Innovative Strategies in Designing the Micro-Credentials Module

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ABSTRACT

The twenty-first century is marked by rapid and disruptive change. In such a fast-paced economy, individuals either workers or students must be able to reskill and upskill to stay on top of it. However, not everyone has the opportunity to enter a higher education institution to obtain a certificate for the required skills. Thus, Micro-Credentials Courses are the solution to develop one's skills and they are eligible for everyone. Therefore, this research aims to present a unique and innovative strategy to develop and manage the process of designing the Micro-Credentials module in Mathematics topic in Universiti Teknologi MARA. Educators have proposed a series of strategies for developing the Micro-Credentials module based on basic principles recommended by the Malaysian Qualifications Agency, namely outcome-based, personalized, on-demand, transparent, secure and shareable. The findings revealed that the Micro-Credentials developed and designed based on these basic principles is suitable for online distance learning. The designed module provides a shorter duration course, a flexible education model and enables workers or students to reskill and upskill on a particular mathematics topic.

Keywords: *Mathematics, Micro-Credentials, Online Learning*

INTRODUCTION

In 2018, Malaysia launched National Policy on Industry 4.0 (The Asean Post, 2018). The policy was primarily concerned with digitally transforming the manufacturing sector and other connected services to embrace Industry 4.0. Furthermore, Malaysia is envisioned as a strategic partner for smart manufacturing, a primary destination for high-technology enterprises, and a total solutions supplier for the region's manufacturing sector, according to the policy. One of the policy-focused initiatives is skills and talent. The strategy's goal is to upskill and future-proof the workforce. This initiative has become a motivation for this study to design an innovative strategy for designing the Micro-credentials module.

According to Schwab (2016), employment markets in the 4th revolution industry will require more high-skilled and specialized individuals. This movement is strongly related to the field of education, where professionals' responsibility is to train students to navigate society successfully. This trend is closely tied to the field of education, where experts' role is to prepare students to successfully navigate society. However, not everyone has the opportunity to enrol in a higher education institution to obtain the essential skills certification. Furthermore, common professional development or diplomas are usually accomplished in a whole-group format to adapt education to the needs of districts and schools. It is also frequently expensive, time and space-constrained, and offers few opportunities to demonstrate the content (Bill and Melinda Gates Foundation, 2014). As a result, Micro-Credentials have been proposed, to provide essential professional growth and link the field of education with current industry and commercial trends. Furthermore, according to Wheeler (2020), a study on digital badges related to Micro-credentials had an initial surge of enthusiasm among enthusiasts but then settled into a pattern of more tiresome long-term acceptance. Most scholars represent a confluence of important challenges for educational technology, such as developing user-friendly, scalable technology, increasing public awareness, and establishing policies and support frameworks to make them valuable. Only the first of these concerns are directly related to technology; the others, which are more serious, concern awareness and legitimacy. As a result, the importance and benefits of Micro-credentials entice Malaysian higher education institutions to promote Micro-Credentials in learning.

Universiti Teknologi MARA has begun to include Micro-Credentials in its Strategic Planning UiTM2025, to offer courses in the form of Micro-Credentials. Students and working adults in the country, as well as international students, can profit from the courses. Indirectly, it may improve graduates' employability. The Institute of Continuing Education and Professional Studies (iCEPS) oversaw managing and promoting the Micro-Credentials offered by UiTM (Ahmat, 2021). The UiTM Micro-Credentials are in the form of online distance learning, with materials offered online platform. It is simple to access at any time and from any location, and it can be learned by many individuals with the necessary direction provided in the Micro-Credentials. The courses of Micro-Credentials in UiTM are developed by educators in the university. Educators create the content following the comprehensive Guidelines to Good Practices given by the Malaysian Qualifications Agency (Malaysian Qualifications Agency, 2020). Moreover, the content of the Micro-Credentials courses is vetted by course experts as well as exhibited in the yearly e-Content Development Competition organized by the university. Many constructive comments and recommendations are given for the continuous improvement of the Micro-Credentials. Hence, the quality of the content is continuously checked and controlled.

Hence, this paper is to develop the strategy of a Micro-Credentials module by the educators in Universiti Teknologi MARA. The Micro-Credentials module involved the algebra topic was developed. This is a fundamental topic in Mathematics mainly taken by science and engineering students in the first semester. This paper aims to present the unique strategy for developing and managing the process of the Micro-Credentials module in the algebra topic. The process began with planning to successfully create the e-content of the Micro-Credentials module.

LITERATURE REVIEW

The concept of the Micro-Credentials course is to provide an adult to follow a shorter, work-related and self-learning module for continuous improvement in various knowledge and skill. To remain competitive, employable in this globalized and fast-changing world, lifelong learning for all adults is indeed essential. Most of the Micro-Credentials courses are offered through the mode of online learning using an online learning management platform under higher education institutions. Online learning has the advantage of self-paced learning, and it is easy to access anywhere and anytime (Acree, 2016; Yahya et al., 2021). It especially provides convenience to working adults in obtaining certificates in part timely.

In recent years, Micro-Credentials has gained its popularity globally with the concept of providing lifelong professional learning to people through open distance learning (Ahmat, 2021). Not every adult has the opportunity to enter formal higher education institutions to obtain a certificate. With the advance in technology, online distance learning has become possible and accessible to many people. The emergence of Micro-Credentials has provided the opportunity for many people who wish to have a mix of alternative credentials. There are different types of Micro-Credentials that include micro-degrees, certificates, badges, nano-degrees, licenses, specializations and so on (Mischewski, 2017). Therefore, Micro-Credentials also enable adults to organize their learning into an aggregated qualification.

The advancement of technology has led many industries or sectors including the education sector to an unprecedented change in recent years. Since the beginning of the late 20th century, the traditional industry has shifted to an economy based on information technology due to the Industrial Revolution. In Third Industrial Revolution, computers were introduced, and many processes are computerized by computer technology. Living in the 21st century, the digital environment influences more people to have access to the internet connection and owning smartphones or tablets, a noticeable change is observed in the way people work, live and study. How people spend their leisure time also cannot be separated from the Internet. Therefore, the impact of the Internet and technology on our daily life is huge. The economy is moving towards Industry 4.0 now. Industry 4.0 is also known as the Fourth Industrial Revolution. It is a phase in Industrial Revolution that depends highly on the Internet, real-time data, machine learning and automation (Xu et al., 2018). With the high connectivity among the electronic devices with the Internet, the Internet System and the Internet of Things has made Industry 4.0 a reality (Bloem et al., 2014; Morrar et al., 2017). With the emergence of the Fourth Industrial Revolution, the era of education is also entering a new phase of the revolution, that is Education 4.0. Education 4.0 is an approach to learning that is aligned with the advancement of technology. Learning management in Education 4.0 should evolve with time (Puncreobutr, 2016). Many higher education institutions have adopted new approaches to teaching and learning to produce human capital that is equipped with skills needed in the Fourth Industry Revolution era.

Micro-Credentials also allow professionals to identify the links that teachers have made to their practice by requiring teachers to produce artefacts that show how they have integrated the practice into their classrooms. They were able to adjust the lesson plans by adding up some strategies to help students solve mathematics questions in an easy way such as long division (Acree, 2016). The majority of engineers were taking an extra classes for specific work areas such as statistics, software and project management. Additional courses taken are projected to be constructed through the Micro-Credentials approach since it is only for the required skills and learners are tied with working hours. The need of having Micro-Credential for Mathematics topics is crucial for certain professions, as they required financial mathematics knowledge, mathematical modelling and programming skills (Cook et al., 2017). Research conducted by Cook (2021) stated that the module designed specifically for engineering students to master a few topics in mathematics such as geometry, algebra, calculus, statistics and probability provides a practical approach to delivering mathematics content in a project-based assignment. Additionally, it gives various pathways for students with different mathematics backgrounds and majors to learn the required topics. This new approach helped students to develop and increase flexibility in mathematical skills required in the engineering profession.

This has also been explored in prior studies by Pandey and Falemaa (2018) where Micro-Credential in Mathematics for engineers was offered in secondary school for students to develop the skills required to be applied in the engineering field as well promoting STEM-related education. The goals of this course are to improve mathematical skills, concepts, and understanding so that students can improve calculations and problem-solving skills in the context of engineering. The topics covered in the syllabus were chosen by using the curriculum mapping process. For instance, the areas covered in the courses are algebra related with logic expression and graphs, calculus and statistic approach.

According to Hunt (2020), the novel design of Micro-Credentials can address many of these difficulties. It is done by personalization, competency-based, adaptable, and collaborative professional development. Therefore, Micro-Credentials, despite their adolescence, can deliver meaningful professional development, and link the field of education with current industry and commercial trends. For example, Micro-Credentials give benefit to educators and learners by offering professional learning that addresses diverse, personal needs and goals to adult learners as well as educators. In addition, Micro-Credentials can develop and demonstrate leadership and instructional skills for both educators and learners. Micro-Credentials also promote effective collaboration among administrators and educators with shared platforms to discuss, meet, spread information and leadership practices, reducing costs, despite more flexible learning. Moreover, the increase in acceptance level of Micro-Credentials is mainly due to three important factors. First due to the importance of lifelong learning to continuously acquire new knowledge. Second, broader coverage of internet connectivity. Third, higher usage of electronic devices such as smartphones, laptops and personal computers.

Numerous studies discussed the issues and challenges in developing successful Micro-Credentials. The issues covered different ways to create personalized, technology-oriented learning, to motivational aspects in learning (Crow, 2016; Ellis et al., 2016). It is stated in Ghasia et al. (2019) that the Micro-Credentials in higher learning institutions allow for the integration of digital badges within university and community engagement. The result of the study also suggested that students and lecturers were optimistic that Micro-Credentials could stimulate lifelong learning and expand the scope of the university's mandate. However, the approach and strategy in designing learning materials in different courses of Micro-Credentials, need to be carefully planned and carried out. In addition, previous studies show there is still a lack of studies on the Micro-Credentials module on mathematics topics. Thus, in this paper, the unique strategy in designing the Micro-Credentials module related to a mathematical especially topic of Functions is focused on.

METHODOLOGY

The study presented in this article is focused on the strategy adopted to develop the Micro-Credentials module on the topic of Functions. The module was developed by the educators in Universiti Teknologi MARA Campus Johor. The targeted learners for the module are those who wish to enhance their understanding of basic knowledge in Preliminary Level Mathematics. It is suitable for any learner from science and engineering studies in diploma studies in university. Besides, students from the secondary school at the upper level are also suitable to enrol in this Micro-Credentials module to enhance their mathematics skills.

Process of Developing the Micro-Credentials Module

The details of the process of developing the Micro-Credentials module are further elaborated in the following sections. In this study, there are five steps included starting from identification to end product (module of Micro-Credentials). Figure 1 shows the steps in developing the Micro-Credentials module in this study.
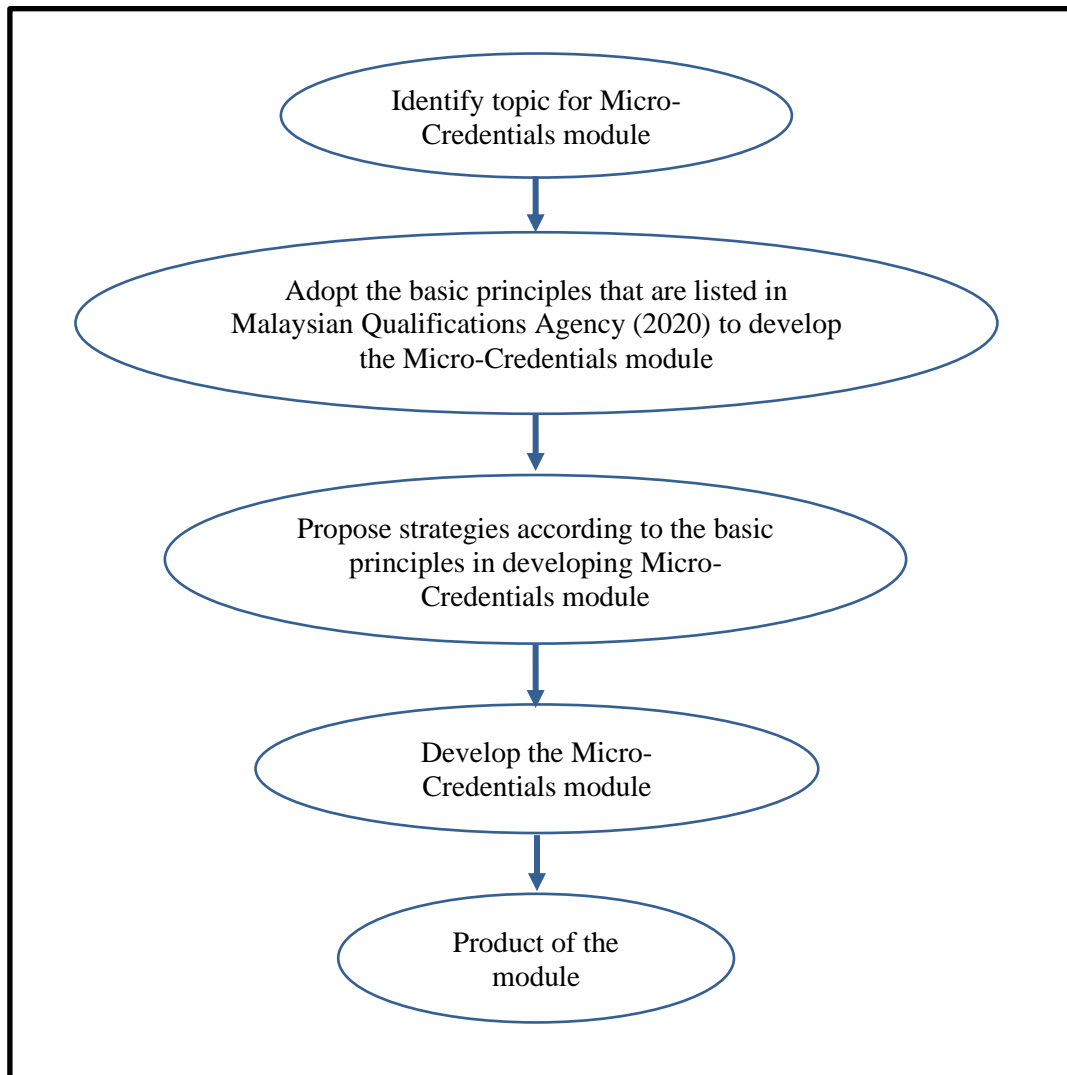
Figure 1: Process of Developing the Micro-Credentials Module

Identify Topic for Micro-Credentials Module

Before the development of the Micro-Credentials module on the topic of Functions, a preliminary review is done to identify the need and importance to develop the module on this topic. It was found that there is a wide range of mathematics subjects offered in engineering and science courses. The mathematics topics are such as pre-calculus, algebra, calculus, advanced calculus, statistics and linear algebra. Having a strong foundation in the preliminary level of mathematics would be the prerequisite for the students to perform well in an advanced level of mathematics. It is reported in Ismail (2012) that engineering students who hold a strong mathematics foundation are motivated to progress in their engineering programs. Pre-calculus is the first preliminary level of mathematics at the diploma level. A check on the topics covered in pre-algebra are: 1) Coordinates, graphs and lines, 2) Functions, 3) Systems of equations and inequalities and 4) Trigonometry. Among these topics, the Functions topic is the basis for other advanced level mathematics. Students who have a good understanding of Functions can perform well in topics like plotting a graph, understanding the behaviour of a line or a curve, applying the technique of differentiation and integration. Therefore, the topic of Functions is identified to be a critical topic for students to master. This had motivated educators to create a Micro-Credentials module.

The Basic Principles to Develop Micro-Credentials Module

Micro-Credentials is designed to be a short course focusing on a smaller volume of learning compared to the traditional on-campus course. Most learners aim to complete the course in a shorter duration and many of them even study in part timely. The targeted learners of Micro-Credentials comprise career adults and on-campus students. Hence, flexibility learning has been the main challenge and indirectly become the unique feature of the Micro-Credentials module. Technology is used to design and develop modules that can cater for different types of learners. The e-content is stored online and can be easily accessed by most people.

Several basic principles in designing and developing good Micro-Credentials are listed in the Malaysian Qualifications Agency (2020). The basic principles are outcome-based, personalized, on-demand, secure and shareable, transparent (Figure 2).
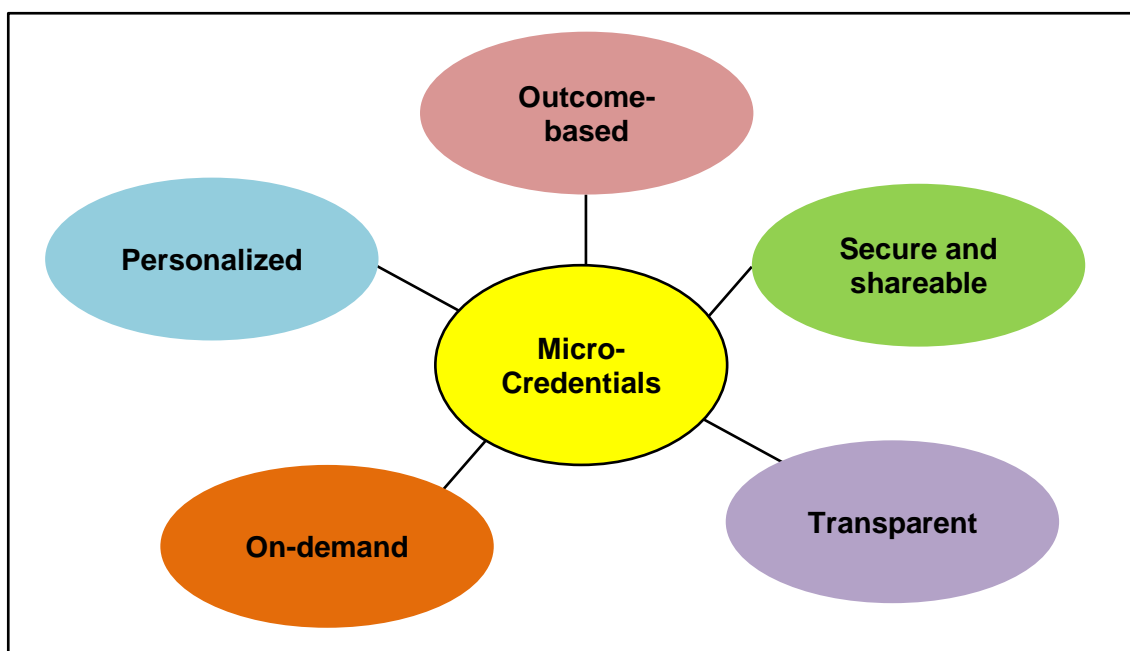

Figure 2: Basic Principles in Designing and Developing Good Micro-Credentials Listed in the Malaysian Qualifications Agency (2020)

Proposed Strategies Based on the Basic Principles to Develop the Micro-Credentials Module

The educators in Universiti Teknologi MARA Campus Johor have proposed a series of unique strategies in developing the Micro-Credentials module for Functions topic based on the basic principles recommended by the Malaysian Qualifications Agency (Table 1).

Table 1: A Series of Innovative Strategies Proposed in Developing the Micro-Credentials

Basic principles in designing and developing good Micro-Credentials recommended by the Malaysian Qualifications Agency	Strategies proposed in this study to develop and design the Micro-Credentials in the topic of Functions
Outcome-based	Assessment is provided. The attainment of the outcome is measurable through assessment.
Personalized	Asynchronous Learning through Teaching Videos. The pace of learning is personalised where asynchronous learning is allowed.
On-demand	The Micro-Credentials module is designed to be short and focus on a specific fundamental topic in Mathematics.
Secure and shareable	The learning materials are placed in a secured online learning management system.
Transparent	The Micro-Credentials module provides a transparent detailed information on the mode of delivery, learning hours, assessment, credit, course objectives and learning outcomes.

Tools to Develop the Micro-Credentials Module and the Product of the Module

To develop the Micro-Credentials module, several teaching and learning tools are explored and used. Textbooks and internet resources are used as references to develop the content. Microsoft PowerPoint is used for developing learning materials in the form of presentations and voice recordings. The web-based Desmos application is used for developing the learning guide for the properties of the graph. The final product of the Micro-Credentials module is in the form of recorded teaching videos and the learning materials in PDF format. The duration from the early stage of planning until the final product took about one year to complete in the year 2021. The launching of the module is yet to begin. Therefore, the sampling of the learners' experience in this module has yet to be collected and analyzed.

RESULTS AND DISCUSSIONS

One of the uniqueness of this Micro-Credentials module is that lesson is delivered in smaller modules. Through these Micro-Credentials, students are able to complete each topic in a short period. Compared to MOOC (Massive Open Online Courses), Micro-Credentials require a shorter time to complete, and the scope of the module is smaller and more specialised. This Micro-Credentials consists of 7 chapters (Figure 3).

Figure 3: The Seven Chapters in Proposed Micro-Credentials

Each chapter is separated into several subtopics. For example, Chapter 1 is about the Introduction of Function. Chapter 1 is further divided into 3 subtopics, namely Introduction, Relations and Functions, Domain and range. Each subtopic has its learning materials such as teaching videos, learning outcomes, learning material, tutorials and formative assessments (quizzes). Examples of learning materials for Chapter 1 is shown in Figure 4. Through these learning activities, students will be able to understand clearly each chapter.
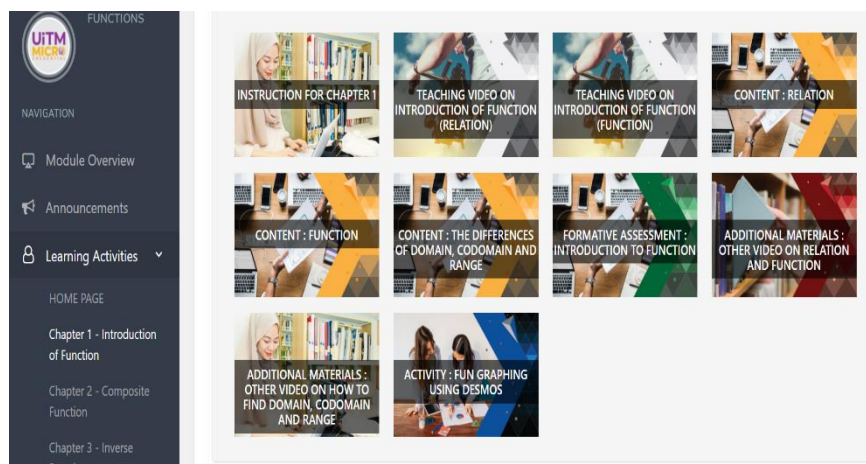

Figure 4: Learning Materials for Chapter 1 in Proposed Micro-Credentials Module

When the students complete all learning activities including continuous assessments and final assessments, they will be awarded an online certificate on these Micro-Credentials. Other than the learning materials and learning activities, some course-related information and survey are also developed for these Micro-Credentials (Figure 5). The information and survey are such as learner's satisfaction feedback, course information, scheme of work, student learning time, learning etiquette, disclaimer, survey before the lesson, survey after the lesson and frequently asked questions. These materials are designed to provide sufficient information to the students as well as get feedback from the learner's experience.
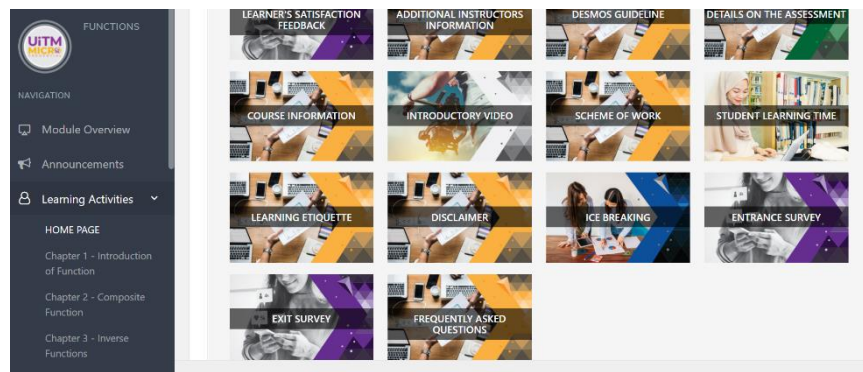
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Figure 5: Course-Related Information and Survey Developed for Proposed Micro-Credentials

Moreover, based on the educators' experience, not all students could excel in this preliminary level of mathematics due to a lack of confidence, shyness to consult a lecturer or could not fully understand the lesson during normal lecture hours. For educators' to encounter these common students' weaknesses, a few innovative strategies to create the Micro-Credentials module that is related to mathematics topic has been adopted. The strategies are i) incorporate technology in asynchronous learning, ii) repetitive learning approach, iii) immediate reflection after lesson. Figure 6 shows the flow of learning adopted in this Micro-Credentials module. Although there is no physical lecture conducted in Micro-Credentials, students could still gain knowledge by following the module systematically. It is further elaborated in the following sections.
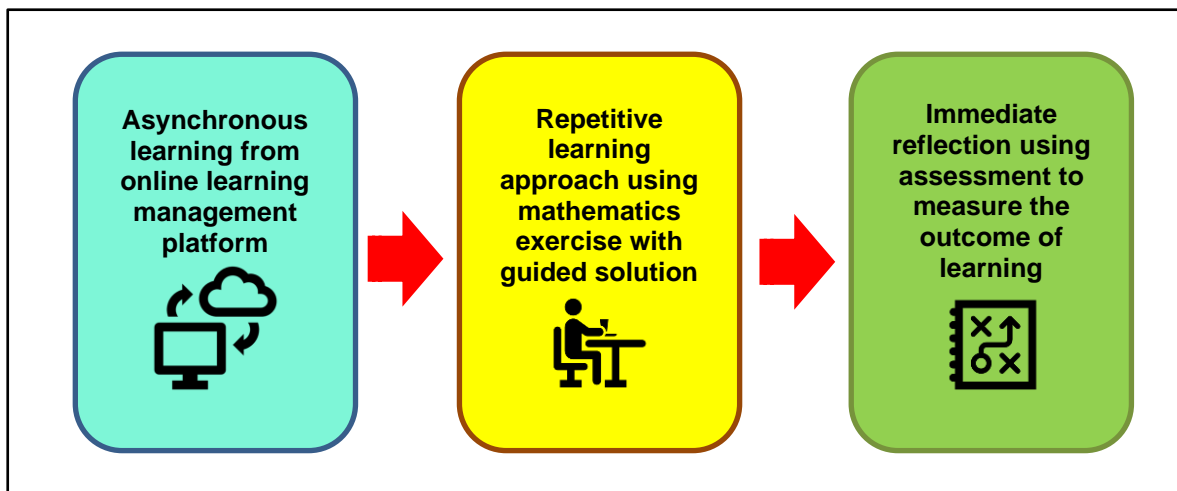

Figure 6: Flow of Learning Adopted in Micro-Credentials Module

Asynchronous Learning through Teaching Videos

The lesson for each sub-topics is delivered in the form of recorded teaching videos. A few factors are taken into consideration when developing the teaching videos. This is to enable the learner to have a humanizing experience in learning the lesson asynchronously through teaching video. The factors are i) clear presentation slide, ii) recorded with educators' voice, iii) speaking at moderate speed. To have a clear presentation slide, the content of the lesson is presented in Microsoft PowerPoint and Canva with animation. For each teaching video, the lecturer began the teaching by emphasizing the learning outcome to students. To engage students through teaching videos, the lecturer chose to use his

voice rather than computer narration to present the lesson. Personal reminders are constantly given to students in the teaching video. For example, the lecturer gives reminders to students to prepare necessary learning tools before starting the lesson. During the teaching video, the lecturer reminds students to write down the important point and make their notes.

When the explanation of the content is recorded in the educators' voice, the lecturer chose to speak at moderate speed. This is to ensure that learners can understand the lesson clearly. If the speed of speaking is too fast, students might miss the words. If the speed of speaking is too slow, students might feel bored in the lesson. Recorded teaching videos are well suited for mathematics courses because the lengthy working solution required a longer time for students to learn. Teaching videos can be paused and replayed. This could enable students to write down the lesson at their own pace. It is reported by Hartsell and Yuen (2006) that the use of video in teaching and learning also allows a learner to use their auditory and visual senses to learn courses with complex concepts and lengthy procedures. Furthermore, the videos created for this module are generally short videos where the duration is between 3-10 minutes. It is reported by Ng et al. (2021) that students preferred short teaching videos.

Repetitive Learning Approach

The teaching videos have advantages for learners where they can learn the lesson many times. It is different from in-campus classroom learning where a lesson is only delivered in the lecture hall. A lesson could not be repeated if the student was absent from the lecture. In this Micro-Credentials module, various activities are designed and provided to students after every lesson. As the nature of the course is mathematics, students should practice plenty of exercises to master the topic. According to Rosário et al. (2015), practice by doing more mathematics homework has a positive impact on mathematics performance. Hence, the activities provided are mainly mathematics questions related to the lesson. The activities are such as solving questions in the form of multiple-choice, short working solutions and checking to understand the concepts. As this Micro-Credentials is to cater for asynchronous learning, guided answers are provided for each activity.

Immediate Reflection After Each Lesson

After students complete learning a sub-topic, an assessment is provided for students to assess their understanding. Assessment is part of every learning process. With the assessment, students can reflect on what they know and what they do not know. This Micro-Credentials module is designed to provide a complete learning cycle for each learner. Knowing the learning outcome from the beginning of each topic until self-assessment at the end of the lesson, help build learner confidence. The element of outcome-based education is embedded into the development of this Micro-Credentials module. It is reported in numerous studies that outcome-based education is an important element in the learning process (Davis, 2003; Kaliannan & Chandran, 2012; Rao, 2020).

CONCLUSION

The Micro-Credentials module developed in this study used an online distance learning approach. By adopting technology in learning, it has provided an opportunity for students or working adults to acquire new knowledge and skills outside of the formal higher education system. The newly created Micro-Credentials module has the following advantages: i) shorter duration course that is manageable by students or working adults, ii) flexible education model that allows learners to learn at their own pace, iii) enable students to reskill and upskill on a particular mathematics topic. It is hoped that the unique and innovative strategies presented in this paper in developing the Micro-Credentials module could add to the reference of other educators who wish to develop a similar Micro-Credentials course.

Norbaiti Tukiman, Ng Set Foong, Mohamad Faizal Ab Jabal, Nurhazirah Mohamad Yunos, Nur Intan Syafinaz Ahmad,
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REFERENCES

Acree, L. (2016). Seven lessons learned from implementing micro-credentials. Friday Institute for Educational Innovation at the NC State University College of Education. https://www.fi.ncsu.edu/wp-content/uploads/2016/02/microcredentials. Pdf

Ahmat, N. H. C., Bashir, M. A. A., Razali, A. R., & Kasolang, S. (2021). Micro-Credentials in Higher Education Institutions: Challenges and Opportunities. *Asian Journal of University Education*, *17*(3), 281-290.

Bill and Melinda Gates Foundation (2014). Bill & Melinda Gates Foundation's 2014 Annual Report. https://www.gatesfoundation.org/about/financials/annual-reports/annual-report-2014

Bloem, J., Van Doorn, M., Duivestein, S., Excoffier, D., Maas, R., & Van Ommeren, E. (2014). The fourth industrial revolution. *Things Tighten*, *8*, 11-15.

Crow, T. (2016). Micro-credentials for impact: Holding professional learning to high standards. *Digital Promise*.

Cook, E., Chandrasekaran, S., Crossin, E., & Mann, L. (2017). The fundamentals are important… but what are they? In Proceedings of the 28th Annual Conference of the Australasian Association for Engineering Education (AAEE 2017), Sydney, 10-13 December 2017/Nazmul Huda, David Inglis, Nicholas Tse, Graham Town (eds.) (pp. 731-737).

Cook, E. (2021). Practice-Based Engineering: Mathematical Competencies and Micro-Credentials. International Journal of Research in Undergraduate Mathematics Education, 1-22.

Davis, M. H. (2003). Outcome-based education. *Journal of Veterinary Medical Education*, *30*(3), 258-263.

Ellis, L. E., Nunn, S. G., & Avella, J. T. (2016). Digital badges and micro-credentials: Historical overview, motivational aspects, issues, and challenges. In Foundation of digital badges and micro-credentials (pp. 3-21). Springer, Cham.

Ghasia, M., Machumu, H., & Smet, E. (2019). Micro-credentials in higher education institutions: An exploratory study of its place in Tanzania. *International Journal of Education and Development Using ICT*, *15*(1).

Hartsell, T., & Yuen, S. C. Y. (2006). Video streaming in online learning. *AACE Journal*, *14*(1), 31-43.

Hunt, T, Carter, R, Zhang, L & Yang, S (2020), Micro-credentials: the potential of personalized professional development, *Development and Learning in Organizations: An International Journal,* 34 (2), 33-35,

Ismail, N. A., Nopiah, Z. M., Asshaari, I., Othman, H., Tawil, N. M., & Zaharim, A. (2012). Mathematical performance of engineering students in Universiti Kebangsaan Malaysia (UKM). *Procedia-Social and Behavioral Sciences*, *60*, 206-211.

Kaliannan, M., & Chandran, S. D. (2012). Empowering students through outcome-based education (OBE). *Research in Education*, *87*(1), 50-63.

Malaysian Qualifications Agency (2020). Guidelines to Good Practices: Micro-Credentials.

Mischewski, B. (2017). Micro-credentials: A model for engineering education. New Zealand: Report commissioned by the Tertiary Education Commission (TEC).

Morrar, R., Arman, H., & Mousa, S. (2017). The fourth industrial revolution (Industry 4.0): A social innovation perspective. *Technology Innovation Management Review*, *7*(11), 12-20.

Ng, S. F., Ismail, A., & Tukiman, N. (2021). Students' perception on using teaching video in online learning during COVID-19 pandemic. *Journal of Creative Practices in Language Learning and Teaching*, *9*(1), 10-19.

Pandey, N., & Falemaa, L. (2018, January). Using micro-credentials to improve Pasifika participation in engineering education. *In 29th Australasian Association for Engineering Education Conference 2018 (AAEE 2018)* (p. 533). Hamilton, New Zealand: Engineers Australia.

Puncreobutr, V. (2016). Education 4.0: New challenge of learning. *St. Theresa Journal of Humanities and Social Sciences*, *2*(2).

Rao, N. J. (2020). Outcome-based education: An outline. *Higher Education for the Future*, *7*(1), 5-21.

Rosário, P., Núñez, J. C., Vallejo, G., Cunha, J., Nunes, T., Mourão, R., & Pinto, R. (2015). Does homework design matter? The role of homework's purpose in student mathematics achievement. *Contemporary Educational Psychology*, *43*, 10-24.

Roy, S., & Clark, D. (2019). Digital badges, do they live up to the hype? *British Journal of Educational Technology*, *50*(5), 2619–2636. https://doi.org/10.1111/bjet.12709

Schwab, K. (2016). The fourth industrial revolution: what it means, how to respond. Available at: www.weforum.org/agenda/2016/01/the-fourth-industrialrevolution-what-it-means-and-how-to-respond/

The Asean Post (2018, November 1). Malaysia launches Industry 4.0 policy. https://theaseanpost.com/article/*malaysia-launches-industry-40-policy*

Xu, M., David, J. M., & Kim, S. H. (2018). The fourth industrial revolution: opportunities and challenges. *International Journal of Financial Research*, *9*(2), 90-95.

Wheeler, M. (2020). 25 years of ed tech. AU Press. https://doi.org/10.15215/aupress/9781771993050.01

Yahya, N. A., Said, J. M., & Yusof, A. M. (2021). Students' self-regulated learning in open and distance learning for Mathematics course. *EDUCATUM Journal of Science, Mathematics and Technology*, *8*(1), 1-5.