Impact of technology-enabled project-based assessments on learner outcomes in higher education

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Abstract: The classroom based applied-research explores a shift towards technology-enabled formative and summative project-based assessments as a replacement to campus-based assessments conducted in the context of polytechnics in Singapore. The investigation focuses how the integration of technology contributes to the development of attributes or learner profiles suitable for workplace and real-world performance while meeting the skill-based learning outcomes. Two scenarios have been addressed: student-generated video creation as summative assessment for full-time pre-employment training (PET) students and the application of student response system (SRS) for case-based formative tasks using a shared digital wall for part-time continuing education and training (CET) students who are adult learners. The qualitative study uses a hermeneutic phenomenology coupled with a quantitative survey to ensure valid interpretation of student feedback. While video-enabled summative assessment helped develop transferable soft-skills amongst tertiary students, the application of a shared SRS revealed higher intrinsic motivation towards life-long learning among adult learners.

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1   Introduction

The main purpose of polytechnic education in Singapore is to prepare students for work in the real world. To fulfil this purpose, the institution has adopted an outcome-based curriculum whereby the learning activities and assessment are designed to help students develop relevant skills and knowledge which they are expected to apply and perform at the workplace.

The COVID-19 pandemic has brought much disruption to the way teaching and learning is carried out. For a start, face-to-face lessons held during pre-COVID had to transit to home-based learning (HBL). With HBL, it demands that learning activities to be facilitated using online medium. Hence there was a need to rethink assessment design at the subject level without compromising on the fundamental purpose of assessment, coherent with an outcome-based curriculum adopted across the institution. In the process of re-designing assessments, HBL provided opportunities to harness the potential of technology-enhanced strategies.

Biggs and Tang (2007) stated that constructive alignment is the most suitable approach for outcomes-based teaching and learning. This approach seeks to drive students towards new learning based on relevant standards, develop learning activities that help to achieve these target outcomes and assessments to understand the extent to which the outcomes have been achieved.

This concept resonates well with the purpose of polytechnic education. Constructive alignment (Biggs, 2003) was hence adopted as the foundation for formulating learning activities when redesigning the assessment tasks in a HBL mode. The intended learning outcomes were kept in view to ensure the redesigned activities and assessments did not deviate from them.

'Teach Less; Learn More,' student-centred learning, constructivist learning, are terms that have been much acquainted in Singapore's education system, and beyond.

Underpinning project-based learning (PBL) is educator Edgar Dale's model (1)-s cone of learning. Quoting him,

> "We remember 10% of what we read; 20% of what we hear; 30% of what we see; 50% of what we see and hear; 70% of what we discuss with others; 80% of what we personally experience; 95% of what we teach others."

PBL aims to elevate the learning experience of students such that they retain a higher percentage of the intended learning objectives with minimal traditional didactic teaching but sufficient for students to engage in independent inquiry work (Kokotsaki et al., 2016). Introducing an authentic real-world problem for students to research and investigate, creates opportunities to cultivate generic skills such as collaboration, reflection, and presentation as part of delivering the end-product (Kwon et al., 2014; Patton, 2012), is ideal for a practice-based skills education in preparation. Grant and Branch (2005) explored that student extensively use their generic-skills during PBL.

However, Bridgstock (2009) argued that the world of work, required more than generic attributes. Employers' views of the desirable qualities of job-seeking graduates were evident in the literature (Yorke and Harvey, 2005). Bosanquet et al. (2010) further focused these characteristics may be categorised into four broad categories: employability; lifelong learning; preparing for an uncertain future; and acting for social the good.

Given this backdrop, this research study aims to explore the influence of project-based assessments that leverage technology as an enabler on learner attributes or transferable characteristics that prepare students for the rapidly evolving workforce. Specifically, the following research questions were examined:

1   How effective is the use of student-generated video creation for assessment as a replacement for face-to-face project presentation (summative assessment) to achieve employable characteristics outlined for pre-employment training (PET) students?

2   How effective is the use of student response system (SRS) with open-ended questions as a tool for formative assessment on the motivation for life-long learning of adult learners as a part of the continuing education and training (CET)?

Both research questions are different studies aligned to the same research topic, hence the target groups are naturally different. Research question (1) is targeted at full-time polytechnic students as part of their PET. On the other hand, research question (2) was targeted at part-time polytechnic students (i.e., adult learners) as part of their CET. In both instances, PBL was the pedagogical context.

2   Literature review

2.1   Technology-enabled project-based assessments

While the use of technology for project-based assessments is nothing new, it has not been widely practiced due to concerns over whether the assessment is authentic and fair (Khan and Jawaid, 2020). With the COVID-19 pandemic, there is a need to rethink the way technology is used to support assessments given the fact that there is a shift towards online teaching and learning delivery via asynchronous or synchronous means.

The literature review presented here looks at the influence of technology, namely student-generated video creation and SRS, on the assessment experience.

2.1.1   Student-generated video creation for summative assessment

The construction industry transformation map (ITM) was launched by Singapore in 2018 (MND, 2018) in close partnership with the industry, trade associations and chambers, institutes of higher learning and unions after extensive consultation. Through the initiative, the government hopes to transform the construction sector to adopt technologies driving towards advancement and integration. The increase in adoption of integrated digital delivery (IDD) through shared platforms along with the support to build the newly identified core skill was identified as one of the key strategies towards achieving the vision.

Apart from global, local, and institutional policy agendas to encourage digital literacy for economic and social reasons, it has been widely documented that 21st century students, which include the Generation Y and Millennials often have pre-existing technological skills and experiences that support video creation, though limitations vary based on student backgrounds (Beetham and Sharpe, 2013; Cox et al., 2010). However, the above investigations also noted that even the 'techno-savvy' can have difficulty transferring these skills into an academic or professional context. The development of digitally relevant skills as an essential element in the skills profile of a graduate from the built environment sector directed the inclusion of assessment practices to inculcate confidence in the ability to transfer digital skills and knowledge to industry practice.

Some of the benefits stated in the past literature on increased competency in using technology like video editing software, basic photography, and filming, recording of video presentation; intensive nature of video creation process which entails script preparation, repeated reviews of contents before final submission; opportunity to use and develop creativity. Apart from the digital skills related to video creation, the development of communication skills was another notable benefit (Alpay and Gulati, 2010; Orús et al., 2016) given the increasing importance of communicating effectively using digital media in the current era. In this regard, the benefits brought about by such an assessment approach go beyond the fulfilment of assessments. In fact, students would find these skills useful and relevant in their future work.

From the perspective of students learning, there is far better learning engagement with student-generated video creation (Greene and Crespi, 2012) since the process of creating the video entails much active learning. The act of preparing the script and repeated review of video contents helped in fostering deep learning.

As the take up of video for assessment is not as desired, especially within the higher education (Hawley, 2018), one of the purposes of this study is to lend more evidence of benefits, rationale, and guidance on how to implement an effective video assessment, However, leaning on the recommendations for a successful implementation of PBL from Kokotsaki et al. (2016), elements of student autonomy to give a sense of ownership, is explicitly planned and included when the video-enabled assessment is designed by the authors.

In view of the constraints posed during the peak of the pandemic that much learning must be taken to online platforms, getting students to record their presentations in a video format became one of the top choices as a replacement for the face-to-face presentation that was required in the previous arrangement. As much has been documented in the past

decade on the benefits of student-generated video creation as a form of assessment, this further affirms the decision of using student-generated video creation as a summative assessment in the study.

2.1.2 SRS for formative assessment

A SRS, typically used in lectures, is a technology that helps instructors pose questions, problems, or tasks, ask students to respond and display the results which could range from multiple choice, numeric, image or free-text answers. With advancement in technology, SRS has come a long way from simple handheld keypads known as clickers, transmitting data to the instructor's computer using radiofrequency or infrared signals to the use of use of digital tools such as web-based and smartphone supported applications. These systems have a variety of synonyms which include, 'audience response system,' 'classroom response system', 'classroom communication systems', 'digital wall', 'real-time voting', and the 'clicker system', in widespread practice.

In this article, the term SRS shall be used, which orients towards an individual student response to a particular stimulus, as opposed to classroom response system or participation systems which may suggest the focus towards a collaborative approach. The individual response indicates a pedagogical adaptation of the instructor directing a specific type of learning and the student responding to the scenario. At present, SRS with mobile technology is considered a significant method to improve learning experience (Fulantelli et al., 2015). Most studies have been focused on the impact of SRS for student engagement, motivation, and facilitation of high order thinking. Very few attempts have been made to explore the relationship between a pedagogical approach or alignment to assessment principles using SRS and their impact on student learning.

Beatty and Gerace (2009) proposed one such pedagogical approach that evolves from A2L with the aid of a SRS for teaching science and mathematics and prepare students for future learning known as technology-enhanced formative assessment (TEFA). TEFA is based on four principles:

1   motivation and focus of learning based on question driven instruction

2   development of understanding based on dialogical discourse

3   adjust teaching and learning decisions with formative assessment

4   development of metacognitive skills and cooperative learning with meta-level communication.

TEFA is one of the few attempts that helps link technology to a pedagogical approach, particularly formative assessment. Recently, researchers (e.g., Gehlen-Baum and Weinberger, 2014; Yılmaz, et al., 2015) emphasised that the application of SRS and mobile-technologies, together with well-designed pedagogical approach, often influence the effectiveness of learning. Though most have had a strong theoretical base, many aspects of the research are established through an empirical base or a practice-based scenario. Fies and Marshall (2006) acknowledged this missing link between SRS in connection with diverse pedagogical approaches and impact on student attributes.

2.2   Learner outcomes

Barnett and Coate (2005) acknowledged the importance of using curricula to prepare students for the workforce. They also recognised the ambiguous or intangible nature of these concepts and proposed that curriculum in this area should include 'knowing' as a personal and positional act to engage with discipline-specific ideas; 'acting' which includes experiences of practice and engagement often connected to a particular form of knowing; and 'being' which involves developing a sense of self and acquiring the capacity to flourish. Attributes often impacting character of the outcomes connected to this aspect of 'being' are the focus of this article defined as 'learner' outcomes in the context of this article.

2.2.1   Desired graduate profile

Institutes for Higher Learning (IHL), polytechnics have increasing demands to prepare students for success in a global workplace characterised by uncertainty and disruption. Employers seek innovative people with intangible personal capacities such as initiative and resourcefulness (Andrews and Higson, 2008). In this regard, Bosanquest et al. (2016) has also identified that, IHLs define student 'attributes' or 'characteristics' to be desirably developed during their time at the institution intended upon graduation which help shape their quality of contribution to their intended profession as well as the society.

Temasek Polytechnic has clearly outlined these competencies and attributes intended to be nurtured within every student embarking on a PET course. The breakdown of attributes related to the sense of 'being' or learner outcomes of the course's students adapted from the Temasek Polytechnic's student profile are:

1   self-directed learners who remain competent in the face of challenges and rapid changes

2   future-oriented creators who possess up-to-date set of workplace-ready digital technologies, problem-solving skills, and an innovative and entrepreneurial spirit

3   value-centred leaders with a service mindset who, through effective communication and collaboration.

The above conceptions of graduate attributes are frequently replicated in institutional and governmental policy and planning documents.

2.2.2   Lifelong learning

Advancement in technologies and the rapidly changing world have mandated the need for learning and relearning throughout the tenure of one's life even after years of initial formal education, into the silver years to stay relevant, employable, and updated with the global developments. Learning is not limited to specific life periods and age groups. Skills Future is Singapore's national movement born in 2016 all Singaporeans had access to opportunities which would help them develop to their fullest potential at various stages of their lives. The movement promotes a cultured and holistic system of lifelong learning through the pursuit of skills proficiency and strengthens the ecosystem of quality education and training in Singapore. For CET, adult learners seek at various institutes courses to upgrade their skills and enhance their employability.

The skills and learning study (SLS) and the Institute of Adult Learning (IAL), Singapore, conducted a survey to collect data on lifelong learning among adults in Singapore, to assess the current state and future progress of lifelong learning. The SLS 2017 is the second iteration of a skills study covering a range of skills topics including skills utilisation, job quality, qualification and skills mismatch, and the gig economy. The study is constructed as a national random sample survey, covering a representative sample of Singapore residents of age 20 to 70 years old, conducted from July 2017 to March 2018.

The findings from the survey suggested that age and educational attainment were the two main factors impacting scores across all six pillars of lifelong learning – workplace learning, personal learning, learning to learn, formal learning, social learning, and technologies for learning. Data analysis observed a modest to strong positive correlation, between 'technologies for learning' and 'learning to learn' amongst seniors above the age of 40. Among non-seniors aging between 20 to 40 the same relationship was also perceived although weaker.

The study concluded that harnessing technologies for learning and enhancing their motivation to learn would help strengthen the overall learning capability of adult learners.

3 Hypothesis

Over the past decade, a few studies have specifically addressed the task relationship between the application of technology, assessments, and student attributes. This needs to be addressed to better understand the role of technology in nurturing of learner outcomes and ensuring the application of technology within assessments more meaningful rather than a redundant strategy adopted for home-based or distance learning. This research seeks to offer a contribution to address this gap.

The research context encompasses project-based assessments adopting extensive application of technology to meet the skill-based learning outcomes in a HBL environment. The study shall focus on the effectiveness of such technology-enabled assessments on the development of targeted learner outcomes based on the student profile, PET or CET. Based on the literature review, six parameters that define learner outcomes in the context of the polytechnics PET graduate profile have been studied, namely, collaboration, communication, creativity, digital literacy, self-discipline, and productivity. For CET or adult learners, the effectiveness of technology to foster intrinsic motivation has been analysed.

Table 1 Research context

#	Learner outcomes	Technology	Assessment type	Student profile
1	Graduate student profile	Video	Summative	PET (full-time)
2	Intrinsic motivation	SRS	Formative	CET (part-time, adult learners)

4   Methodology

A review of the literature on research design pointed to using a qualitative research study suitable for this investigation. Applying the method of hermeneutics takes an interpretive view of the phenomena experienced by individuals and hence requires a careful interpretation of the students' interviews (Seidman, 2006). Using the transcriptions from the students' interviews provide the text and afforded contextual explanations to assist in interpreting individual phenomena (Seidman, 2006). Surveys were used additionally to collate quantitative data that validates the transcriptions of student observations and open-ended feedback.

4.1   Research design

Hermeneutic circle was thus used as the interpretive lens for understanding the lived experiences of the students. The hermeneutic circle begins with the whole, breaks it down into an analysis of the parts, and reforms into the whole from a synthesis of the parts as shown in Figure 1. The approach was independently adopted to each of the research questions identified.

The components of student-generated video for summative assessments and SRS-enabled formative-assessments were examined through an interpretive analysis of lived experiences of the students in their respective learning environments. The students were interviewed, and the responses captured through a survey including open-ended feedback given by them. Transcriptions of interviews and the survey were coded for clusters of meanings and themes based on the research question to determine the central underlying meaning of the students' experiences (Flipp, 2014). The students' experiences were influenced by their cultural background and prior learning experiences. Therefore, the discrete nature of assessments called for a study with a flexible means of interpreting experiences of students. Hence, applying the method of hermeneutics coupled with survey with closed and open-ended responses provides a broader foundation to interpret the lived experiences such as learning outcomes and motivation.

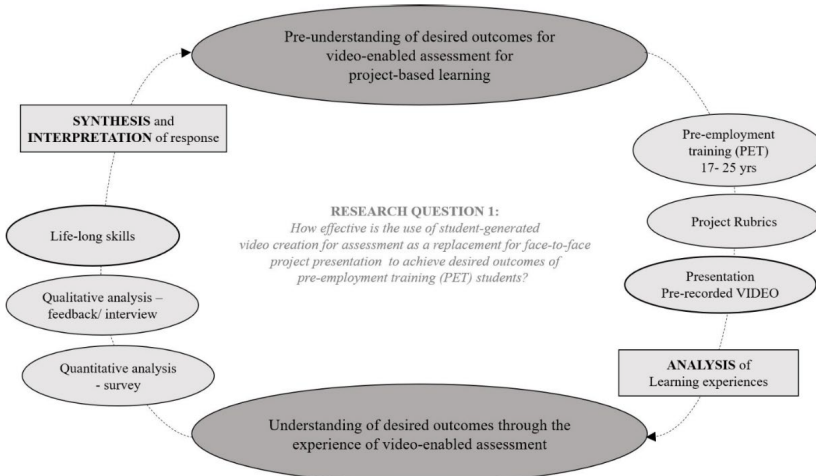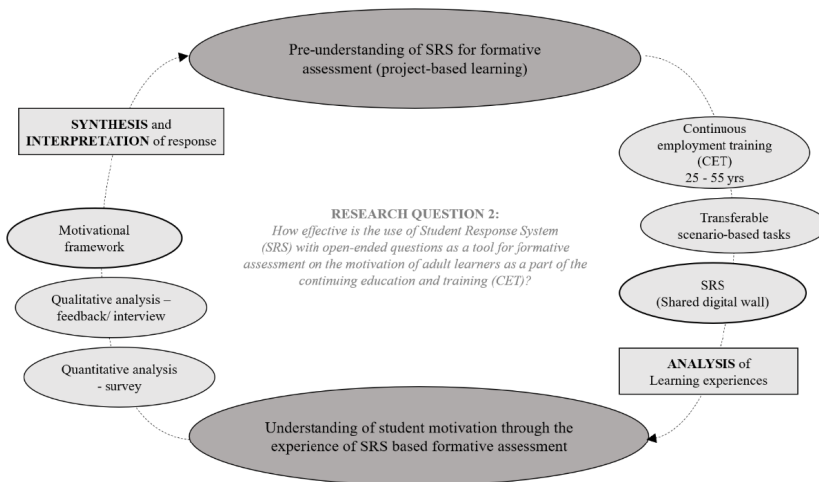**Figure 1**   Research design based on hermeneutic phenomenology

Figure 1   Research design based on hermeneutic phenomenology (continued)

4.2   Data collection

4.2.1   Student-generated video creation: summative assessment for PBL

Target group

The target group comprised 70 first year full-time polytechnic students from a built environment course – Green Building and Sustainability. This training is part of a three-year PET before the students move on to a full-time job upon graduation.

Project scenario

The aims of the project are to research on any local green building, can be physically visiting the building or through online research, or a mix of both; identify the green building features and explain their importance in accordance with the local green building standard, which is Green Mark scheme in Singapore. Students were required to produce a video presentation to demonstrate their achievement of the learning outcomes. This could be a conventional voice-over presentation using photos and slides as the base. Alternatively, the video could be delivered in a more creative format with actual footage taken during the physical building visit.

Prior to COVID-19 pandemic, guided building visits were conducted by the lecturers, or the building facility managers followed by in-class presentation in the subsequent week. Each project group within a class were assigned to a different building to allow for a more diverse exposure and learning through peer-sharing during presentations. However, HBL necessitated the project to be redesigned as building visits in big groups were restricted though the project outcomes and marking rubrics remained the same. Recorded video presentation with self-arranged building visits were thus the adopted mode of summative assessment. The original learning intent was not compromised in this case. A three-week timeframe is usually allocated for the project which remains the same as well.

The marking rubrics are shown in Table 2 as a reference.

Table 2   Project marking rubrics

Criteria	Excellent	Good	Average	Poor
Overall presentation Structure and cohesiveness	Well-presented introduction that set an appropriate background for the rest of the individual presentations. Conclusion that succinctly sums up their findings. Convincing with logical structure and outstanding visual aids.	Some effort made in introduction and conclusion. Some attempts to link the individual presentations and provide a summary. Clear presentation with logical structure and effective visual aids.	A vague introduction and conclusion. Does not seem to show any link to the individual presentation. Structure and comprehensible presentation with some visual aids.	Introduction and conclusion badly or not presented. Unstructured and hard to follow presentation with few visual aids.
Greenmark application	Able to explain and articulate the use of each individual green feature in the building and their role in the Green Mark system.	Able to explain the use of each individual green feature in the building and their role in the Green Mark system.	Green features explanation is mostly appropriate. Wrong understanding of green features in the building and their role in the Green Mark system.	Shallow or no explanation showing photos or images which are mostly irrelevant to green building features.

Technology platform

As highlighted earlier, within the constraints of adhering to the assessment intent, a certain level of student autonomy was factored into the assessment for ownership and control over student learning. Over and above the varied styles of video presentation, there was no restriction on the type of video editing software, or the platforms students used to record their voice-over presentation. This was left to the students' discretion about what was most appropriate for them. Some of the tools used to create a video included YouCut, Filmora, Adobe Rush for video editing. Zoom, an in-built recording feature in PowerPoint, just to name a few, was used for the voice-over presentation. No prior training specific to video editing or recording of presentation was given. All technology-related knowledge was learnt by students independently. The videos were uploaded to YouTube, for peer viewership, feedback, and review. Furthermore, the benefit of uploading the videos to YouTube does not add burden to the already limited bandwidth and space available in the educational institutions' server.

4.2.2   SRS: formative assessment for PBL

Target group

The study involved 40 adult learners, ranging from the age of 25 to 55 years, with 80% students falling in the category between 30–45 years of age. The students were part of a specialist diploma course offered as a part of CET for working adults with a background

related to the built environment industry. They continue to deepen their skills and competencies in this sector through this specialist diploma programme.

Project scenario

The project involves a project scenario of an actual building, which students are required to evaluate the building's energy efficiency and indoor environment quality. The analysis would lead to recommendations to improve the current building energy performance and indoor environment conditions. In a pre-COVID-19 scenario, the formative assessment would involve discussion of drafts and face-to-face consultation to provide formative feedback on their learning application. For the adult learners who have demonstrated achievement in learning, feedback can inform them of their progress, and they are on the right track.

However, HBL posed limitations to these group consultations as online discussion with a class of a substantial number was not found to be effective. In this case, there were 40 students in the class. Assessment of every adult learner's attempt on the application of concepts within a real-life project scenario was challenging as each one of them had a different approach, some acceptable while others had deviations and misconceptions. There were also cases when repeated feedback was needed and hence was time-consuming for the tutors. In a face-to-face scenario, it was easier to capture the class's attention while providing feedback and to group and regroup students based on differences in learning progress. The regrouping will facilitate appropriate feedback on their formative drafts and learning attempts, hence creating an optimal learning environment.

Technology platform

In view of the constraints posed by HBL, as well as the class size, the need for valid formative feedback, higher-order authentic application and time management, an SRS technology based on a 'digital wall' format for students' response has been utilised. This online authoring platform allows students to read peer posts, post and share responses on a shared digital board based on a specific question, scenario, or task that has been allocated. Duration of ten days was allocated for students to respond. After all responses were collated on the digital board, four more days were given for responses to be read and evaluated.

The project was broken down into bite-sized tasks to be addressed over four weeks. Similar tasks with focused authentic open-ended questions were created such that the skills and knowledge applied were transferable to the project scenario. The questions were posted on the SRS with sample answers and recommended word count. Students were tasked to find answers which are real examples from buildings within their immediate surroundings or access based on COVID-19 limitations and post their responses and short analysis using the SRS. They were encouraged to avoid using the same building example for evaluation to obtain a variety of perspectives.

At the start of every lesson, a discussion based on the various student responses was facilitated by the tutor. This not only served as a recap of the previous lesson, but also developed higher order thinking, meta-level communication on the possible applications of the given topic in an authentic building context. The discussion facilitated by the tutor was taken with reference to the actual project marking rubrics. This was deliberately done

so that students could gauge how the final project submission would be evaluated. Feedback was provided with specific reference to students' answers or posts that could be considered as good samples. Feedback was done in relation to the various aspects of the rubrics, to revisit common misconceptions and to provide directions for those who missed the mark.

From a class of 40 adult learners, five to six posts from various levels of learning were selected for collective feedback. Attention was paid to ensure that postings from different adult learners were addressed every week to ensure all were given equal consideration.

5   Analysis and findings

5.1   *Student-generated video creation: summative assessment for PBL*

To ascertain the effectiveness of using student generated video as a replacement for face-to-face presentation on graduate learner profile (collaboration, communication creativity, digital literacy, and self-directedness – planning and initiative), 29 students were surveyed out of a cohort of 70 students. Students were asked if they have developed any of the identified 'personal' skills, and they were given the choice to choose multiple options based on the reflection of their individual learning experiences after the video submission. This part of the survey aims to collate quantitative feedback. The survey also includes open-ended questions, with interviews for selected students, to allow students to substantiate the benefits of using student generated video creation assessment. This is for the purpose of qualitative feedback. The percentages in Table 3 were computed from the quantitative part of the survey, based on the total of 29 students who responded. Do take note the total responses exceeded the sample size of 29 students as students can pick more than one option.

Table 3   Survey results on skills developed from video assessment

From the video assignment, I have developed better _____ (More than one option may be selested)	Responses (no./%)
Teamwork/collaborative (learning skills)	16 (55%)
Creativity (learning skills)	8 (28%)
Digital/technology (literacy skills)	10 (34%)
Communication/social (life skills)	13 (45%)
Time management/planning/ productivity (life skills)	19 (66%)
Self-discipline/initiative (life skills)	10 (34%)

From the survey results, it was apparent that student-generated video creation for assessment could be a good replacement for face-to-face presentation, since most students mentioned this assessment approach gave them opportunities to apply and pick up the 6 selected learner outcomes. For instance, digital literacy skills are clearly needed to create the video presentation, compared to if the presentation was done in a physical setting where only basic slides creation skills are required. To dispel the notion that students need to have prior knowledge of video editing software or technological tools to record voice-over presentation, the full-time students mostly younger than 25 years old

are typically digital natives. Hence picking up a new software would not be too difficult, as confirmed in one of the student's qualitative feedbacks: "It was my first time recording a group video presentation and it allows me to pick up new digital skills by using the software for recording". Over and above technology literacy skills, the opportunity to acquire other lifelong skills such as collaboration, communication and productivity was not jeopardised, as indicated by 55%, 45% and 66% respectively of the respondents, agreed to have developed such skills when they underwent this assessment.

Since the format of the video presentation are allowed to be varied, and students must do their own research to acquire the technical skills to create the video, these allowed for the other two learner outcomes, creativity, and self-discipline respectively, to be developed. Overall, more than a quarter of the respondents agreed to be given opportunities to develop these two skills.

What was also done in this research was to ensure unique content for different project groups, while keeping to the same project objectives. Though the effectiveness of this specific strategy was not explicitly validated in this research, this can be assumed to help ensure the assessment to be authentic, that is the assessment measures the student's achievement and not of others since the likelihood of students cross referencing to one another's work is reduced.

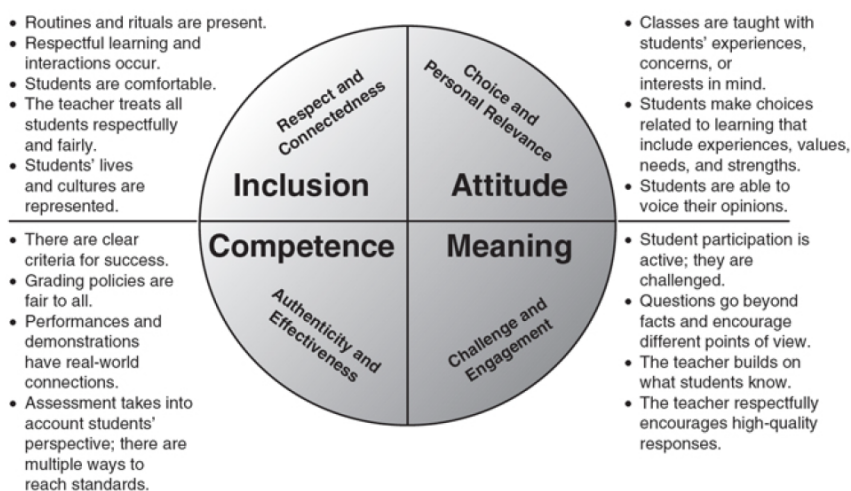## 5.2 SRS: formative assessment for PBL

SRS-enabled formative assessment is observed to address all principles of formative assessment mentioned in the literature review. However, considering that the application of SRS for formative assessment was targeted towards adult learners, it becomes important that the approach is evaluated against andragogical principles. As concluded from the literature review, the impact of technology on intrinsic motivation towards the need to learn (learning to learn) has been identified as the specific *learner* outcome for analysis based on life-long learning characteristics for adult learners of Singapore.

A guide which has been acknowledged and adopted by practitioners is the framework for culturally responsive teaching proposed by Ginsberg and Wlodkowski (2009), to encourage adult intrinsic motivation as shown in Figure 2. From this framework, it has been noted that the SRS increases the ability for students to see, review and learn from peer responses, gaining different perspectives while tackling the same question. This aspect of 'Inclusion' has been observed to enhance the competency of the students as they learnt collectively. It was also noted that the postings were quite varied depending on the student's familiarity with the building context. This personal relevance, i.e., the dimension of 'Attitude,' helps shape their positive attitude, another dimension of the given framework for increased motivation. As mentioned earlier, the given task is based on the project scope, marking rubrics, and providing appropriate feedback. The objectives of the tasks designed for SRS were thus kept the same as the actual project tasks. This tackled the dimension of 'Meaning' by providing challenge and engagement but at a lower level in comparison to the actual project itself. This has indirectly positively impacted the project quality as well. The basic assessment principles of validity and authenticity were ensured by setting a realistic context like the project scenario and orienting feedback based on the given project rubrics. These strategies encompassed the last dimension of 'Competence' from the framework as well.

A survey conducted amongst 35 students revealed that 57% agreed that the technology-enhanced formative digital-wall task positively impacted their project

performance with an additional 24% who strongly agreed. 19% remained neutral and indicated that the tasks had no impact on their PBL. Time management and the ability to find suitable authentic tasks were mentioned as barriers by these students. The survey additionally probed students to assess the impact on their intrinsic motivation. Students were asked to choose multiple options on engaging aspects of the formative tasks which motivated them to complete the task qualitatively. One-third (33%) indicated the authenticity and effectiveness of the task was compelling. 28% and 26% respectively agreed that challenge involved to display good thoughts and the personal relevance to choose scenarios made the formative task engaging. Only 13% agreed that the ability to address the task with ease was a consideration for completion. The project results as well as the student feedback thus indicated outcomes of higher intrinsic motivation among adult learners, including a positive outlook towards life-long learning, particularly during this COVID-19 period.

Figure 2   The motivational framework adapted from Ginsberg and Wlodkowski (2009)

From our research findings, the effectiveness of using SRS with open-ended questions for formative assessment, in this case using a technology-enhanced formative digital wall is conclusive. More than 80% of the students agreed on having a positive impact on their motivation impacting their performance in the assessment. The choice of the open-ended questions plays a key role in enhancing the overall authenticity, validity, and sustainability of the learning experience.

6   Adaptations and obstacles

6.1   Student-generated video creation: summative assessment for PBL

For educators who are thinking that transiting to video assessment may have a negative impact on the intended learning outcomes, one thing to bear in mind is to keep the marking rubrics similar whenever possible, as compared to if the assessment is done as a traditional project or assignment in a face-to-face setting. Educators must be cognisant

that the assessment is not on video creation skills but to appraise and assess how well students have assimilated and demonstrated the knowledge as required in the project, using the video produced as a knowledge transmission vehicle. The rubrics must not have any explicit criteria specific to the quality of the video. To guard against less than desirable quality videos submitted since no marks are given for video quality, peer competition can be leveraged by requiring students to submit on a platform which their peers have accessed.

The video assessment can be easily adapted across disciplines when there is an element of project presentation in its assessment. If the assessment outcomes are not about video recording and editing skills, it is recommended that the options on video platforms be kept open so that the sense of ownership on the assessment is transferred to the students. In addition, this enables students to exercise their creativity in the presentation. However, video-enabled assessment is not without its limitations. For instance, students' accessibility to digital technologies should not be taken for granted while some may be uncomfortable with the use of digital platforms for assessment. To add further, the requirements of students with special educational needs must also be considered and, if needed, alternative methods of assessment to be provided. Finally, there must be measures in place so that tutors can identify students' contribution in the video presentation. For example, include a talking head in the video presentation as evidence that it is presented by the students.

6.2   SRS: formative assessment for PBL

The change from one-to-one consultations on project progress to technology-enabled project-based formative tasks radically altered the formative assessment approach. This not only impacted on the student motivation but also the overall project performance of the entire class. As adult learners, many faced difficulties understanding the concept of digital wall to post photos. However, this concern has been addressed through guided hands-on sessions with sample posts. Additional video links were also given to understand the 'technology' of digital wall. The strengthening of this technology dimension reduced the inherent fear of failing the task.

To be applied across various disciplines, the project-based tasks need to focus on addressing a specific skill-based learning outcome that is to be completed within 20 to 30 minutes. Posting a sample 'answer' and setting a specific 'word limit' were some strategies adopted for this purpose. These strategies also facilitated the lecturers in reading the posts and filtering them for class discussion. For effective reading and student identification, the digital wall was organised based on student register numbers. This has helped to ensure that the posts from the same student were not repeatedly discussed. In the qualitative feedback, the adult learners also mentioned that viewing works from peers provided different industry perspectives while addressing the same issue.

7   Conclusions and recommendations

The use of student-generated video creation for summative assessment is an effective replacement for face-to-face presentation given the pivot towards HBL. Based on the quantitative and qualitative findings from the survey and interviews, students appreciated how this assessment method has enabled them to acquire life skills such as teamwork,

time management, and communication skills that enhance employability. Moreover, students have demonstrated the ability to pick up new technological skills to record voice-over presentations even though they have not been taught to do so. Such transferable skills would enhance students' ability to adapt well to the rapidly changing world where real-world problems are complex and interdisciplinary, and this is in alignment with the desired student profile for the full-time PET students.

The use of SRS-enabled technology for formative assessment had a positive impact on the motivation of the adult learners towards their learning for the project-based assessment based on the findings of the survey done on the adult learners. They found meaning and relevance in the activity of responding to the given question via postings on the 'digital wall' as this required them to leverage on their experience, hence lending authenticity in learning. The motivation to learn and participate in the learning process was further enhanced by the fact that the adult learners were able to view each other's postings, thereby broaden their perspectives from different industries. Most importantly, all these have helped improve the quality of learning and thus performance as the activities in the formative assessment were designed in a way to support the adult learners for this assessment. The choice of the open-ended questions played a key role in enhancing the overall authenticity, validity, and sustainability of the learning experience.

7.1   Limitations

Limitations to qualitative methods such as varied perspectives, expectations and interpretations have been noted. It is also recognised that small population samples, common to qualitative studies, impacted the students' background as well as institutional setting. This is because the adoption of HBL and the reliance on technology for all assessments were unexpected in the above context. Within the limited time, lecturers were tasked to shift the mode while the underlining principles of pedagogy, constructive alignment and assessment principles remained the foundation. The study would have been comprehensive if responses were collected from more than one batch of students and tutors could have helped understand implications of subject delivery on the adopted assessment design. While the analysis provided meaningful results on student learning, the findings may not be readily generalised as the differences were not statistically tested.

7.2   Recommendations for further studies

The decision on whether to adopt a technology-enhanced assessment practice, in the same module or across disciplines, is recommended for expansion with consideration of various parameters. Factors such as a student's prior knowledge of technical skills and ease of access to hardware are suggested to be included. Comparison of research outcomes with a non-HBL context is recommended to understand the influence of delivery on the adoption of technology.

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