

# The 21st Century Assessment Strategies in Medical Laboratory Education: Sharing Experiences between Two Higher Institutions in Malaysia

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## Abstract

Assessment affects both instructional strategies and learning. Thus, the effectiveness of teaching and learning can be recognised and enhanced. However, the previous study failed to consider explicit discussions on the perspectives among different parties, especially in the medical laboratory field in Malaysia. This study is being conducted to investigate the perspectives of educators from two different institutions of the Medical Laboratory Technology (MLT) Diploma Programme regarding assessment strategies that they have implemented to provide a positive learning environment in their 21st century classrooms as well as to enhance student learning gains. The qualitative descriptive approach with semi-structured interviews designed for one-on-one interviews is employed. Four participants were recruited through purposive sampling. The interviews were transcribed and analysed thoroughly several times before being reported. The findings suggest that the participants understand the assessment methodologies for 21st century skills. The study revealed several assessment approaches, challenges, and ways educators employed in ensuring positive 21<sup>st</sup> century learning gained by sharing their views and experiences. These results may give insight into future advancements in instructional and assessment approaches focusing on medical laboratory education.

**Keywords:** 21<sup>st</sup> Century Assessment, Medical Laboratory Technology, Education, Assessment Strategies, Higher Institution, Sharing Experience

## Introduction

Assessment is an essential component of both teaching and learning. It allows the quality of teaching and learning to be identified and improved. It also has an impact on both instructional methods and learning. It is considered ineffective if the curriculum and learning

objectives have undergone changes but the assessment method remains the same. Assessment may be classified into two types: formative and summative. Formative assessment is more of a way to determine students' levels of proficiency in order to strengthen teaching approaches. Summative assessment is used to assess student achievement at the end of a course or programme. Traditional educational methods solely act as centres of input, in which the subject's content is directly provided. Students are exposed to the curriculum, and an examination is given at the end. Grades are issued regardless of whether students have learned or not. Today, most higher education institutions have implemented outcome-based education (OBE) into their own educational systems.

The Malaysian Qualifications Agency (MQA) also requires higher education institutions to implement OBE in their curricula in order to achieve accreditation standards. OBE specifies the desirable outcomes that students should be able to achieve after engaging in the educational programme (MQA, 2014). These desired objectives ensure that students graduate with functioning skills. Students must be able to demonstrate their abilities based on the established standards, which can be observed and measured. Therefore, assessment is the process of obtaining evidence that the minimal performance or competence level of established learning outcomes (LOs) has been achieved once students have successfully completed a specific course or graduated from a programme offered by a higher education institution. Assessing outcome achievement includes creating performance criteria and standards for each of the outcome elements or outcome characteristics provided in each LO. In OBE, there is no single specific type of teaching or evaluation. Depending on the desired outcomes, the faculty member's function changes to that of an instructor, trainer, facilitator, and/or mentor. Specific learning outcomes are measurable tools with regards to what students can actually do with what they know and have learned. Educators must employ action verbs like describe, explain, analyse, or create when defining and producing outcomes rather than undefined or hidden non-demonstration processes like understand, know, think, consider, appreciate, reflect, feel, believe, and so on. The key to identifying well-defined outcomes is to seek out demonstration verbs that specify the procedures that the learner does at the end.

In recent years, clinical laboratories and their workforce have faced the challenges of fast technological progress, scientific advances, and the significant impact on the landscape of disease as well as the approach to diagnosis and therapy. For example, when the CoVID-19 outbreak occurs and impacts the whole world in a variety of ways, Laboratory testing, formerly done in small laboratories with few manual tests, now demands highly automated and interconnected facilities that perform millions of tests each year (Plebani, 2017). The increased understanding of the molecular basis of human disease, the identification of risk factors and disease prediction, and the introduction of personalised treatment have all contributed to an increase in the need for more numerous and more reliable laboratory tests. Given that added value underlies the ultimate quality of laboratory information, which was based on analytical performances, it is now transitioning to quality in the complete testing process, which includes control over and improvement in the extra-analytical phases. Laboratory personnel must always be active members of the diagnostic team, providing cooperation and guidance to optimise clinical pathways and patient outcomes. Therefore, due to the changing nature of work and society, students of the Medical Laboratory Technology (MLT) Programme must be able to evaluate, synthesise, and apply what they have learned to handle new challenges, create solutions, cooperate successfully, and communicate

persuasively, which is valued in today's world. As a consequence, examinations and other types of assessment should serve a broader range of functions and in a larger diversity of forms suitable for the 21st century.

Assessment is indeed frequently used today for competency certification, monitoring educational standards, and providing feedback to learners. The emphasis will have to be on thoroughly grasping principles and developing new skills and competencies that will enable graduates to cope with the demands of a quickly changing workplace. The Diploma in Medical Laboratory Technology (DMLT) program is widely available in both private and public institutions.

*This study addressed the following objectives*

- To explore the views of educators from different institutions in the Medical Laboratory Technology Diploma Programme on assessment strategies in the 21<sup>st</sup>-century classroom.
- To identify the assessment practises of educators from different institutions of the Medical Laboratory Technology Diploma Programme that may support students' learning in the aspects of critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a learning tool for 21st century skills.
- To explore the views of educators from different institutions of the Medical Laboratory Technology Diploma Programme to ensure they have provided a positive learning environment in their 21st century classrooms to enhance student learning gains.

## **Literature Review**

### **The 21st Century Classroom**

With the transition from the 20th to the 21st centuries, the term "21st century skills" has emerged as a fundamental idea and keyword in the area of education. In addition, this phrase encompasses a wide range of abilities, including problem solving, creativity, computer and information literacy, cooperation, and many more. While these aspects are not strictly creations of the late twentieth or early twenty-first centuries, they do highlight the growing importance of these complicated talents in a rapidly changing world in which rote information becomes less relevant and broad skills become more relevant. It is frequently stated, particularly in the field of education, that today's generation must leave school with a complete and well-organised set of 21st century abilities.

Focusing on cognitive skills, intrapersonal skills, interpersonal skills, and technical skills is one way to develop 21st century skills and abilities (Hilton, 2015; Geisinger, 2016; Pellegrino, 2017; Care et al., 2018; Mitsea et al., 2021). Problem solving, critical thinking, and systems thinking are examples of cognitive skills. Intrapersonal skills are a set of metacognitive abilities that include self-management, time management, self-development, self-regulation, adaptation, and executive function. Interpersonal skills include communication as well as social skills, e.g., collaboration and teamwork, cultural sensitivity, and dealing with difference. Meanwhile, technical skills are primarily concerned with research and information proficiency, as well as entrepreneurial and financial literacy.

Furthermore, in order to meet the demands of education and employment in the 21st century, it involves extra layers for communication skills, technology savvy, global perspective, collaboration, digital skills, and more innovative applications rather than memorization (Becker et al., 2017; Varier et al., 2017; van Laar et al., 2022). For example, the past century's

curricula could not have predicted the fast progress of cellular technology, capacity, and spread across the global community, or that the internet would enable global communications virtually. Expertise has also become so specialised that it is critical for teams to collaborate in order to solve numerous issues and challenges. As a matter of fact, problem solving requires collaborative abilities, teamwork skills, and cross-cultural awareness. Indeed, in an ever-changing environment, proactive problem solving and entrepreneurial abilities are required for people to adapt immediately and successfully. Success relies on a symbiotic interaction between educators and the service industry.

In 2013, the Ministry of Education (MOE) of Malaysia launched The Malaysia Education Blueprint 2015–2025 (Higher Education) in order to prepare Malaysia for the transition to a high-income nation. The approach contains ten shifts that will empower higher education. All ten shifts address core system performance issues, such as quality and efficiency, as well as global events that are reshaping the higher education industry. The first four shifts are concerned with outcomes for stakeholders in the higher education system. For example, academic and TVET students, the academic community, and all who participate in lifelong learning. While another six shifts are concentrated on higher education ecosystem enablers such as funding, governance, innovation, internationalisation, online learning, and delivery (MOE, 2015). Although higher education continues to expand its global distribution network, the number of Malaysian graduates who are unemployed is also increasing.

This trend is also acknowledged by the Malaysian Department of Statistics (2021), where the number of unemployed graduates increased to 4.4 percent from 3.9 percent (165.2 thousand people) in 2019. This implies that higher education is critical to producing individuals who are well-educated for life and responsible enough to contribute to societal peace and increased living conditions. Consequently, international organisations, NGOs, private-sector organisations, and academics all around the world have developed theoretical frameworks that define and explain 21st century talents, as well as elaborate on their significance. For example, the Malaysia Education Blueprint 2015–2025 (Higher Education) focuses on a diverse set of 21st century capabilities as well as elements of Education 4.0 and Industrial Revolution 4.0. However, when it comes to actually measuring these skills, many questions remain unanswered, such as how the assigned tasks can adequately reflect theoretical frameworks, how these trained skills can be meaningfully and effectively assessed, how performance can be graded and scored, and what the implications and versatility of those assessments are (Greiff & Kyllonen, 2016).

### **Assessment Strategies in the 21st Century Classroom**

Assessments of student learning offer data to assist educators, administrators, policymakers, students, parents, and researchers in evaluating the level of student learning and making judgements regarding implications and actions. The exact reasons for which an evaluation will be used are considered at all stages of its development (Pellegrino, 2014). Several nations have been working for more than a decade to integrate 21st-century skills into their curricula (Gryphon & Care, 2015). Singapore is one of the more forward-thinking countries in this area. Singapore initiated a process of revamping curriculum, teaching, and evaluation to integrate critical thinking, problem solving, decision-making, cooperation, and creativity under the title "Thinking Schools, Learning Nation" in 1997.

Curriculum materials addressed these abilities, and new teacher training began to emphasise them. Some assessments, such as project work and investigation, as well as teamwork and collaboration, were even integrated into the examination system. Finland's awareness of 21st century skills was strengthened in 2004 when the Finnish government reopened discussions on a new iteration of the national curriculum. This decennial process includes the creation of a baseline document for the national curriculum as well as accompanying laws. In the framework of goals for teachers, the present curriculum incorporates several 21st century abilities, such as learning via peer interaction, assisting students in taking responsibility for their own learning, and assisting them in developing strategies for applying skills in new contexts.

However, when it comes to really measuring 21st-century skills, there are many questions regarding how the task distribution will accurately represent the theoretical framework. It is challenging to determine how these skills may be assessed in a meaningful and effective manner. Also, on how to scale and measure performance accurately, as well as the consequences and value of these evaluations, most have yet to be adequately answered. As a result, implementing innovative and creative 21st century assessment requires an open mind, a willingness to take chances, and transformative leadership. Educational institutions must first commit to an honest and in-depth examination of their existing assessments, followed by the development of policies suited to attaining the desired goals.

### **Methodology**

A qualitative study approach was utilised to better understand educators' perspectives regarding the Medical Laboratory Technology Diploma Programme's 21st-century assessment strategies for providing a positive learning environment and increasing learning gains. This research is based on 21st-century skills taught in today's health science education. A qualitative approach facilitates in-depth analysis because researchers tend to probe participants and gather sufficient data by asking relevant questions. Furthermore, qualitative data provides insight into why participants use such strategies, and they are free to express their opinions, which leads to the collection of more detailed information (Hamilton & Finley, 2019; Creswell & Guetterman, 2021).

This study employed a semi-structured one-on-one interview. The semi-structured interview is broken down into three (3) parts. Part 1 is concerned with the basic demographic, which contains questions about the length of time teaching Medical Laboratory Technology courses and the current position at the corresponding institution. Part 2 focuses on educators' perspectives in accordance with the first and second research questions of this study. The questions in this part require participants to explain their perspectives on assessment methodologies in the 21st century classroom. The questionnaires are also designed to explore participant assessment practises that may support students' learning of the following 21st century skills: critical thinking, collaboration, communication, creativity and innovation, self-direction, making global connections, making local connections, and using technology as a learning tool. For each of the stated aspects, they were questioned on how they assess whether or not students have developed or gained the skills, what assessment methods they use, and what problems they have and how they overcome them. Part 3 corresponds to the third research question of this study, which concerns how educators ensure that their teaching practises contribute to creating a positive learning environment in their 21st century classrooms in order to improve student learning gains.

Pilot studies with multiple volunteers with relevant educational backgrounds were conducted to avoid misinterpretation and ensure that the questions were aligned with the study aims and research questions. Following that, the questions were slightly tweaked before the actual interview began. For ethical consideration, both higher education institutions have granted authorization to utilise data and study samples. The procedure of getting permission and approval to conduct a study and finding participants takes about a month.

Participants for this study were chosen using a purposive sampling procedure. The participants were collected from two different institutions in Kuala Lumpur, Malaysia, that offer the Medical Laboratory Technology Diploma Programme. In each study institution, the target group or sample size consists of two educators teaching for the Medical Laboratory Technology Diploma Programme. In qualitative research, it is common to study a few individuals or cases. This is because a researcher's overall ability to provide an in-depth picture diminishes with the addition of each new individual or site. In some cases, researchers may focus on a single person or site. In other cases, the number could range from 1 or 2 to 30 or 40. The larger number of cases can become unwieldy and result in superficial perspectives due to the need to report details about each individual or site. Furthermore, gathering qualitative data and analysing that data takes time, and adding each individual or site is merely increasing the time (see Creswell & Guetterman, 2021).

Participation is still entirely voluntary, and no financial incentive was provided. Participants signed a consent form and were reminded that they were able to withdraw from the study at any time. Aside from that, participants were informed about the nature of the study, what was expected of them, and how the data would be used via an information sheet and consent form. Each participant was assured of confidentiality, and the intention to publish any additional findings was made clear. Prior to the interview, all participants signed the consent form. To increase the response rate, all potential study participants were given a softcopy of the questionnaire at least a week before the interview session to mentally prepare them for the interview questions. The interview questions were distributed via WhatsApp and email. The researcher performed interviews with four participants, each lasting between 45 and 60 minutes. The interview was conducted via Google Meet or face-to-face, and both were recorded. The data collection period lasted from February 25th to March 10th, 2022.

Several steps are used to examine the data that has been collected. The transcribed interviews will be read several times to ensure that the intended meaning is fully grasped and clearly understood. The interviews are then mapped and classified in accordance with the appropriate themes. All interviews were anonymized. Both institutions were represented by Institution A and Institution B. Institution A participants were represented by participants "A1" and "A2". Participants from Institution B were represented by Participants "B1" and "B2".

## **Findings**

### **Part 1: Basic Demographic**

For Part 1 of the questionnaire, participants were asked to provide basic demographic information such as length of employment at the current institution, and current position at the relevant institution. Table 1 is a summary of the relevant information gathered from the participants. All participants have at least four years of experience teaching Medical Laboratory Technology programmes at their respective universities. Participant B1 has taught in the same programme at different institutions for about ten years.

Table 1

*Summary of information related to the two participants of respective institution.*

Participant Criteria	Institution A		Institution B	
	A1	A2	B1	B2
Length of employment at the current institution	14 years	5 years	4 years	13 years
Current position	Course coordinator	Tutors	Course coordinator	Course Coordinator Department Quality Manager for MLT programme, Secretary for MLT Programme Examination

## Part 2: Educators' General Perceptions on 21st Century Assessment Strategies

According to Participant A1, assessment strategies in the 21st century classroom are more student-centered. Whereas the educator serves as a facilitator and assessment questions must be more towards level of higher order thinking. Furthermore, she stated that practical evaluation should take the form of a simulation identical to the real-world setting in the pathology laboratory. This can provide students the opportunity to practise and learn in scenarios that are very similar to those encountered in a clinical environment. Padilha et al. (2019) also found that in nursing education, clinical virtual simulation can serve as a facilitator of information, clinical reasoning, better learning satisfaction, and enhanced self-efficacy. Participant A2 recommended for the diversification of evaluation techniques, as well as the use of technology applications to attract learners. Participant B1 emphasised the importance of producing graduates who meet the needs of the industry. She also highlighted the importance of students understanding on why certain assignments must be done. She suggested task such as problem-based learning, which incorporates components of communication, reflective learning, and creativity, is one example of an activity that could be implemented. While Participant B2's views are similar to those described by Participants A1 and A2. That is, 21st century assessment strategies should be more towards student-centered, students should be taught similar to real-world situations, utilise online platforms to be comparable to international, include online assessment for appropriate course content, learning should be creative rather than relying solely on lecture notes, and provide more assignments.

Students in the twenty-first century have grown up surrounded by information and communication technology (Scott, 2015). Thus, results in various learning and information processes. Besides that, educators should aware that these students able to access information in real time. Moreover, they prefer visual graphics to text and able to operate when networked. They also demand for instant satisfaction and regular reinforcement (Scott, 2015; Fotaris et al., 2016; Cladis, 2020)

Participant B1 further indicated that 21st century skills should not be included all at once in a single course code, but rather there should be a distribution of 21st century skills that would be assessed for each course code in the Medical Laboratory Technology Diploma Programme. This statement is in accordance with Scott, (2015) where there is no single framework that

can be applied for all aspects of 21st century skills. Therefore, it should involve a combination of several frameworks to reach the overall 21st century skills for the Diploma in Medical Laboratory Technology curriculum.

**21st Century Assessment Strategies**

Majority of the evaluations conducted by Participant A1 are based on rubrics that have previously been prepared specifically for the chosen 21st century component. She also addressed challenges and how she overcome them. Table 2 shows a summary of her response.

Table 2

*Summary of information related to Participant A1 's answer for assessment strategies.*

21st century skills	“How do you assess whether or not students have the skills and what assessment methods do you use?”	“What are the challenges and how do you overcome them?”
<b>Critical thinking skills</b>	Provide constructive assignments that are assessed based on the rubric that has been set. Assignments in the form of written assignment, presentation, MCQ or short answer questions.	<p>Challenges: There are still at least 10% of students who prefer more to teacher-centered approach. They demand questions and answer schemes, not even try to find answers first.</p> <p>Overcome: Educator will be firm with the decisions and will have discussions to stimulate students to think.</p>
<b>Collaborative skills</b>	Provide constructive assignments that are assessed based on the rubric that has been set. Assignments in the form of written assignment, presentation or laboratory case study. Implement peer assessment so that everyone in the group will be responsible and cooperate with each other.	<p>Challenges: There are students who will remain as passengers in group assignments. These students do not contribute and there are also those who cannot be contacted to finish the group assignments. There are also students who are too overconfident and become dominant in the group, causing other students unable to show their performance.</p> <p>Overcome: Reshuffle group members, reduce evaluation scores for collaborative aspects.</p>



21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Communication skills</b>	By giving presentation assignments; through on-going response in the classroom; and give students the opportunity to determine the method of presentation either infographic-ally or in any other appropriate method.	Challenges: There are some students who lack of knowledge in digital applications.  Overcome: Educator will guide students who need help
<b>Creativity and innovation skills</b>	Provide constructive assignments such as video presentation or infographic based on the rubric that has been set.	Challenges: There are some students who lack of knowledge in digital applications.  Overcome: Educator will guide students who need help
<b>Self-direction skills</b>	Provide appropriate task to encourage students’ self-direction skills. Monitor how frequently students share and discuss and come to meet with teachers on a regular basis to discuss their learning concerns.	Challenges: Students do not want to be more proactive in improving their understanding and prefer to just wait to be provided all of the necessary information.  Overcome: Reinforce students to engage in self-directed learning in order to avoid them from being left behind.
<b>Global connections</b>	Provide constructive assignments that are assessed based on the rubric that has been set. Assignments in the form of written assignment, case study or presentation.	Challenges: Hard to obtain data regarding the relevant topic.  Overcome: Allow students to obtain general data through annual reports
<b>Local connections</b>	Provide constructive assignments that are assessed based on the rubric that has been set. Assignments in the form of written assignment.	-

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Using technology as a tool for learning</b>	Provide constructive assignments that are assessed based on the rubric that has been set. Assignments in the form of presentation, videos and infographic.	Challenges: There are some students who lack of knowledge in digital applications.  Overcome: Educator will guide students who need help

Participant A2 also employs rubrics in assessment, and also asked students verbally from time to time to promote to enhance 21st century skills among students. Previous research indicates that problem-based learning is a successful teaching and learning strategy, particularly when it comes to long-term knowledge retention and application (Yew & Goh, 2016; Carrió et al., 2016; McBride & Drake, 2016). Other studies revealed both teachers' and students' perceptions of problem-based learning were positive, with significant gains in students' knowledge of science concepts as well as in taking responsibility for students own learning (Gorghiu et al., 2015).

Table 3 shows a summary of Participant A2's response. There are several 21st century skills that are formally assessed, with the marks earned contributing to the course's grade. However, there are some elements of 21st skills were not assessed but are infiltrated indirectly among the students.

Table 3

*Summary of information related to Participant A2 's answer for assessment strategies.*

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Critical thinking skills</b>	Provide constructive task that are in the form of lab case study.	Challenges: Students prefer to wait for responses from their classmates. Furthermore, they solely refer to class notes and do not want to seek answers from other sources.  Overcome: Ask the specific student again, pay attention to the student, and offer assistance and guidance. If it's still not possible, the question will be open to others who can answer

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Collaborative skills</b>	Through assignments in the form of presentations. The distribution of work is seen through subtopics presented by each group member. Students will be asked questions on the subtopics presented by their group members so that they would cooperatively discuss and understand the material being presented as a group and not on their own.	Challenges: Some students have a tough time finding cooperative group members.  Overcome: The result of the group assignments will be evaluated by lecturers. If it does not meet the requirements criteria, the group will be requested to redo the assignment, and the presentation will be repeated at a later date.
<b>Communication skills</b>	Ask verbally if there is a problem to understand the assignment and will provide an explanation to the student.	Challenge: Some students are reluctant to ask question.  Overcome: Provides the option to ask questions using WhatApps. Instructors will continue to improve communication -related problems.
<b>Creativity and innovation skills</b>	Through presentation assignments	Challenges: Students do not want to look for additional information
<b>Self-direction skills</b>	Educator will look at the steps the students took to complete their practical case study.	Challenges: Issues with students from semesters 1 and 2 as they are still new to the concept of scenario - type of questions.  Overcome: Educators will provide information and guidelines to ensure that students follow the instructions and see the results obtained.
<b>Global connections</b>	The Q&A session will begin with "have you heard?", "have you read?".	Challenges: Students are lazy to read and do not want to be aware of current issues.

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
		Overcome: Provide advice, explain the importance and need to know about related issues
<b>Local connections</b>	-	Time constraints for outdoor activities.
<b>Using technology as a tool for learning</b>	Through tutorials and online continuous assessment.	Challenges: The issue of honesty in answering questions  Overcome: Request that students use an additional camera when taking online tests.

Participant B1 were presentations, case studies, and producing video/ posters. She also assesses the 21st century skills using specific rubric that has been established. Participant B1's challenges include educators struggle to provide the best rubrics, student attitudes, internet access, and student technological facilities. Table 4 shows a summary of her response.

Table 4

*Summary of information related to Participant B1 's answer for assessment strategies.*

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Critical thinking skills</b>	Assessed based on the rubric that has been set. Assignments in the form of case study questions.	Challenges: Instructors struggle to create case studies that are consistent with the desired elements. A quality rubric is required to assess the important aspects, and precise explanations need to be provided.  Overcome: Rubrics need to be prepared in advance. Verify and discuss the quality of the questions with a more knowledgeable instructor. Carry out vetting.

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Collaborative skills</b>	Assessed based on the rubric that has been set. Assignments in the form of case study questions and presentation. Students will be given questions on the subtopics presented by their group members so that they need to discuss and comprehend the subject as a group rather than on their own. Implement peer assessment strategies. Remind students to understand the entire presentation.	Challenges: To ensure that students understand what will be assessed and what the instructor's actual expectations for the task.  Overcome: Instructors will display assignment questions and rubrics on the appropriate platform and remind students verbally.
<b>Communication skills</b>	Assessed based on the rubric that has been set.	Challenges: The question instructions are not understood by the students.  Overcome: Provide explanations during class briefings and upload instructions in the learning system.
<b>Creativity and innovation skills</b>	Assessed based on the rubric that has been set specifically for creativity and innovation.	Challenges: Student accessibility and less effort to perform assigned tasks.  Overcome: Give explanations so that students grasp the question's purpose.
<b>Self-direction skills</b>	No assessment	-
<b>Global connections</b>	Assessed based on the rubric that has been set and give marks for the effort, attached appendices and referenced journals	Challenge: The level of difficulty varies according to the topic. For instance, the amount of time it takes to obtain information; the commitment and degree of students understanding.

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
		Overcome: Always provide encouragement, motivation and open the minds of students about the need to learn the related topic.
<b>Local connections</b>	Assess the number of comments obtained on the uploaded video	-
<b>Using technology as a tool for learning</b>	Assessed based on the rubric that has been set	Challenges: Internet connectivity, especially for people who live in rural areas and cannot afford it.  Overcome: Educate families with an awareness of the significance of technology in supporting student learning. Educators provide encouragement and support.

Participant B2, on the other side, included various activities such as group work projects in her assessment strategies. Table 5 represent her responses for assessment strategies of the questionnaire.

Table 5

*Summary of information related to Participant B2 's answer for assessment strategies.*

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Critical thinking skills</b>	Based on the written report answers given by the students	Challenges: Students lack hands-on clinical experience.  Overcome: Educator provide training so that students are familiar with various types of clinical problems.

21st century skills	<i>“How do you assess whether or not students have the skills and what assessment methods do you use?”</i>	<i>“What are the challenges and how do you overcome them?”</i>
<b>Collaborative skills</b>	Implement peer evaluation and rubrics that have been set	Challenges: Students do not provide accurate peer evaluations, and the grades they receive are just the same among them.  Overcome: Educator will explain the importance of the assessment given along with its impact
<b>Communication skills</b>	Implement peer evaluation and rubrics that have been set	Same as the answer for collaboration skills.
<b>Creativity and innovation skills</b>	There is no specific assessment, only seen through laboratory findings obtained following innovation of techniques or procedures.	-
<b>Self-direction skills</b>	Through the results provided as well as the capacity of students to acquire new knowledge for their own learning.	-
<b>Global connections</b>	Through the results provided as well as the capacity of students to acquire new knowledge with regards to global issues.	-
<b>Local connections</b>	-	-
<b>Using technology as a tool for learning</b>	Implement peer evaluation and rubrics that have been set	Challenges: Lack of digital skills  Overcome: Provide examples from previous batch.

**Part 3: Creating a positive learning environment in 21st century classrooms to improve student learning gains**

Participant A1 indicated that it is difficult to maintain such a positive environment for students. However, it is possible that it would be designed because everything is depended on the students' acceptance. For example, students may be encouraged to participate in village visits to conduct interviews; or volunteers may be asked to answer questions provided during practical/class discussions; or students could be taught digital skills. She added that educators would have to provide assignment as an assessment and making the results significant in course grading to triggers students' participation and cooperation. But according to Participant A2, providing students with encouragement, inspiration, and appreciation is one way to ensure a positive learning environment. Participant B1 emphasised on the need of developing an appropriate framework for the syllabus, students' learning time, and course material. Instructors must also understand the framework that has been established. Students need to be informed about the framework and ensure they understand the values that will be incorporated. Educator must also provide students with clear information about the assessment and when it will be conducted. Whilst, participant B2 emphasised the relevance of student feedback in improving the quality of education and assessment. This kind of feedback and analysis that directly evaluates students based on their performance are likely to promote performance goals.

Consequently, for each of the identified 21st century skills criteria, the majority of the participants' strategies consist of presentations and written assignments in the form of laboratory reports or case studies. While for digital skills, the majority of the tasks assigned are such as creating videos or posters. The majority of the difficulties encountered are due to students' unwillingness to try, cooperate, and simply demand complete notes, as well as a lack of digital competencies. Furthermore, whether students can afford to purchase internet access, laptops, or compatible mobile phones for learning and assessment purposes is dependent on their financial situation. Figure 1 depicts the main themes that emerged as contributing variables to 21st assessment strategies and challenges as well as strategies educators use to create a positive learning environment in 21st century classrooms in order to improve student learning gains.



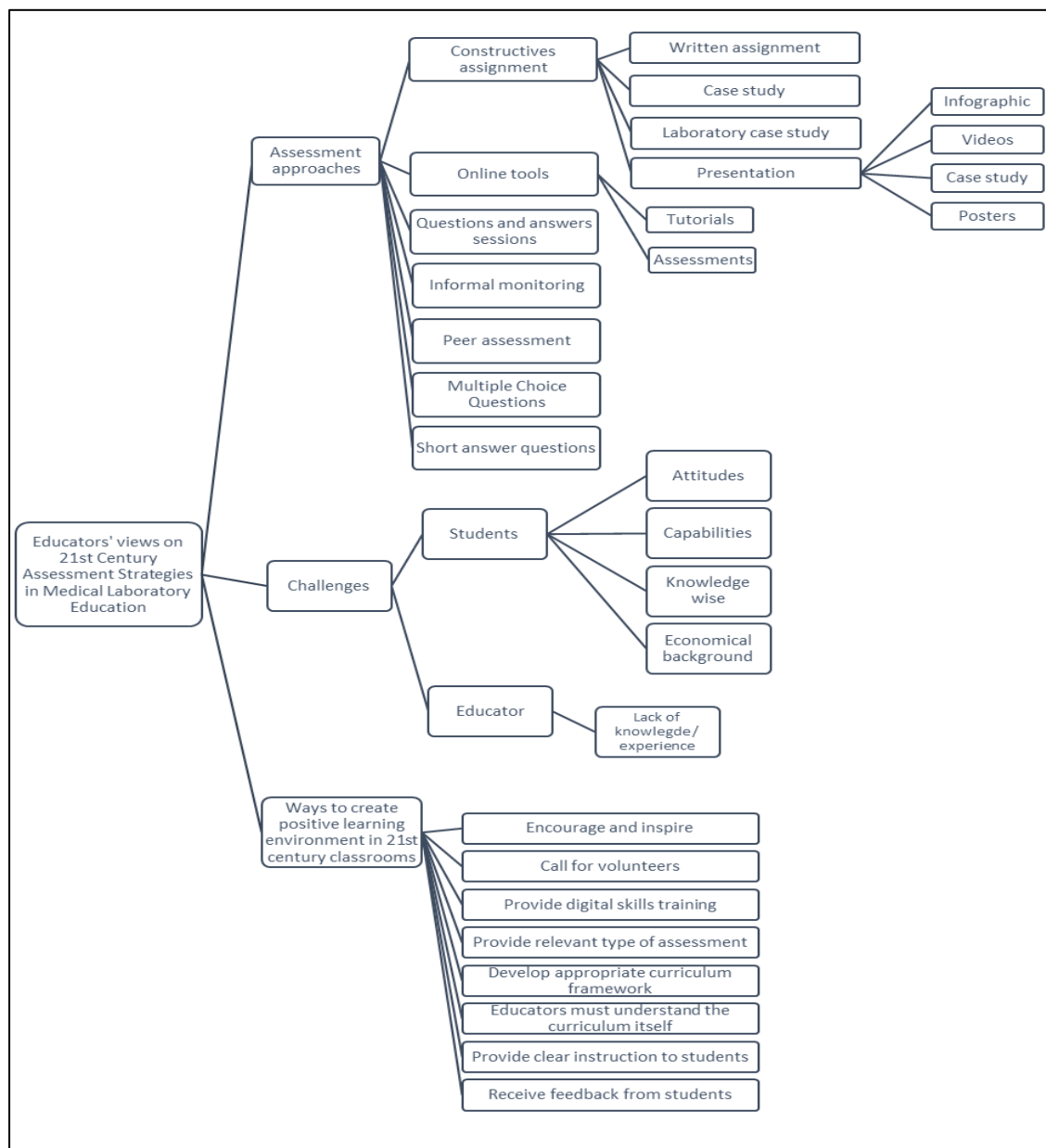


Figure 1: Main themes that emerged as contributing variables with regards to Educators' views on 21st Century Assessment Strategies in Medical Laboratory Education

**Discussion**

Through the result of the study's findings. It is clear that no single assessment can measure all types of learning that educators value in students, and no single instrument can achieve all of the goals that have been set. However, it is crucial to design a well-structured assessment system. For example, educators must create a good-quality rubric to assess the desired component. All assessments should properly represent the standards that have been established, and they must also serve as models for effective teaching and learning practises (Pellegrino, 2014). The majority of the tasks assigned are constructive in nature. A constructive task requires students to think about the information being taught and interpret it based on their past experiences, personal views, or cultural background. Moreover, students do not merely learn passively; they also attempt to generate new ideas. Besides, knowledge is best

gained through a process of action, reflection, and construction (Brau, 2020; Kimmons & Caskurlu, 2020). Furthermore, 21st-century skills include abilities such as collaboration, communication, creativity, digital literacy, collaboration, critical thinking, and many more, all of which can be applied to constructive tasks.

Students' enthusiasm and intrinsic motivation to study may be boosted by experiences that foster independent, critical, and creative thinking, as well as problem-solving abilities. Students should be given ample time to finish tasks and, at the same time, be clear about the expectations of the task (Filgona et al., 2020). Besides that, it is important to make students feel valuable through collaborative projects and team spirit. It is better to cultivate cooperative group work than individual competing efforts. Educators could also include parents, coworkers, and other stakeholders in student learning through written, oral, and technological communication. Educators must also encourage students to learn about different cultures and instill awareness, sensitivity, and respect towards other people and their uniqueness (Grapin & Pereiras, 2019). Students should receive feedback that would assist them in improving or strengthening their knowledge, abilities, or attitudes. The student's self-evaluation and peer assessment must be provided along with all feedback, but it should not be taken negatively. This may be overcome by improving learning strategies such as fostering discussion, debate, and reflection. Giving these activities appropriate time and structure is crucial so that they can be properly integrated into the learning or assessment system (Carrió et al., 2016; Fotaris et al., 2016; Greiff & Kyllonen, 2016).

While all participants stated their thoughts towards the challenge posed by students, Participant B1 noted that educators or instructors themselves encounter difficulties in formulating suitable tasks and ensuring that students comprehend the task requirements. This scenario substantiates the idea that formulating an assessment framework is a complicated task. Numerous factors must be considered, particularly the extensive scope of expertise required to construct a task that aligns with the intended learning outcome (Meyer & Norman, 2020).

The responsibility of educators in the 21st century classroom requires changes in educators' knowledge and classroom behaviours. An educator must be able to act as a facilitator, creating a learning environment that allows students to generate their own knowledge by utilising relevant resources and experiences. Educators have to be aware of their students' needs, be able to pace lessons, and develop meaningful work that actively engages students in their learning. Educators must also ensure that the learning atmosphere is secure, supportive, and motivating, as well as providing a proper learning environment for students with special needs. Educators must also have a diverse set of skills in order to foster an active learning environment and minimise any disruption that can affect student learning (Akil & Adnan, 2022). Furthermore, educators must cultivate student collaboration inside the classroom by modelling and promoting democratic principles and best practises that are significant in the real world.

One of the pedagogical approaches employed in medical laboratory technology education involves the necessity of conducting clinical visits to ensure that students stay up-to-date on the latest advancements in the technology utilised. One noteworthy aspect of a participant's interview pertains to their implementation of a video-making task centred on current technology. The task necessitated that students look for information to create a video that was relevant to the subject matter. Students are indirectly exposed to a wider range of lab technologies that may not yet be used in Malaysian medical institutions but are available on

the market. In contrast to clinical visits, variations in technological resources across medical institutions in Malaysia may pose a challenge for students trying to gain exposure to different laboratory settings. It is unfeasible for students to visit every clinical laboratory institution within the country. Thus, it can be inferred that these assessment approaches have the potential to facilitate the dissemination of knowledge among students and provide them with opportunities to educate themselves with the latest developments in the field of pathology services (see Akil & Adnan, 2022).

The integration of technology in the realm of education has paved the way for the possibility of conducting medical laboratory education assessments through online means in order to cater to the demands of contemporary skills in the 21st century. The employment of technology by educators to devise captivating assessments is indicative of their ingenuity. Hence, it is imperative for policymakers and professionals in the medical laboratory field to devise effective assessment strategies that can facilitate the production of competent medical laboratory graduates in tandem with the growth of the industry.

### **Implication of the Study**

The findings of this study will help determine the extent of instructional and assessment strategies used in the Medical Laboratory Technology Diploma Programme at two institutions of higher learning in the twenty-first century. Furthermore, the information gathered may aid in a better understanding of the strategies they use to ensure that 21st-century skills are successfully incorporated into teaching and learning activities.

Based on the perceptions of the four participants, it is possible to conclude that 21st century skills include important skills that medical laboratory technology diploma students need to have in order to ensure that the health service has quality employees and is keeping up with the current health industry development. Based on the context of MLT education, the following characteristics of 21st century skills can be concluded:

- The educator acts as a facilitator.
- The classroom is more student-centered.
- Assessment questions are more focused on higher-order thinking.
- Learning should be creative rather than relying solely on lecture notes, and more assignments should be provided.
- There should be a distribution of 21st century skills that would be assessed for each course code in the Medical Laboratory Technology Diploma Programme.

This study's findings provide knowledge of assessment strategies by sharing relevant strategies to address the gap in the literature regarding the implementation of 21st century skill assessment in medical laboratory technology education. As well as to raise awareness among institutions and all stakeholders about future requirements and the need for curriculum improvements in medical laboratory technology education. thus capable of ensuring that healthcare delivery meets the demands of the twenty-first century by developing professionals with appropriate clinical skills, which are critical for future employment in a healthcare medical laboratory, as well as handling the increased demand of industry.

Furthermore, with the Malaysian Qualification Agency's (MQA) accreditation guidelines and requirements, the existence of various circulars and guidelines issued by the Ministry of Education related to higher learning, and the Malaysian Ministry of Health Malaysia's mission

and vision, medical education and health sciences should keep moving to keep up with current developments. The context of assessment should change in tandem with the changing environment of medical and health education around the world. It can be seen, for example, that assessing students in the context of psychomotor, affective, and cognitive domains using simulation or real-time clinical laboratory environments is gaining worldwide acceptance among medical and health sciences educator professions, as these techniques have been shown to improve assessment validity and reliability. This research also helps to understand how both schools overcome challenges, which can be useful for other institutions.

### **Limitation**

Concerning the study's limitations, the use of data from two institutions may not work for another, although it may provide some insights. The willingness of participants to share their views was also limited. Hence, the results of the study were interpreted with caution.

### **Conclusion**

In summary, this study is highly fascinating to explore since it allows readers or researchers to identify things that need to be changed, including critical elements for instructional and assessment in the 21st century, while ensuring the learning environment is positive and supportive. Participants in this study demonstrate understanding and knowledge of various assessment methods to ensure that students are able to employ 21st-century skills. Educators who have fallen behind in adopting digital learning must be given special attention and additional training to help them deal with technological changes in the classroom. Formative assessment, which has been shown to have a significant impact on student progress, will undoubtedly be used more frequently as a result of technological advancements. Furthermore, the findings of this study show that the assessment method for MLT initiatives in Malaysia is going through changes and innovations in order to keep up with the industry's development and needs. Evaluation methods are not only limited to multiple-choice questions, essays, and practicals but also include more constructive evaluation methods. Instructional strategies such as group work and practise should be promoted. Students will articulate their cognitive processes when participating in active-learning tasks such as small group learning. This will help educators assess whether or not the course learning objectives have been achieved, as well as identify and rectify student confusions. The medical laboratory educator must be aware of the learning outcomes for each activity and learning opportunity, especially before providing clinical skills training. It is critical for the tutor to be concerned with what is being taught, as well as the knowledge and skills that will be required, and to understand how to evaluate the students' performance. Aside from clinical abilities, the educator must be knowledgeable in the respective health science areas and medical ethics, and most importantly, he or she must be able to establish a pleasant learning environment. The educator should build rapport with the students and make them feel comfortable participating actively in the study of various clinical skills. To make teaching more successful, the educator must first identify the students' prior knowledge, motivation level, and learning requirements. Educators must pay close attention to students while they practise any skill and provide help and comments when they seem to be making the wrong decision. It is vital that educators assigned to clinical skills training tasks get proper training on the methodologies to be used so that students may attain the learning goals.

### **Future Research/ Recommendation**

If the opportunity to expand this study is given, it would be beneficial if the study was conducted with several other higher education institutions that offer DMLT programmes. This is due to the fact that each institution may have varying financial and infrastructure capacities. As a result, it is possible that additional evaluation methods for the DMLT programme can be identified and provided to other institutions. Collaboration may be possible to improve the DMLT program's educational and assessment quality. The research's duration can also be increased until it reaches a saturation point of information, at which point there will be no unreported data. Furthermore, additional research can be conducted to determine the extent to which the relevant participants' strategies are effectively implemented.

### **Ethics Approval and Consent to Participate**

All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional. Informed consent was obtained from all participants.

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The author declared no conflict of interest when carrying out and publishing this research study.

### **References**

- Akil, W. F. H. W. M., & Adnan, A. H. M. (2022). Promoting Digital Literacy in Higher Education: Case Study of a Medical Laboratory Program in Malaysia. *International Journal of Academic Research in Progressive Education and Development*, 11(4), 735–755.
- Becker, S. A., Cummins, M., Davis, A., Freeman, A., Hall, C. G., & Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition* (pp. 1-60). The New Media Consortium.
- Brau, B. (2020). Constructivism. In R. Kimmons & S. Caskurlu (Eds.), *The Students' Guide to Learning Design and Research*. EdTech Books.
- Care, E., Kim, H., Vista, A., & Anderson, K. (2018). Education System Alignment for 21st Century Skills: Focus on Assessment. *Center for Universal Education*. Brookings Institution.
- Carrió, M., Agell, L., Baños, J. E., Moyano, E., Larramona, P., & Pérez, J. (2016). Benefits of using a hybrid problem-based learning curriculum to improve long-term learning acquisition in undergraduate biology education. *FEMS microbiology letters*, 363(15).
- Cladis, A. E. (2020). A shifting paradigm: An Evaluation of The Pervasive Effects of Digital Technologies on Language Expression, Creativity, Critical Thinking, Political Discourse, And Interactive Processes of Human Communications. *E-Learning and digital Media*, 17(5), 341-364.

- Creswell, J. W., & Guetterman, T. C. (2021). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Pearson.
- DSM (2021). Department of Statistics Malaysia Press Release: Graduate Statistic 2020. *Department of Statistics Malaysia, Putrajaya*.
- Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in learning. *Asian Journal of Education and social studies*, 10(4), 16-37.
- Fotaris, P., Mastoras, T., Leinfellner, R., & Rosunally, Y. (2016). Climbing Up the Leaderboard: An Empirical Study of Applying Gamification Techniques to A Computer Programming Class. *Electronic Journal of e-learning*, 14(2), 94-110.
- Geisinger, K. F. (2016). 21st century skills: What Are They and How Do We Assess Them? *Applied Measurement in Education*, 29(4), 245-249.
- Gorghiu, G., Drăghicescu, L. M., Cristea, S., Petrescu, A. M., & Gorghiu, L. M. (2015). Problem-Based Learning-An Efficient Learning Strategy in The Science Lessons Context. *Procedia-social and behavioral sciences*, 191, 1865-1870.
- Grapin, S. L., & Pereiras, M. I. (2019). Supporting diverse students and faculty in higher education through multicultural organizational development. *Training and Education in Professional Psychology*, 13(4), 307.
- Greiff, S., & Kyllonen, P. (2016). Contemporary Assessment Challenges: The Measurement Of 21st Century Skills. *Applied Measurement in Education*, 29(4), 243-244.
- Griffin, P., & Care, E. (Eds.). (2015). *Assessment and teaching of 21st century skills: Methods and approach*. Springer.
- Hamilton, A. B., & Finley, E. P. (2019). Qualitative methods in implementation research: An introduction. *Psychiatry research*, Volume 280, 112516.
- Hilton, M. (2015). Preparing students for life and work. *Issues in Science and Technology*, 31(4), 63.
- MQA (2014). Malaysian Qualifications Agency. *Guidelines To Good Practices: Assessment of Students*. Retrieved on March 10, 2022, from [https://www2.mqa.gov.my/QAD/garispanduan/2019/GGP%20Assessment/3.%20GGP%20-%20Assessment%20of%20Students\\_BI%20-%20\[FB\].pdf](https://www2.mqa.gov.my/QAD/garispanduan/2019/GGP%20Assessment/3.%20GGP%20-%20Assessment%20of%20Students_BI%20-%20[FB].pdf)
- McBride, J. M., & Drake, R. L. (2016). Longitudinal Cohort Study on Medical Student Retention of Anatomical Knowledge in An Integrated Problem-Based Learning Curriculum. *Medical teacher*, 38(12), 1209-1213.
- Meyer, M. W., & Norman, D. (2020). Changing Design Education for the 21st Century. She Ji: *The Journal of Design, Economics, and Innovation*, 6(1), 13-49. <https://doi.org/10.1016/j.sheji.2019.12.002>
- Miller, G. E. (1990). The Assessment of Clinical Skills/Competence/Performance. *Academic medicine*, 65(9), S63-7.
- Ministry of Education Malaysia. (2015). *Malaysia Education Blueprint 2015- 2025 (Higher Education)*. Putrajaya Malaysia.
- Mitsea, E., Drigas, A., & Mantas, P. (2021). Soft Skills & Metacognition as Inclusion Amplifiers in the 21 st Century. *International Journal of Online & Biomedical Engineering*, 17(4).
- Padilha, J. M., Machado, P. P., Ribeiro, A., Ramos, J., & Costa, P. (2019). Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial. *Journal of medical Internet research*, 21(3), e11529.

- Pellegrino, J. (2017), "Teaching, learning and assessing 21st century skills", in Guerriero, S. (ed.), *Pedagogical Knowledge and the Changing Nature of the Teaching Profession*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264270695-12-en>.
- Pellegrino, J. W. (2014). Assessment as a positive influence on 21st century teaching and learning: A systems approach to progress. *Psicología Educativa*, 20(2), 65-77.
- Plebani, M. (2017). Quality In Laboratory Medicine: 50 Years on. *Clinical Biochemistry*, 50(3), 101-104.
- Prunuske, A. J., Batzli, J., Howell, E., & Miller, S. (2012). Using Online Lectures to Make Time for Active Learning. *Genetics*, 192(1), 67-72.
- Scott, C. L. (2015). The Futures of Learning 1 - Why Must Learning Content and Methods Change in the 21st Century? *UNESCO Education Research and Foresight*, 13, 16.
- van Laar, E., van Deursen, A. J., & van Dijk, J. A. (2022). Developing Policy Aimed At 21st-Century Digital Skills for The Creative Industries: An Interview Study with Founders and Managing Directors. *Journal of Education and Work*, 1-15.
- Varier, D., Dumke, E. K., Abrams, L. M., Conklin, S. B., Barnes, J. S., & Hoover, N. R. (2017). Potential Of One-To-One Technologies in The Classroom: Teachers and Students Weigh In. *Educational technology research and development*, 65(4), 967-992.
- Yew, E. H., & Goh, K. (2016). Problem-based learning: An Overview of Its Process and Impact on Learning. *Health professions education*, 2(2), 75-79.