed by Modulation,

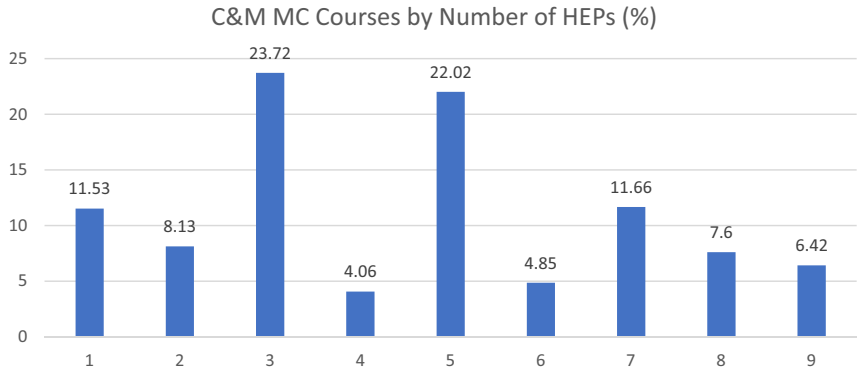

Fig. 10. C&M micro-credential courses by number of HEPs.

Notes: 1 — Data Communication and Networking; 2 — Multimedia-related Courses; 3 — Information Technology and Multimedia (Multimedia Programming); 4 — 4G and 5G Standards, Technologies and Architecture; 5 — Modulation, Channel Equalisation and Diversity Techniques for Mobile Radio Communication Systems; 6 — Multimedia Technology (Graphic and Multimedia); 7 — Data & Network Security; 8 — Advanced Signal Processing; 9 — Multimedia-based Instructional Design.

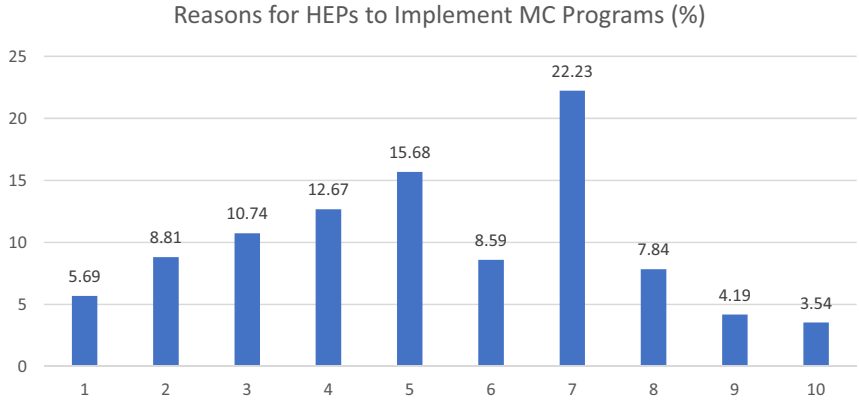

Fig.11. Reasons for HEPs to implement micro-credential programmes.

Notes: 1 — To offer flexible learning style; 2 — Market needs (external forces) — students and working adults; 3 — To recognise digital certification through micro-credential courses as part of professional development; 4 — New business model; 5 — Market needs from industries (prefer micro-credential than conventional degree certificates); 6 — Improve quality of course design; 7 — A sampler of diploma/undergraduate programmes; 8 — Marketing tool for acquiring new students through credit transfers; 9 — Expanding outreach (programme taster); 10 — Greater collaboration with industries (dual award certification).

Channel Equalisation and Diversity Techniques for Mobile Radio Communication Systems, 4G and 5G Standards, and Technologies and Architecture courses.

6.1.7. *Reasons for HEPs to implement micro-credential*

In order to understand the role of micro-credentials from the HEPs' perspective, the reasons for the institutions to implement these courses were investigated. Figure 11

shows the data obtained for this study. Most of the HEPs offered micro-credentials as a sample of diploma/undergraduate programmes. On the other hand, institutions offered micro-credentials since there are market needs from industries which prefer MS to conventional degree certificates. This is because micro-credentials are seen as a way of meeting upskilling requirements for individuals looking to advance their career and to provide a skilled workforce for rapidly changing industries (Oliver, 2019; Desmarchelier and Cary, 2022).

6.1.8. *Construction validity and reliability test*

Initially, this study proposed a set of 12 factors that were expected to impact the implementation of micro-credentials. However, it was found that six of these factors had a Cronbach's alpha value lower than 0.7, indicating a weak interrelatedness among the items (Ekolu and Quainoo, 2019). This implies that the questionnaire used in the study did not include enough questions, and the items with low alpha should be eliminated due to their poor correlation (Tavakol and Dennick, 2011). Furthermore, the factors with poor alpha values also resulted in insignificant outcomes. Consequently, a step-by-step approach was taken to remove the items with weak correlation one by one, as depicted in Fig. 12, until all remaining items achieved a Cronbach's alpha value higher than 0.7.

Outer loading is important for the relationship between construct and observable items. The accepted value for outer loadings should be 0.4 and above, values 0.7 are good (Hair *et al.*, 2021). As Table 2 shows, all items are higher than 0.4, and a majority of them are greater than 0.7. Besides, the construct validity such as composite reliability (CR) and Cronbach's alpha is used to measure whether the collected items are measuring the same characteristic consistently (Barbera *et al.*, 2020; Schrepp, 2020). One way to determine the construct validity is to have CR that is larger than 0.7, it is the same as Cronbach's alpha. As Table 3 shows, both CR and Cronbach's alpha are all greater than 0.7. In other words, this is a good sign of variance for a construct held towards the measurement error. While average

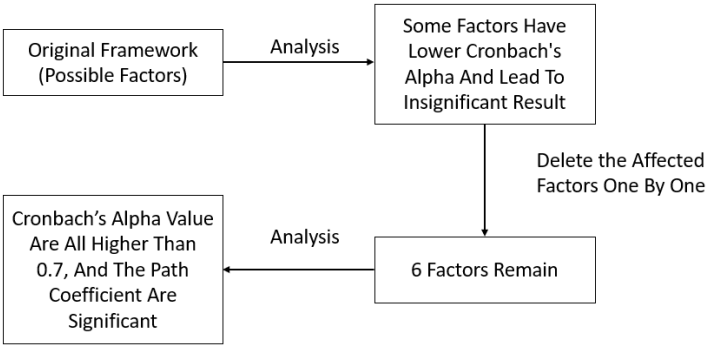

Fig. 12. The analysis process of the research.

Table 3. Construct validity and reliability.

Construct	Items	Outer loadings	Composite reliability (CR)	Cronbach's alpha	Average variance extracted (AVE)
Deliverables competency	DC1	0.481	0.769	0.704	0.414
	DC2	0.753			
	DC3	0.483			
	DC4	0.869			
	DC5	0.533			
Infrastructure readiness	IR1	0.662	0.817	0.701	0.529
	IR2	0.741			
	IR3	0.714			
	IR4	0.786			
Learner centricity	LC1	0.672	0.815	0.727	0.424
	LC2	0.697			
	LC3	0.628			
	LC4	0.672			
	LC5	0.623			
	LC6	0.608			
Management support	MS1	0.724	0.817	0.702	0.528
	MS2	0.719			
	MS3	0.702			
	MS5	0.763			
Perceived outcome	Out1	0.665	0.8	0.702	0.401
	Out2	0.678			
	Out3	0.632			
	Out4	0.633			
	Out5	0.575			
	Out7	0.609			
Quality assurance	QA1	0.717	0.823	0.731	0.482
	QA2	0.624			
	QA3	0.712			
	QA5	0.725			
	QA7	0.687			
Competency skillset	TC1	0.612	0.807	0.713	0.411
	TC2	0.579			
	TC3	0.673			
	TC4	0.700			
	TC5	0.628			
	TC6	0.650			

variance extracted (AVE) is a measure for the variance captured by a construct in a relationship due to the measurement error. The accepted value for AVE is any value higher than 0.5, while for any value less than 0.5 with CR higher than 0.6, the convergent validity for a construct is still sufficient (Lam, 2012; Huang *et al.*, 2013). As Table 3 shows, the values of CR are all higher than 0.6, and the AVE with 0.4 is accepted. This indicated that the construct validity and reliability are both satisfactory.

6.2. *Discriminant validity analysis*

The discriminant validity test is to determine whether the constructs are truly distinct from each other by empirical standards. According to Henseler *et al.* (2015), the Heterotrait–Monotrait (HTMT) value should be smaller than 1 to indicate that the true correlation of the constructs is different from one another. Another way to access discriminant validity is to examine the value of the Fornell–Larcker criterion, in which the accepted value should be higher than the other correlation (Franke and Sarstedt, 2019). As Table 4 shows, all the HTMT values are smaller than 1, indicating a construct is different from the others. Table 5 indicates the value of the Fornell–Larcker criterion is larger than other correlations. To this extent, it can be concluded that the results proved the existence of discriminant validity in this study.

Table 4. HTMT ratio.

Construct	Competency skillset	Deliverables competency	Infrastructure readiness	Learner centricity
Competency skillset	0	0	0	0
Deliverables competency	0.154	0	0	0
Infrastructure readiness	0.900	0.168	0	0
Learner centricity	0.968	0.165	0.933	0
Management support	0.941	0.148	0.974	0.951
Perceived outcome	0.956	0.211	0.963	0.934
Quality assurance	0.895	0.162	0.86	0.809

Table 5. Fornell–Larcker criterion.

Construct	Competency skillsets	Deliverables competency	Infrastructure readiness	Learner centricity	Management support	Perceived outcome	Quality assurance
Competency skill set	0.641	0	0	0	0	0	0
Deliverables competency	0.126	0.644	0	0	0	0	0
Infrastructure readiness	0.636	0.147	0.727	0	0	0	0
Learner centricity	0.651	0.14	0.669	0.698	0	0	0
Management support	0.666	0.133	0.686	0.678	0.727	0	0
Perceived outcome	0.679	0.187	0.633	0.677	0.659	0.686	0
Quality assurance	0.647	0.138	0.621	0.593	0.626	0.647	0.694

6.3. *Multicollinearity analysis*

Multicollinearity is present where there is a correlation between multiple independent variables which can impact the regression results (Gujarati, 2011). Besides, the importance of multicollinearity analysis is to ensure that the framework can be run correctly (Shrestha, 2020). The Variance Inflation Factor (VIF) is one of the measurements for multicollinearity. Therefore, any value greater than 5 refers to the existence of a multicollinearity issue. MS4 and Out6 were removed due to the higher VIF, Table 6 shows the VIF value for all items is smaller than 5 which means there are no multicollinearity issues in this study.

Table 6. Multicollinearity analysis.

Construct	Items	VIF
Deliverables competency	DC1	1.272
	DC2	1.419
	DC3	1.415
	DC4	1.408
	DC5	1.278
Infrastructure readiness	IR1	1.251
	IR2	1.446
	IR3	1.333
	IR4	1.514
Learner centricity	LC1	1.367
	LC2	1.537
	LC3	1.345
	LC4	1.506
	LC5	1.368
	LC6	1.309
Management support	MS1	1.354
	MS2	1.383
	MS3	1.338
	MS5	1.474
Perceived outcome	Out1	1.310
	Out2	1.386
	Out3	1.319
	Out4	1.341
	Out5	1.285
	Out7	1.257
Quality assurance	QA1	1.380
	QA2	1.169
	QA3	1.435
	QA5	1.444
	QA7	1.363
Competency skillset	TC1	1.254
	TC2	1.280
	TC3	1.398
	TC4	1.485
	TC5	1.306
	TC6	1.402

6.4. *Hypothesis testing*

The hypothesis framework and each relationship are shown in Fig. 13. It is believed that the infrastructure readiness and deliverables competency under technological factors have an impact on the HEPs to adopt micro-credentials. Besides, as mentioned above, the organisational factors, including management support and quality assurance are significant for HEPs to prepare for micro-credentials adoption. Last, the people factors such as competency skillset and learner centricity are suggested to have a positive effect on the HEPs to adopt micro-credentials.

Hypothesis testing is used to determine the relationship between each variable for a random sample, with a two-tailed 95% confidence level. The hypothesis test enables evaluation of the strength before implementing the framework (Emmert-Streib and Dehmer, 2019). As shown in Table 7, the hypotheses were tested, and some of the factors are insignificant. Therefore, there are only six hypotheses that are significant.

6.5. *Discussion from HEPs perspective*

H_1 has pointed out the significant relationship between infrastructure readiness and the adoption of micro-credentials. This is the most significant factor for HEPS to implement micro-credentials. HEPs should allocate enough funds to acquire appropriate technology infrastructure to provide the best online learning experience for

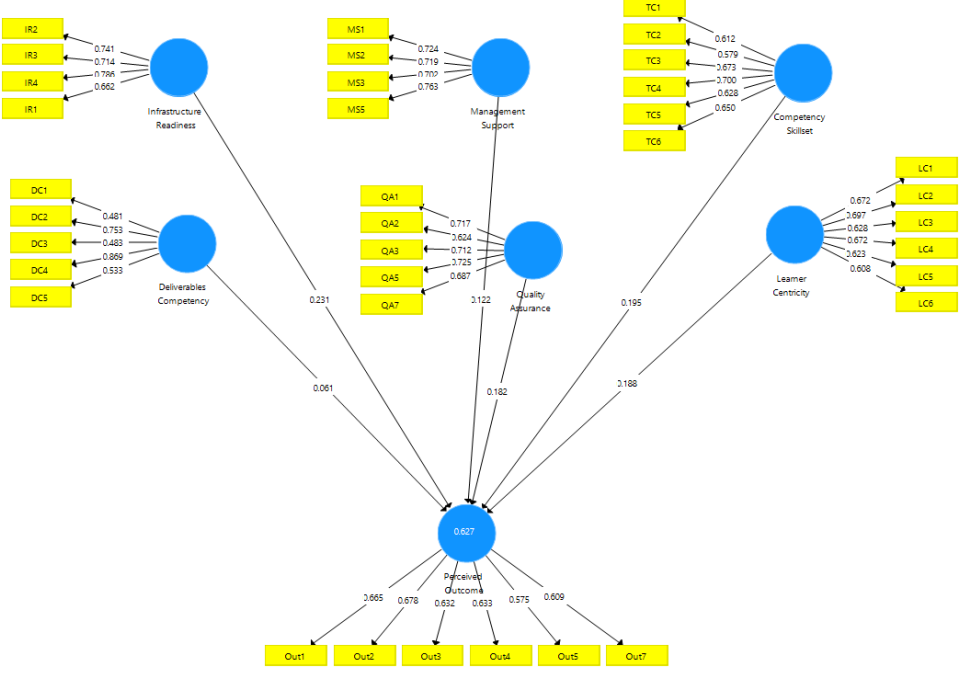

Fig. 13. Hypothesis testing.

Table 7. Hypothesis testing.

Hypothesis	Beta	SE	*t*-statistics	*p*-values	Decision
H_1 Infrastructure readiness → Perceived outcome	0.145	0.144	2.812	0.005	Accepted
H_2 Deliverables competency → Perceived outcome	0.051	0.057	1.942	0.052	Not accepted
H_3 Security and reliability → Perceived outcome	0.029	0.029	0.515	0.607	Not accepted
H_4 Organisational culture → Perceived outcome	0.105	0.105	2.238	0.025	Accepted
H_5 Management support → Perceived outcome	0.061	0.062	1.141	0.254	Not accepted
H_6 Strategic alignment → Perceived outcome	0.032	0.033	0.572	0.567	Not accepted
H_7 Cultivation of innovation → Perceived outcome	0.07	0.067	1.28	0.201	Not accepted
H_8 Customer centricity → Perceived outcome	0.145	0.142	2.735	0.006	Accepted
H_9 Quality assurance → Perceived outcome	0.121	0.123	2.613	0.009	Accepted
H_{10} Competency skillset → Perceived outcome	0.075	0.075	1.302	0.193	Not accepted
H_{11} Learner centricity → Perceived outcome	0.107	0.108	1.742	0.082	Not accepted
H_{12} Adaption and agility → Perceived outcome	0.084	0.089	1.852	0.064	Not accepted

learners (Che Ahmat *et al.*, 2021; Fischer *et al.*, 2022). For instance, the internet connectivity of the online platforms is fundamental for online learning. Furthermore, the collaboration with third-party to provide subscription-based pre-record lecture videos for troubleshoot handling (McGreal *et al.*, 2022). For example, HEPs can work with famous online learning platforms such as Moodle, Google Classroom and Open Learning to provide the best and smoothest learning experience for learners. Besides, H_2 shows a positive relationship between deliverables competency and perceived outcome. This requires the HEPs to implement a supportive and

computing online learning environment to deliver knowledge and skills to the learners (Mugayitoglu *et al.*, 2021). For example, interactive video recording and built-in exercise can make the understanding of a difficult topic easier. Furthermore, convenient and organised platforms are important in delivering competencies for learners (Kumar *et al.*, 2022). For example, the HEPs need to ensure their online learning platforms are smooth and supportive to ensure the maximum effectiveness of the online learning experiences.

Furthermore, H_5 shows that management support is significant for micro-credential implementation. The top-level management support in technical capabilities and funding for support systems is critical for micro-credential implementation (Mathur *et al.*, 2018). For example, the leadership perception to support the micro-credential implementation is important and needs to be communicated across the HEPs. In addition, the HEPs' management should put in more effort including admission, recruitment, professional educators training and many more to ensure the quality of micro-credential provided (Ahsan *et al.*, 2023). For instance, the financial support from top management for micro-credentials is critical. H_9 refers to the positive relationship between quality assurance and micro-credential implementation. The quality assurance of micro-credentials is critical when it comes to the recognition of the new education forms. In other words, this means the HEPs should establish a recognised and standardised value for the micro-credentials to improve the micro-credentials status (Resei *et al.*, 2019; Fisher and Leder, 2022). For example, the recognition of learning assessment across HEPs and industries needs to be communicated and to agree on a standard examination to recognise the digital badge earned. In addition, HEPs should improve the teaching quality, to further analyse the operation of micro-credentials internationally. Besides, HEPs should also implement quality assurance systems for online education including sharing mechanisms, evaluation systems and operation models to ensure the learning experience provided (Brown *et al.*, 2021). To this extent, learners can choose high-quality micro-credentials to maximise their learning experience.

As the result shows, H_{10} indicates the greater the competency skillset, the larger the readiness for HEPs to adopt micro-credentials. This is because the HEPs should have higher skills to educate learners successfully. For example, the usage of blockchain technology of HEPs educators can provide better guidance for learners during online learning (Alsobhi *et al.*, 2023). In addition, the professional tools set usage of educators can minimise the learners' training time and cost to achieve effective and efficient learning outcomes (Wheelahan and Moodie, 2021). H_{11} shows that learner centricity has a positive impact on micro-credentials implementation. This is because the HEPs need to provide the learning option between online and face-to-face for learners to meet their needs. Many of the HEPs have focussed on the implementation of online learning during COVID and forced the students to remain online. Therefore, the ownership of choosing the option between online and face-to-face can generate a better micro-credential result that leads to effective learning outcomes (El-Farra *et al.*, 2022; Rof *et al.*, 2023). In addition, the communication

between educators and learners can establish a trust-based relationship that can smoothen the learning experience (Ramlall and Cross, 2021). For example, with support from educators, learners can achieve professional standards by having academic freedom such as learning engagement.

7. Discussion

7.1. *MQA perspectives — policy makers*

Findings from the study have pointed out the importance of micro-credentials and the challenges faced by HEPs during the implementation process. As such, it becomes critical that the development and implementation of micro-credentials at the HEP level be monitored and quality assured (Tham and Chong, 2023). There have also been calls for a more centralised and standardised management of micro-credentials to ensure the equivalency and recognition of micro-credentials throughout HEPS in Malaysia (Sabtu and Ismail, 2022).

On this note, the MQA who takes on the responsibility as the quality assurance and accreditation agency in the country has been a major facilitator and supporter of flexible education in Malaysia. One such initiative in support of flexible education was the development of the Guidelines to Good Practices: Micro-credentials (GGP: Micro-credentials) in 2020. The GGP was developed with the intention to serve as a reference to the HEPs in the development of micro-credential-based programmes or courses. The GGP aimed (1) to support the implementation of flexible learning by providing references to the stakeholders on the introduction of micro-credentials; (2) to facilitate and empower all types of micro-credentials whether it is used as supplementary or substituting contents; and (3) to provide a policy on breaking down content for recognition of stand-alone awards and credit transfer purposes.

7.2. *HEPs readiness*

In conclusion, while the popularity of micro-credentials in the general Malaysian population is still relatively low owing to poor marketing and awareness levels, the degree of readiness amongst Malaysian HEPs is indicating an upward trend with more and more recognising the potential of micro-credentials in meeting the evolving needs of learners and the job market both domestically and internationally. This is especially seen in rapidly evolving technological fields such as healthcare, C&M, and engineering.

7.3. *Recommendation*

This study proposes several recommendations to enhance the recognition and value of micro-credential programmes in the field of Communication and Multimedia. Firstly, it is recommended that government agencies and universities establish a centralised system for recognising and accrediting micro-credential programmes.

This would create a transparent ecosystem where industry players and service providers can ensure the widespread acceptance and value of these programmes for learners. Efforts should be made to develop a framework that guarantees the quality and rigor of micro-credentials, ensuring their recognition by employers, educational institutions, and other relevant stakeholders. Involving industry players in the development of programme content can ensure that the programmes align with the demands of the global market, thereby enhancing the reputation and recognition of micro-credential programmes.

Additionally, the government can enforce policies that enable flexible learning pathways, such as the implementation of "Training Leave". Currently, learners often have to take personal leave to attend different micro-credential programmes. However, micro-credentials offer the advantage of flexible learning, allowing individuals to acquire skills and credentials at their own pace and convenience. By

Table 8. Summary of recommendation for each role.

Roles	Recommendation
MQA	Monitoring and quality assurance for the development of micro-credential at the HEPs level
	To support flexible education in Malaysia
	Develop clear definition of micro-credential and outlines key principles for their development and delivery
	Require HEPs to register their micro-credential to ensure the quality is embedded to the design and delivery
HEPs	HEPs needs to increasingly promote micro-credential programmes in Malaysia due to the poor marketing and awareness levels
	Collaboration between HEPs, industry experts and employers is important to bridge the gap between academia and job market
	HEPs' management needs to allocate adequate financial resources and digital technologies for micro-credential learning
	Educators need to be trained to develop interactive lessons for effective learning experiences
Moving forward and future direction	Recommendations to propel the implementation of micro-credential in Malaysia: – Harmonised integration between conventional degree and micro-credential to offer diverse learning pathways – Focus on industry recognition and credibility of micro-credential among employers – Emphasise lifelong learning in workplace to facilitate professional and career development – Utilise technological advancements for secure and efficient micro-credential delivery
	Suggestions for developing new micro-credential programmes: – Conduct group discussion with industry to identify the skills and knowledge required – Develop standard syllabus to ensure transparency – Consider covering the micro-credential learning fee under HRDF to increase acceptance and motivation

leveraging online platforms and digital technologies, accessible and personalised learning experiences can be provided. Therefore, by enforcing policies that allow employees to utilise "Training Leave" for upskilling purposes, both employers and employees can benefit. This approach would enhance the competitiveness and competency of Malaysia's workforce in the globalised market.

Overall, these recommendations (Table 8) aim to establish a recognised and valued ecosystem for micro-credentials in Communication and Multimedia, promote flexible learning pathways, and empower employees to enhance their skills and competencies in alignment with the demands of the modern job market.

Acknowledgments

This research project is jointly funded by Malaysian Communications and Multimedia Commission Digital Society Research Grant Project Code: MCMC(RED)700-8/2/11/JLD.4(15) and UCSI University REIG Grant Project Code REIG-ICSDI-2022/070.

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