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Promoting Digital Literacy in Higher Education: Case Study of a Medical Laboratory Program in Malaysia

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Abstract

Digital literacy has become a significant challenge in the education industry. Even the policymakers are now requiring digital literacy components to be incorporated in the learning domain. Thus, in reaching the goals, Medical Laboratory Technology educators should be digitally more literate. This study aims; 1) to investigate the perspectives of educators with regards to the implementation of digital literacy in teaching and learning for Medical Laboratory Programme; 2) to explore on how digital literacy in teaching and learning for Medical Laboratory Programme are implemented; 3) to identify the challenges of implementation of digital literacy in teaching and learning for Medical Laboratory Programme including ways to overcome it; 4) to identify the sustainability measures in implementing digital literacy in teaching and learning for Medical Laboratory Technology programme. This study employed a qualitative semi-structured interview to collect data from selected participants at a higher education institution in Kuala Lumpur. Following the theme analysis, the data was thoroughly examined in several stages before being reported. According to the findings, participants employed a variety of digital mediums or platforms to integrate digital literacy into teaching and learning. All of the participants expressed enthusiasm for the application of digital literacy in teaching and learning. They adhere to the syllabus requirements, design excellent instruction, utilise various literacies, and continually improve. However, difficulties such as a lack of digital competency, resources constraints, and a restricted budget were some of the identified barriers to digital literacy adoption. As a result, educators have to develop innovative planning and support strategies to address these issues. Therefore, this study suggests that greater consideration should be given to digital literacy by developing technical facilities, pedagogy, and policymakers.

Keywords: Digital Literacy, Higher Education, Case Study, Medical Program, Malaysia

Introduction

Medical Laboratory Technology (MLT) is one of the fastest growing health care fields. MLT is the field of medicine that is in charge of doing laboratory investigations for illness diagnosis, treatment, and prevention. According to the United Nations, the world's population will have expanded by a billion from 2011 to 8.1 billion by 2025, owing in part to an increase in the number of women reaching reproductive age, despite an overall reduction in fertility rates (Greaves et al., 2019). With this fast development comes an increasing strain on current healthcare resources, as well as the need to improve access to healthcare for all. As a consequence, laboratory services will need to be tailored to support the population while remaining affordable and significant to the future of laboratory medicine.

Continuous development and implementation of new technologies and techniques are key components in improving medical laboratory students' learning, performance, and abilities. Malaysia has not fallen behind in terms of digital learning adoption (see, Adnan, 2020; Adnan et al., 2020; Adnan et al., 2021). Most Malaysian educational institutions already have digital learning tools in place, but they are underutilised since there are limits on physical teaching and learning in the classroom. Furthermore, the Malaysian government has previously issued the Malaysia Education Blueprint 2015-2025 (Higher Education) in order to fulfil the Education 4.0 and Industrial Revolution 4.0 goals (MOE, 2015). The blueprint highlights several shifts, including “holistic, entrepreneurial, and balanced graduates”, “talent excellence”, and “transformed higher education delivery”. Furthermore, CoVID-19 has resulted in a huge shift in educational institutions' utilization of digital technology in teaching and learning, as well as evaluation methodologies. Face-to-face instructional approaches must be substituted in this circumstance with online or video records. Higher education institutions must identify gaps in the use of digital tools to ensure that student skills quality is not compromised particularly in medical laboratory education. One of the challenges for higher education in Malaysia is to accomplish the 4.4.2 thematic indicator in the fourth sustainable development objective, which is associated with United Nations Sustainable Development. The indicator requires youths/adults to have minimum competency of digital literacy skills. It may, however, be addressed through study findings from multiple models related with the concept of digital literacy (Shelyugina et al., 2022).

The main goal of the medical laboratory technology education programme is to create high-calibre healthcare workers who can hold responsibilities, think critically, and able to operate in an inter-professional healthcare team to provide quality patient care. Educators rely on significant instructional strategies to offer quality learning in a complex and diversified curriculum to achieve this level of competency in health care graduates. Both pre-clinical educators and clinical instructors are responsible for effectively teaching and preparing students for current demands, as well as supporting them in developing holistic healthcare professional traits. Aside from that, all instructional techniques to the education curriculum must be viewed critically. These training programmes are diverse and complex, and even little changes can have far-reaching repercussions. Decisions on future teaching approaches must have an impact in order to guarantee that the outcomes are good and do not hinder student learning or education quality. Thus, carefully structured learning activities enable allied health students to develop the ability to integrate conceptual and procedural material obtained on campus and in clinical settings with knowledge such as propositional, procedural knowledge, transferrable personalities, ethics, and culture.

Medical laboratory technology education is no exception to the changing circumstances in which education is delivered. Furthermore, financial demands, keeping up with worldwide

innovations, maintaining standards, and changing patterns of lifelong learning are pushing educational institutions and government bodies to adopt online means of communication, engagement, and instruction. This poses problems to the traditional paradigm of learning and teaching, as higher education institutions must find novel methods to address these challenges. Being technologically savvy is not enough; students must also be digitally literate in order to prosper in this ever-changing world. As a consequence, opportunities and substantial resources for students are required. Especially nowadays, there are enormous expectations for the higher education system to rise to the task of driving human capital development. Integrating digital literacy into teaching and learning must be investigated in order to ensure that students receive relevant industry-based skill sets that are aligned with actual industry needs (see, Adnan et al., 2019; Karim et al., 2020; Adnan, 2020).

Problem Statement

With the development of digital technology, the concept of literacy has expanded and developed to include digital literacy, which serves as the basis for future study, involvement in society, and employment. Integrating digital literacy into the teaching and learning process fosters engagement, literacy of fascinating reading sources and diversified resources. Digital literacy may assist learners in comprehending their learning material (Rafi et al., 2019; Zulkarnain et al., 2020). However, this could be challenging because allied health students might have diverse degrees of technological experience. Aside from that, the digitalization of educational institutions as a result of the closure of face-to-face classes due to COVID-19 highlighted the need to reconsider opportunities and barriers for students' development of digital skills. As a consequence, educational institutions at all levels, including higher education, are faced with a significant challenge. Malaysia had released plenty of blueprints, plans, and policies aimed at encouraging and improving lifelong learning, high-quality literacy practices and people with learning disabilities. However, limited digital literacy among educators and students of medical laboratory technology educational institutions continue to be apparent.

Objectives and Research Questions

The general objective of this study is to investigate on the implementation of digital literacy in teaching and learning of Medical Laboratory Technology programme at a higher educational institution in Kuala Lumpur. This study addressed the following questions:

1. What are the perspectives of educators with regards to the implementation of digital literacy in teaching and learning for Medical Laboratory Programme?
2. How is digital literacy implemented in teaching and learning for Medical Laboratory Programme?
3. What are the challenges to implement digital literacy in teaching and learning for Medical Laboratory Programme and how do educators overcome it?
4. How do we sustain the implementation of digital literacy in teaching and learning for Medical Laboratory Programme?

Literature Review

The rapid advancement of digital technologies requires the use of digital literacy skills by educators. This is critical in equipping students to deal with challenges in digital worlds. This section examines relevant research literature on these subjects.

Theoretical Underpinning / Conceptual Framework

Definitions of digital literacy in the past includes digital media such as images, symbols, video, music, and animation as modes of communication in addition to words and language (Buckingham, 2006; Thorne, 2013; Osterman, 2013). There are several benefits to learning about complex issues via the Internet, such as hyperlinks that can non-linearly display multiple representations of information that users can manage (Fan, 2010; Greene et al., 2014). The multimodal, dynamic, and interactive nature of internet learning can foster the skills necessary for students to transfer their knowledge to real-world challenges. However, given the varying accuracy of information on the internet, digital literacy must include not just the ability to search for information effectively, but also the ability to analyse while achieving the learning objectives.

According to Sharma et al (2016) digital literacy is defined as the capacity to use the Internet and new media to access and critically analyse various formats and types of digital information. This will allow engagement in a community's socioeconomic activities through digital content creation, communication, and exchange. Thus, digital literacy requires awareness on how information may be addressed effectively, as well as an evaluation of the many forms of media that transfer information.

According to the European Framework for Educator Digital Competence (Redcker & Punie, 2017), being digitally competent at all levels of education entails professional competencies, pedagogical competencies, and learner competencies. The DigCompEdu framework (Figure 1) defines six primary areas in which educators' Digital Competence is conveyed through a total of 22 skills. The six areas are interconnected and complement one another, forming educators' digital pedagogical competency, which, needs to support efficient, inclusive, and innovative teaching and learning practises. The six DigCompEdu areas focus on various aspects of educators' professional activities as such; 1) utilizing digital technology; 2) developing, obtaining, and transferring digital resources; 3) management and coordination; 4) assessment; 5) strengthening learners; and 6) enhancing learners' digital competency.

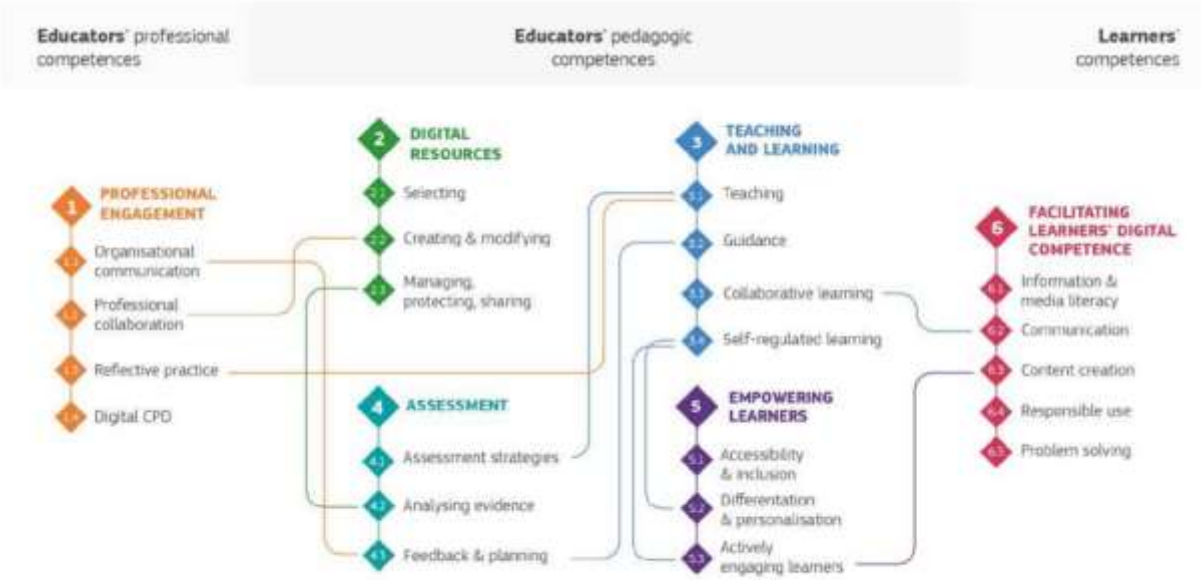

Figure 1: DigCompEdu framework (Redcker & Punie, 2017)

Bravo et al (2021) also defined digital literacy as a set of competencies, knowledge, abilities, and attitudes. This enables safe and critical use of information and communication technology (ICT) to consume, produce, and participate in the digital ecosystem. Digital literacy entails the same core skills as conventional literacy, namely the capacity to read, comprehend, give meaning, and communicate, but through various protocols, forms, and digital contexts.

Ajzen's (1991) Theory of Planned Behavior (TPB) was used as a theoretical framework to analyse educator perspectives on their intentions to integrate digital literacies in their classroom. The TPB assumptions generally impact a person's intentions, as indicated in Figure 2. Intentions are made up of three types of perceptions: behavioural beliefs, normative beliefs, and control beliefs. The TPB assumes that the foundation of attitude is the perception that certain behaviours (for example, educators' integration of digital literacy) are related with specific results or consequences. Educators' own opinions of the efficacy of each outcome are used to weight each desired result. The normative beliefs of social support and social pressure to behave in a specific way serve as the foundation of subjective norms. Educators' desire to follow the perceived prescriptions of significant people weighs in on the strength of this belief. Educators' decisions to include digital literacy in the classroom may be influenced by the opinions and suggestions of others, such as peers, administrators, and students. Control beliefs serve as the foundation for measures of perceived behavioural control, which imply that the stronger educators' confidence in their competence and availability to resources, the greater their perceived control. The level of control is on how much educators believe the control will support or hinder the integration of digital literacy in their classroom setting.

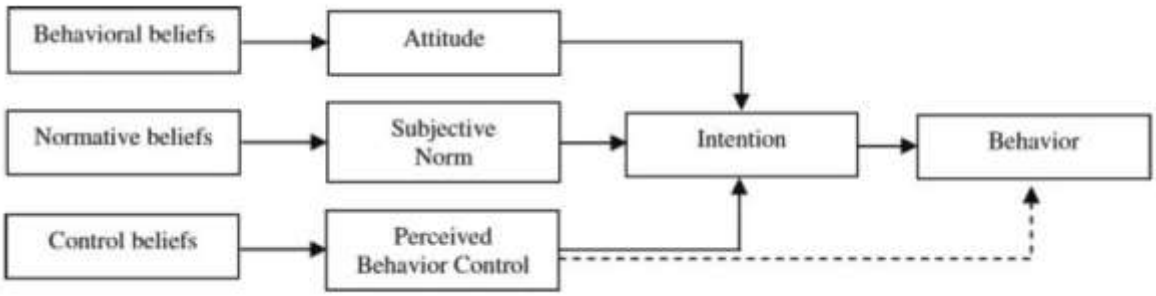

Figure 2: Azjen's theory of planned behavior (Ajzen, 1991).

We could not find any research on digital literacy in Malaysia Medical Laboratory Technology programme classrooms, particularly how digital literacy was introduced, the obstacles it faced, and its sustainability. Besides that, it is possible that bombarding the young generation with technology, such as films, videos, or visuals that cause attention distraction, is hazardous to their health. As a consequence, more research is needed to determine whether the Medical Laboratory Technology programme can employ digital literacy in teaching and learning. It is important to look into the issues of implementing digital literacy, specifically from the perspective of lecturers on how they include digital literacy into the MLT classroom, the obstacles they encountered, and how they dealt with them.

Digital Literacy and Higher Education

Educators and students nowadays communicate and obtain information via a number of digital settings. Their jobs, social lives, and educational settings all involve some level of digital literacy. Digital literacy includes more than just learning how to utilize technology. It is about

navigating and communicating in various digital contexts. A person requires a certain level of digital literacy to turn on a computer, but various abilities are required to discover an information. People's engagement in various aspects of the digital world is frequently determined by their own desire for the resources and opportunities that it provides. Some people use social media to stay in touch with friends and organize their social schedules, while others don't use it at all. However, there are some areas where having the necessary abilities is critical for success in the modern world (Garrido et al., 2010; Elsaadani, 2015; Finnie et al., 2018; Wahi et al., 2019). The majority of new graduate positions require advanced Information and Communication Technology, or 'ICT' capabilities. The employment market is more competitive and volatile, and possessing the necessary digital literacy skills is critical for employability. This has a direct impact on the realm of education. Students must have digital literacy skills in addition to their qualifications in order to be employable when they graduate. There is also a plethora of new ways to learn. In addition to browsing through real books, students can now access information and do research instantaneously via the internet. Video, audio, and photos can all be used in the classroom and for student tasks. Work is increasingly being submitted electronically, and feedback is being provided online. A variety of internet platforms can be used to facilitate communication and collaboration on material. All of these new prospects bring with them new needs and responsibilities for everyone.

Methodology

As previously stated, this study was done to explore the adoption of digital literacy in teaching and learning for the Medical Laboratory Technology programme. The Higher Education Institution (HEI) where the study was conducted has 205 students enrolled in the specific programme being investigated. To fulfil the Malaysian Qualification Agency's (MQA) requirement, the program curricular design includes a programme learning outcome associated to digital literacy. It is incorporated in some of the curriculum and is assessed in some courses. As the definition of digital literacy is too broad, the purpose of this study was to determine the extent to which digital literacy was implemented in teaching and learning, as indicated in the objectives of this study. Permission to conduct a study has been granted to the top management of the relevant HEI in order to collect empirical evidence that will support the theories in this study. Following permission, some participants were approached to see if they agreed to collaborate and provide data for the study. From requesting the approval for conducting a study and to finding participants, the process takes roughly three weeks. An interview process with five main areas has been designed. Prior to the study, a research plan is created using Carspecken's Qualitative Research Method. Carspecken suggested that the researcher use a preliminary brainstorming approach to create two lists of questions and particular issues for investigation. The first list should identify concerns that can be examined, while the second list should explain the information needed to answer inquiries as they emerge. Figure 3 illustrates the overall flow of this study.

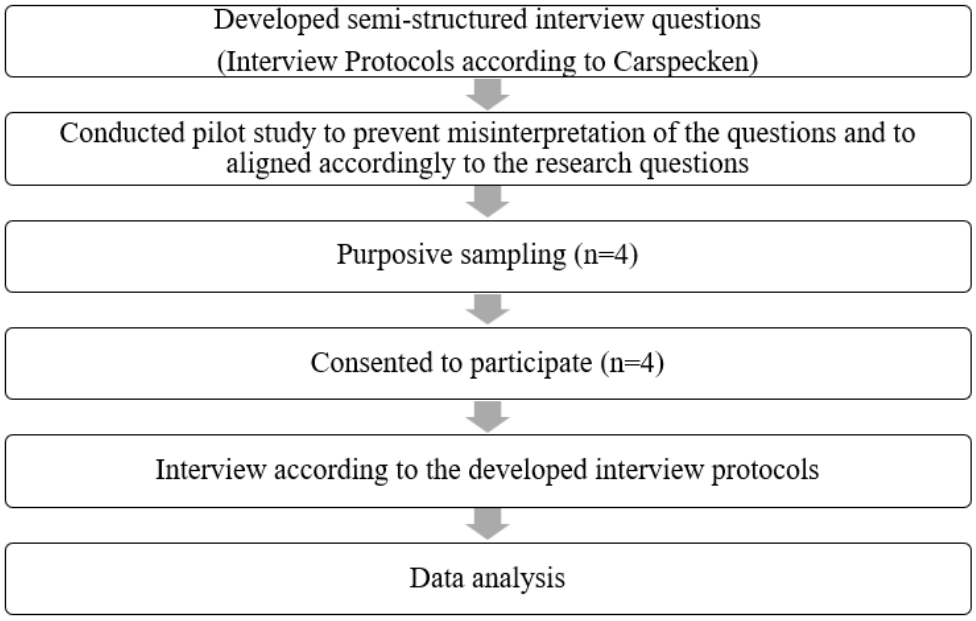

Figure 3: Study flow

Research Design and Ethical Consideration

This is a descriptive qualitative study. Any qualitative study's purpose is to research a topic in depth and in a flexible manner. This technique was used to better understand the perspectives of Medical Laboratory Technology Diploma Programme educators (for example, the Deputy Director of Academic Affairs, the Course Coordinator, and two lecturers) on digital literacy in teaching and learning. For ethical reasons, the HEI's upper management has authorised permission to use data and research samples under certain conditions in which, if part or all of the study findings are to be published, the final copy of the research report must be presented to management, and prior authorization must be obtained.

Population and Samples

After ethical clearance is obtained to conduct the study from institution and higher authority. Educators working in the Medical Laboratory Technology Programme were purposely selected to participate in this study. Those participants signed a consent form and were reminded of their right to withdraw from the study at any time. Data were included only from the selected participants who consented to participate.

Instrumentation

The semi-structured interviews employed in this qualitative study was based on the theoretical framework outlined in the literature. Some of the semi-structured questionnaire was adapted from Sadaf and Johnson (2017); Zhao et al (2018) with some modifications. The semi-structured interviews are divided into five (5) parts. Part 1 addresses the respondent's name, age, gender, qualifications, teaching experience, current job, and teaching and/or administrative responsibilities. Part 2 focuses on the perspectives of participants as stated in the first research question of this study. In this part, participants are asked to explain their thoughts on the adoption of digital literacy in teaching and learning for the Medical Laboratory Programme in the context of behavioral, normative, and control beliefs. Part 3 is corresponding to what participants have done to address the aspect of digital literacy in teaching and learning as stated in the second research question. Part 4 is concerned with the

third research question, which aims to investigate the challenges and what participants did to overcome it. Part 5 is the final part, and it addresses the fourth research question to investigate on how to sustain the implementation of digital literacy in teaching and learning for the Medical Laboratory Program. All responses were kept anonymous. HEI was also treated with discretion and labelled as Institution A. To prevent misinterpretation and to ensure that the questions are aligned with the study aims and research questions, pilot studies using semi-structured interview questions were performed with several volunteer that have education backgrounds. Following that, the questions were slightly adjusted to ensure that the research question of the study can be answered.

Data Collection

Data was collected using specially designed study interviews based on the predefined research questions. A selected sampling approach was used to choose participants for this investigation. The participants were chosen from various roles and responsibilities at the respective Higher Educational Institutions in Kuala Lumpur, Malaysia that offer the Medical Laboratory Technology Diploma Programme. The institution is denoted as Institution A. The selected educators for the Medical Laboratory Technology Diploma Programme represent the target group or sample size. According to Fridlund and Hildingh (2000, cited by Bengtsson, 2016), "in qualitative investigations, data are typically based on 1 to 30 informants." Institution A participants were represented by Participant 1 (P1), Participant 2 (P2), Participant 3 (P3) and Participant 4 (P4). Participation is fully voluntary, and no incentive was provided. The data was collected between the 11th and 15th of July 2022. Prior to the interviews, all respondents signed a consent form.

Data Analysis

To analyse the collected data, many processes are taken. Transcribed interviews were coded line by line manually as the participants were answering in Malay dialect. The whole responses to each question will be evaluated several times to get a feel of the responses offered by the participants. The answers are then mapped and classified according to the appropriate theme. The answers will be read numerous times to ensure that the intended meaning is precisely and clearly appreciated. During the writing process, thematic analysis is used, and the results section provides emergent themes with a separate discussion tying the analysis to the literature study. In actuality, however, they are cyclic rather than independent processes. In this study, it is critical to apply the principle of constant comparison. As a result, both the data collection and analysis processes were cyclic, iterative, and not linear.

Data Presentation

Part 1: Basic Demographic

Part 1 of the interview required participants to provide basic demographic information such as their name, age, gender, teaching experience, teaching and/ or administrative responsibilities. Table 1 summarizes the pertinent information received from participants. All participants have at least five years of experience working at the institution being studied.

Table 1
Summary of information related to the four participants in institution A

Participants Criteria	Institution A			
	Participant 1 (P1)	Participant 2 (P2)	Participant 3 (P3)	Participant 4 (P4)
Gender	Male	Female	Female	Female
Age	58 years old	41 years old	39 years old	41 years old
Teaching experience	20 years	14 years	14 years	5 years
Teaching and/ or Administrative Responsibility	1. Managing academic affairs 2. Teaching MLT courses	1. Coordinate and managing MLT courses 2. Teaching MLT courses	1. Teaching MLT courses	1. Teaching MLT courses

Part 2: Educators' Perspectives

As for P1, he believes that digital literacy is in line with the current times. Students in today's age prefer to use digital tools. As a result, educators may engage students by utilising the proper digital application resources. Furthermore, the information is now readily available, and it is in line with the students centred learning pedagogies emphasised by MQA. Only in terms of drawbacks, there is a shortage of data on medical laboratory technology courses, and students must rely on references supplied by educators to prevent gaining incorrect information. The virtual library service provided by institution assists students in searching and retrieving relevant information. P1 also stated that top-level support is crucial in the process of incorporating digital literacy into teaching and learning. When compared to the past, students are strictly barred from using cell phones in class. Previous senior educators who do not want to change and favour teacher-centred instruction have indeed contribute to difficulties in the implementation of digital literacy in teaching and learning. Digital literacy can be implemented efficiently if it has a stable internet speed capacity and students have access to adequate online facilities.

P2 as the head of the Microbiology module, she believes that incorporating digital literacy would make teaching sessions more organised. This is due to educators' efforts to prepare teaching and learning materials in advance rather than at the last minute. Furthermore, better teaching materials will be provided, which might also potentially be utilised as continuous medical education materials in the future, either for presentation in a clinical context or for working purposes afterwards. Furthermore, for P2, learning outcome will be more achievable since it can display real video or simulation pictures, and time will be saved because there will be no need to sketch on the whiteboard. Furthermore, any information can be shared in softcopy, which can reduce the usage of paper. Somehow, the disadvantage is that students will become overly reliant on the educator because everything has been given by the educator and there is no need to worry if they are unable to attend class. All of this will be more effective if it has support from higher authority. Furthermore, the current age is a population that is prone to digitalization. However, it may be an impediment to implementation if there are still educators who refuse to change and move toward digital teaching and learning. P2 provides a similar perspective to P1, where facilities

also playing a vital role. This is because if the internet's capacity and speed are inadequate, it will be difficult for educators and students to access instructional resources. P2 also advised that educators have more training in advanced of digital technologies, so that teaching and learning approaches can be diversified.

Meanwhile, for P3, she believes that digital literacy in teaching and learning began to grow and received significant attention during the CoVID-19 outbreak. That's when she began using online learning tools like Google Classroom, Google Meet, Zoom, and others. She feels that the digital media really aids her in effectively delivering lectures. The only disadvantage is that she cannot determine the level of student engagement. In addition, if students do not update certain applications, they will not be able to access the learning materials properly. Also, one can't actually tell if a student is focused or not because they could be anywhere without any face-to-face supervision. It is also difficult to enforce punishment since they may be at a faraway location and may only interact virtually. In addition, the disadvantage of integrating digital literacy is when there are internet data constraints, whether for students or educators. Moreover, some students are unable to attend the compulsory lectures because of during public holiday celebrations according to their respective states they stayed. As a result, establishing a consistent schedule for online discussion sessions is challenging. However, for P3, she feels similarly like P1 and P2, that digital literacy is acceptable for the students' ages and in accordance with current trends. Nevertheless, certain groups may still be unwilling to embrace change. As a response, for P3, students or educators are perhaps given a discount on digital tools such as internet subscriptions, external storage devices, Google Suite, and others.

For P4, she believes that digital literacy in teaching and learning is evolving with the flow of time, and that educators may diversify their teaching techniques more effectively and creatively. Furthermore, in accordance with the concept of student-centered learning, students will be able to obtain extra material to strengthen their knowledge. However, since internet capacity is limited and most students cannot afford to subscribe to personal internet packages, they can only rely on the internet capacity from learning institution. Furthermore, educators' unwillingness to change has an impact on the application of digital literacy in teaching and learning. P4 believes similarly to P1 in that learning knowledge in the field of medical laboratory technology is equally difficult to come by, forcing her to rely solely on videos provided by other educational institutions. And there are times when information is difficult to obtain, and she need to consult with experts. Table 2 summarizes the pertinent information received from participants with regards to research question one (RQ 1).

Table 2
Summary of information related to the RQ1

Research questions and Interview Questions	**Answers from Participants**
RQ1: **Interview Question 1** How do you see the outcomes of integrating digital literacy in teaching and learning for Medical Laboratory Programme?	**Advantages:** ● in line with current time (P1, P4) ● match with current generation (P1) ● information is readily available (P1) ● consistent with students centred learning (P1, P4) ● teaching sessions more organised (P2) ● prepare teaching and learning materials in advance (P2) ● better teaching materials (P2. P3, P4) ● learning outcome will be more achievable (P2) ● time saving (P2) ● can be shared in softcopy (P2) **Disadvantages:** ● shortage of data on medical laboratory technology courses (P1, P4) ● overly reliant on the educator (P2) ● attendance issues (P2) ● level of student's engagement (P3) ● updating issues for application (P3) ● punishment is difficult to enforced (P3) ● internet constraints (P3, P4) ● establishing a consistent schedule for online discussion sessions is challenging (P3)
RQ1: **Interview Question 2** How do you see the social support and social pressure of integrating digital literacy in teaching and learning for Medical Laboratory Programme?	**Supporting factors:** ● top-level support is crucial (P1, P2, P4) ● applicable with current generation (P2. P3) **Pressure factors:** ● some educators favour teacher-centered instruction (P1, P4) ● students/ educators refuse to change (P2, P3)
RQ1: **Interview Question 3** How do you see the Internal and external enablers/ constraints of integrating digital literacy in teaching and learning for Medical Laboratory Programme?	● internet's capacity and speed (P1.P2) ● training in digital literacy among educators (P2) ● digital tools (P3) ● educators' range of knowledge (P4)

Part 3: Implementation of Digital Literacy

P1 utilizes YouTube videos in class as learning materials. While in class, he encouraged students to find journal papers relevant to the topic of learning. P1 prefers to integrate information and communication technology in the classroom because it is simple, students understand better, and teaching and learning resources can be accessible outside of the classroom. For P1, perhaps offering learning material on CD or using power point could improve the classroom instruction. However, for P1, utilizing a 100% learning management system may have an impact on students' soft skills and they need to have face-to-face classroom teaching sessions as well.

For P2, in addition to power point presentation during teaching in the classroom, the method she often uses is by sharing video, Google Classroom, creating a specific WhatsApp group for the course, doing live demonstrations throughout practical sessions so that educators do not have to move bench by bench, and students able to see the video shown live at the front of the lab. For P2, she believes that a proportion of instructional approaches should be online learning. In contrast to P1, P2 is more at ease with a specialized learning management system other than Google Classroom that allows students and educators to easily obtain various aspects, as well as the necessity of software to detect plagiarism. She also suggested providing CDs to enable students to understand the mechanism of human body metabolism, which might take time to explain in class. Students can refer to the CD and assured that the material is accurate because it is provided by the institution.

P3 employs an approach that is remarkably similar to P1 and P2, such as the usage of power point, a digital whiteboard application, and encouraging students to find journal articles and utilising the virtual library. While Google Classroom and WhatsApp are used outside of class. She also advocated the use of video in the teaching process and strongly agree if the institutions could increase the capacity and speed of computers provided.

P4 also incorporates video in her lectures to attract students' attention rather than only utilising power point. While in class, students will be required to create a learning video to summarise what they have learnt. Her knowledge may still be insufficient for them; thus, these videos might aid in her teaching to some extent. She also believes same as P4 that a specialised learning management system is necessary to ensure that all knowledge is given to students as a whole. Table 3 summarizes the pertinent information received from participants with regards to research question two (RQ 2).

Table 3
Summary of information related to RQ2

Research questions and Interview Questions	**Answers from Participants**
RQ2: **Interview Question** How digital literacy in teaching and learning for Medical Laboratory Programme are implemented? Please explain.	**Digital media used in /after classes:** ● You-tube (P1) ● E-journals (P1, P3) ● Power point (P1, P2, P3, P4) ● Videos (P2, P4) ● Google Classroom (P2, P3) ● WhatsApp (P2, P3) ● Live demonstration in laboratory (P2) ● Digital whiteboard (P3) **Reason using information communication technology in teaching:** ● simple (P1) ● students understand better (P1) ● teaching and learning resources can be accessible outside of the classroom (P1) ● aid teaching approaches (P4) **Requirements of media from the perspective of the curriculum /syllabus:** ● offering learning materials on CD/power point (P1, P2) ● mix virtual learning environment and face-to-face classroom teaching (P1, P2) ● need to have specialized learning management system (P2, P4) ● increase the capacity and speed of computers provided (P3)

Part 4: Challenges and ways to Overcome

The main challenge faced by P1 is the lack of digital competency and the need for additional training to strengthen digital literacy among educators. Furthermore, the problem of internet speed capacity requires financial support from the Training Management Division in order to increase internet performance. Furthermore, he finds it is difficult to keep students focused when surfing the internet, as they may be doing anything irrelevant during the surfing session, such as browsing chat rooms or social media. As a result, P1 will constantly ask questions following student activities sessions. He also mentioned that transferring students is a good way to stimulate ongoing learning. It's because students' ways of thinking will be more open and cultivated.

While P2 highlights the necessity of educators staying up to date on the latest technologies, engagement from the academic team is also essential for this implementation to go well. She also underlined the value of internet access and digital technologies in the teaching and learning process. According to her, the free learning management system has several usage restrictions and would limit educational creativity.

P3 has challenges such as an unstable internet connection, not knowing whether students understand or not, having to provide supplementary learning information, and

some topics for medical laboratory technologies programme are not ideal for virtual instruction only. It still needs hands-on approaches. Furthermore, students must understand how to manage their time, since over-reliance on online learning can negatively impact students if not managed properly. For P3, the online discussion session should last at least 45 minutes to avoid students from getting distracted. Additionally, a softcopy of the notes may be provided ahead of time to allow students access to the notes prior to the teaching session. Application improvements are also quite beneficial in monitoring student attendance. Furthermore, digital literacy is vital in giving extra support for learning materials to students, particularly those who lack in fundamental science knowledge. One of the challenges that P4 has is an insufficient information because some of the information required needs to be purchased. Moreover, there seem to be time constraints to provide effective learning materials. Therefore, she usually needs extra time to prepared related materials. Table 4 summarizes the pertinent information received from participants with regards to research question three (RQ 3).

Table 4
Summary of information related to RQ3

RQ3: **Interview Question** What are the challenges of implementation of digital literacy in teaching and learning for Medical Laboratory Programme and how do you overcome it?	
Challenges	**Ways to Overcome**
1. Lack of digital competency 2. Internet speed capacity 3. Difficult to keep students focused 4. Limitation of free learning management system 5. Having to provide supplementary learning materials 6. Some topics not relevant to do in virtual instruction 7. Some information needs to be purchased 8. Time constraint to prepare effective teaching materials	1. Additional training 2. Financial support 3. Constantly ask questions following student activities sessions 4. Students' mobility 5. Engagement from the academic team 6. Students must know how to manage time 7. Limit time for online discussion sessions 8. Provide softcopy notes earlier before teaching 9. Advance features of nowadays application 10. Educators need time to provide effective learning materials

Part 5: Sustainability

To maintain the sustainability of digital literacy in teaching and learning, P1 suggest that it is a need to ensure that the virtual library given is provided with reading materials related to medical laboratory technology. Mostly concerned with the most recent technical advancements in Medical Laboratory Technology programme that might enhance the profession and attract students to explore. In regards of P2, she reiterated the significance of having a specialised learning management system to ensure the long-term viability of integrating digital literacy into teaching and learning. This is because students and educators can simply refer to a system that is complete with all features, regardless of where they are

or what time it is. For P3, she also recommended that the institution should have a subscription of online platform where all features could be used maximally and without limitations. For her, the institution must also be ready in the case of another outbreak like CoVID-19. P4 also emphasised the need of institutions providing appropriate internet facilities for students' needs, even in hostels, because students may need internet access to look for information and most students unable pay the cost of internet access. Table 5 summarizes the pertinent information received from participants with regards to research question four (RQ 4).

Table 5
Summary of information related to RQ 4

Research questions and Interview Questions	**Answers from Participants**
RQ4: **Interview Question** How to sustain the implementation of digital literacy in teaching and learning for Medical Laboratory Programme?	● Ensure virtual library is provided with reading materials related to medical laboratory technology ● Specialized learning management system ● Subscription of online platform ● Providing appropriate internet facilities to cater students' needs

Data Analysis

Planning and Implementation of the Change Initiative

According to the findings of this study, educators are aware that digital literacy is suitable with the advancement of technology and generation of students. This is proven by the 2021 progress report provided by the Economic Planning Unit in the Prime Minister's Department Malaysia, which states that 88.7 percent of Malaysians utilize the internet and there is 95 percent of 4G coverage in populated regions. In addition, the top devices used to access the Internet are smartphones which is 98.7 percent, while 37.9 percent are laptops/notebooks/netbooks. This indicated that students can simply access the internet using a smartphone. Furthermore, via partnership with private sector service providers, 1.3 million higher education students are linked through affordable device and plan packages, providing connectivity and access to online learning. Digital literacy improves access to knowledge and books, implying a significant success of efforts toward development and sustainability.

Higher education providers must play a vital role in ensuring that digital literacy is adequately implemented in teaching and learning. Among them are guidelines for implementation, reinforcement of the use of digital media, providing suitable digital resources, and developing digital learning environment platform to facilitate the sharing of knowledge and reference sources. This condition may also result in a diversified improvement of educators' digital literacy. In addition, digital skills and knowledge are now required in higher education as stipulated in MQA requirement of learning domain or in other country educational policy. Nearly every government and country in the world worked tirelessly to promote educators' digital literacy development. For example, at the University of Brighton in the United Kingdom, institutional involvement with digital literacies has been fostered through the development of a Digital Literacies Framework (DLF) aimed at academic staff (Newland & Handley, 2016). The DLF has 38 literacies organised into four categories that

correspond to the 4 major areas of academic work, namely learning and teaching; research; communication and cooperation; and administration. In Malaysia, the government launched the Malaysia Digital Economy Blueprint (MyDIGITAL) with the goal of transforming Malaysia into a digitally-driven, high-income nation and regional leader in the digital economy. In order to continue strengthening this project, the government has planned for the education sector over the next ten years. Among the plan is “My Digital Teacher" Program for Educators. It is being developed as the matter of fact that the efforts would be worthless if the technology was ready, but no one was available to use it. Thus, the purpose of this professional development programme is to help educators become more familiar with digital learning tools and technology, as well as administrative tasks. The government intends to do this by collaborating with technology companies to produce a tech-based creative solution to improve educators' job in areas such as learning plan preparation, teaching aids, and assessment. Several of these challenges have been addressed in the private sector by firms such as Anak2U and Abelytics. The MOE is in charge of this effort. Aside from this training, the MyDIGITAL programme is providing instructors with an open access knowledge library for digital education content. The quality of these instructional materials must meet the rules and standards established by the MOE and the Ministry of Higher Education (MOHE). Workbooks, practise papers, and instructional resources like as videos and podcasts are included in this knowledge bank.

Effectiveness of the Change Initiative

In this study, some of the issues and challenges faced by educators can be classified in terms of educator digital competency, infrastructure facilities, students ’attitudes, curriculum design, and pedagogy. Whilst, training and pedagogy, administrative responsibilities, and proper digital tools/platforms are some of the ways educators might overcome the challenges that arised. Details challenges and ways to overcome has been described in previous section. The data obtained shows that not all educators are proficient in digital literacy. It can be seen that educators are likewise comprised of various age generations. Some people need time to grasp a technology, while others pick it up fast. As a result, it will have an impact on the application of digital literacy in teaching and learning. This finding is consistent with the study done by (O'Doherty et al., 2018). Researchers discovered that inadequate digital competencies of educators can be a barrier to effective digital learning and institutional support and training are necessary to ensure that this barrier is addressed. It is also critical that educators recognize the significance of digital literacy in order for it to be properly integrated into the curriculum. Furthermore, educators' proficiency with digital technologies is critical to supporting the smooth adoption of digital literacy in teaching and learning. According to Pifano et al (2018), examples include employing computer basics such as core computer applications and software, file organisation and operating output and input devices. Other than that, is internet navigation which requires understanding of website fundamentals, safe online conduct, and the ability to access information for daily usage. As well as connecting to a wireless device, generating a secure password, subscribing online, and making a website the browser's default homepage are all instances of what these competencies include. Therefore, as mentioned in previous section, various government agencies and private organizations are currently provided information and communication technology courses to educators to enhance their digital literacies skills. It is critical to support, develop, and enhance digital competence. This support will improve educators'

competencies to be proficient users of digital technology in their instructional settings or have the confidence to transfer on to their students.

Students' diverse attitudes are also a challenge in implementing digital literacy. Examples given by Coldwell-Neilson (2018) include ethical issues about student plagiarism and a lack of awareness about copyright law. Second, students are not utilizing technology properly, and they are unable to analyse the validity of knowledge obtained from the internet. Third, students are unfamiliar with their learning management system. Forth, there isn't enough time or room in the curriculum to enhance digital literacy skills. Fifth, difficulty in engaging and motivating students about digital literacy because students believe they already know enough and do not perceive these abilities as vital for employment. As referring to the Malaysia Digital Economy Blueprint (MyDIGITAL), the blueprint introducing a "My Device" scheme to guarantee that all students have access to digital learning. The scheme is implemented through public-private partnerships, with students receiving data subscriptions and gadgets with rigorous security settings. This initiative aims to improve students' learning experiences while also closing the digital divide between students of all financial levels. The government will also encourage textbook and workbook producers to investigate digitalizing their content. With this programme, the government hopes to consistently enhance digital educational resources at a lesser cost. The blueprint is to create and implement technical norms for data utilization in the educational sector. Furthermore, according to Coldwell-Neilson (2018), course curricula frequently do not recognise or differentiate digital skills that are discipline specific or transferable among disciplines. This perpetuates the mismatch between the skills students are expected to have and the reality of their capabilities. Students must improve their digital abilities to a degree of fluency that will match the demands of the future working environment. Therefore, like any other skills, it must be deliberately scaffolded and integrated across the curriculum.

Critical Factors for the Sustainability of the Initiative

According to the findings in this study, the primary issue that educators highlight to ensure the sustainability of digital literacy is digital support, resources, tools, and reliable infrastructure. Big Data and Artificial Intelligence (AI) as instructional tools, adding value to complex issues in higher education (Abad-Segura et al., 2020). Big Data enables students to identify trends in new teaching approaches, such as adaptive learning, which provides individualized education based on the gathering of student data relating to age, traditions, or behaviour. This technology incorporates lower-cost education, which improves user skills and generates a customized student profile. This will improve the teaching areas where it is tough to design a unique course using the e-learning system. Furthermore, this technology enables the educator identifying student's performance or to manage the instructional strategies if she/he notices a gap in understanding. Therefore, it is crucial for teachers to have information literacy and digital literacy abilities since they play vital role in raising future generations. As it is critical for educators who educate individuals known as the Z generation that are proficient in both information literacy and digital literacy (Gunduzalp, 2021).

Besides that, in order to sustain digital literacy in higher education, institutions must be able to fulfil the special requirements of industry. As according to Microsoft's Vice President of Worldwide Education, Anthony Salcito (Khan et al., 2022), students must equip themselves with the necessary abilities, notably in critical and creative thinking, cooperation, communication, and computational thinking, in order to be prepared for the 21st-century workforce. Therefore, educators are urged to integrate digital learning into their present

teaching style since it is thought that students who are not prepared to meet growing employment expectations and skills would be unable to adjust to a possible workforce with poor digital literacy. It is relatively few institutions can create marketable and job-ready graduates on their own, institutions may partner with the business to meet its requirements and expectations. Nonetheless, due to economic, cultural, social, or political restrictions, an institution might not interact with industries. There was a need for a more effective and efficient system to meet the industry's requirements. A completely traditional face-to-face instructional approach may pose some drawbacks. Therefore, digital literacy may successfully improve in providing better instruction and learning. For in-class learning, digital literacy is a useful operational resource. It should be supplied and utilised in conjunction with other ways in various scenarios using diverse learning instruments, and its implementation should not be restricted to internet technology alone.

Conclusions

First and foremost, all of the participants expressed enthusiasm for the application of digital literacy in teaching and learning in their educational context. They adhere to the syllabus requirements, design, and deliver excellent instruction, utilise various literacies, and continually improve. However, difficulties such as lack of digital competency, resources constraints, and restricted budget were some of the identified barriers to digital literacy adoption. The importance of digital literacy in Malaysia cannot be neglected as technology today drives almost everything. Technology thus has a strong influence on people's daily life and it has altered the way things are done in Malaysia.

That being said, our research effort also shows that obstacles and limits must be addressed in order to integrate digital literacy into teaching and learning in higher education. Consider the amount of preparation of educators, infrastructural facilities, student attitudes, and other factors addressed in the previous sections. By integrating and promoting digital literacy, students will be able to watch online lectures prior to attending class, and they are able to complete in-class work without giving more time that they have committed to the course. Indeed, hybrid and blended learning allow students to learn valuable knowledge outside of class, freeing up time in class for conceptual understanding of the topic. Technologies are generally accessible and educators should be able to access information, develop simulations and scenarios, allow students to participate in learning games, and enhance student interaction.

Students with digital literacy skills can interpret digital material and evaluate the accuracy of information obtained from digital sources. It is also important to note that goals should be set to indicate if the real purpose is to master the topic, technology, or both. For both, resources should be provided to assure goal attainment, and educators should explicitly define how digital literacy meets their course learning outcomes. Educators should not abandon traditional models of knowledge transfer in the classroom; rather, an atmosphere that fosters different instructional techniques should exist. Our study shows that technology integration is acceptable for medical laboratory instruction. Students and educators can surely benefit when digital literacy is integrated into the curriculum in a meaningful way.

Last but not least, educators have to develop innovative planning and support strategies to address so many critical issues. So, we suggest that greater consideration should be given to digital literacy by developing technical facilities, pedagogy, and policymakers. Accordingly, further studies can be conducted to establish the extent to which relevant participants effectively implemented their learning strategies. Also, future studies can be conducted to

evaluate whether these ideas about incorporating digital literacy reflect real classroom use. To acquire more reliable findings, it would be useful to incorporate real classroom observations and documentation in addition to surveys and interviews.

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