

SCHOOL-WIDE STRATEGIES FOR ASSESSMENT OF LEARNING DURING COVID-19 PANDEMIC

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ABSTRACT

Institutes of higher learning (IHL's) face unprecedented, restricted movement challenges during the COVID-19 pandemic. This paper describes how the School of Electrical and Electronic Engineering of Singapore Polytechnic undertook the re-design of teaching and learning practices and remote e-proctoring of assessments, in such an environment. The pandemic accelerated the switch to blended flipped learning, with all face-to-face lectures, replaced with asynchronous e-learning contents. A structured school-wide approach for teaching and learning to help both staff and students to adapt to the new learning environment was implemented. For Academic Year 2020/21, the School mounted large-scale e-proctored remote online assessments, with carefully considered measures to preserve academic integrity and rigour, to satisfy various stakeholders' needs. Semester 1 saw more than 100 staff, 2400 full-time and part-time students, and over 100 modules involved. In Semester 2, more than 400 full-time students and 31 modules were involved. Communication and training of the staff were carried out to prepare for the new way of assessment, and also to guide them to help their students for this. The use of a student response system (SRS) for diagnosing student learning of the asynchronous learning contents in-class was introduced. Survey findings show positive results generally, and these included real-time performance data analysis and immediate feedback, checking understanding, and appropriate learning interventions. Similarly, survey findings on the online assessments to engage students in their learning and progress are also shared. A comparison of the overall academic performance of students, pre-pandemic, against those conducted under the remote e-proctored conditions in the changed learning environment, suggests minimal impact. This paper concludes that SEEE's school-wide strategy supports the learning engagement of the students in the new teaching and learning practices, with the total switch to flipped learning for the diploma engineering courses it offers.

Assessment, Active learning, Diagnostic, Summative, E-proctoring, Standards 2, 8, 10, 11

INTRODUCTION

Since 2003, when SARS (severe respiratory syndrome) caused Singapore schools to close, annual home-based learning (HBL) exercises, typically of short duration, have been in place for the institutes of higher learning to prepare staff and students with online learning platforms for unforeseen closures (Goh, 2020). However the COVID-19 pandemic resulted in unprecedented prolonged campus closures.

Figure 1 illustrates the School of Electrical and Electronic Engineering's strategy to support student learning engagement that covers the learning management system for students to access the asynchronous learning contents, to the conduct of the synchronous lessons and practical, and finally, the assessments. This paper focusses on the areas highlighted (yellow),

namely, the knowledge check and self-reflective quizzes, incorporated into the asynchronous learning contents, students' attempting self-reflective tutorials before the conduct of the synchronous tutorials and the exit polls at the end of such sessions, and those of the assessments which were conducted remotely with e-proctoring, after the series of synchronous lessons have been completed.

Specifically, knowledge checks are integral in all asynchronous learning contents to help students to be aware of their understanding in self-directed learning. Before the synchronous face-to-face (F2F) or online tutorials, they are expected to complete the topical self-reflective quizzes. During such sessions, the students, after facilitation by their lecturers to clarify their understanding and to seek deeper learning, will undertake to complete their tutorials. Before the lessons end, they will indicate their understanding through the exit polls as highlighted (Figure 1).

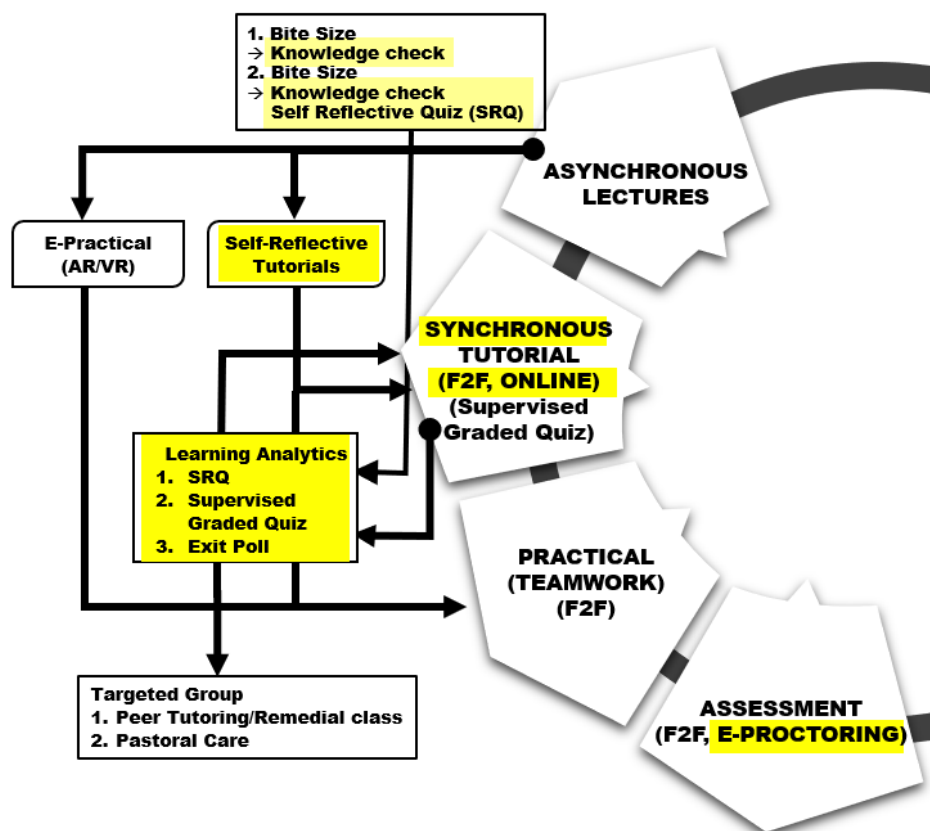


Figure 1. SEEE's School-wide Approach to Support Learning Engagement of Students

It is crucial that for such a large school, a consistent school-wide implementation on the expected teaching and learning practices, and also of assessments, in times of rapid changes such as during the pandemic, is in place. This is to ensure that both staff and students could be better eased, and cope with the new demands of the changed learning environment. Prior to that, all students were already doing flipped learning of at least one module per semester for all year of studies. The pandemic accelerated the switch, with all remaining modules previously delivered as face-to-face lectures, replaced by asynchronous lectures instead.

This paper seeks to determine at the school-level, whether the strategies were deployed effectively to engage students prior, during and at the end of the synchronous lessons. The School forged ahead to stage remote e-proctored online assessments for the mid-semester

test in June 2020 during campus closure. Students' views on their learning and experience with the first-ever implementation of remote e-proctored online assessments were sought, and an analysis on the impact of the academic achievement of the students were also carried out.

Diagnostic Assessment as Part of Structured Teaching and Learning (T&L) Approach

With the school-wide approach for teaching and learning described, co-ordinated efforts were in place to ensure that baseline requirements on the quality of teaching and learning were met. With the above school pedagogic approach, diagnostic and formative assessments are even more important to provide real-time learning data to help students concretise the learning, and make connections across the different lessons and make learning progress in this holistic learning approach. This is aligned to CDIO Standard 11: Learning Assessment, which states that “assessment of learning serves to measure the extent to which students achieve intended learning outcomes within their respective courses” especially in “concepts and competencies ... described in Standards 2, 3 and 7”. Diagnostic assessment contributes to the variety of learning assessment methods to derive learning data that can inform how students are engaged in active (and self-directed) learning and examine the learning progress so as to apply learning design interventions and provide feedback for learning (CDIO Standard 8).

Remote E-Proctored Online Assessments as Part of Summative Assessments

Assessments are conducted to ensure the quality of the curriculum design and delivery (Standard 11). Without any precedent to guide on staging summative assessments in the previous HBL exercises, the School in June 2020 mounted school-wide remote e-proctored online assessments, a possible first on such a large scale in campus. This could not possibly replicate perfectly the usual conditions under the strict in-person, closed-book, written assessments conducted on campus. Measures were taken to ensure minimal compromise on the necessary academic integrity and rigour. More than 100 staff, 2400 full-time and 500 part-time students, and over 100 modules were involved for the mid-semester test (MST) conducted. For the following semester, half of the year 3 cohort, who were previously on their internship in industry in Semester 1, also sat for similar remote e-proctored mid-semester tests. More than 400 full-time Year 3 students and 31 modules were involved. This was aimed to achieve some degree of equity, which is defined as based on the equal treatment for all (National Research Council, 2012), on two aspects. Firstly, in terms of the student learning experience in the form of e-proctored online MSTs. Secondly, as these were deliberately conducted open book, this ensured the whole Year 3 cohort would be assessed on online assessments, with fairly similar academic challenge.

LITERATURE REVIEW

Diagnostic Assessment in Flipped Learning

In many flipped learning models, assessment (for learning) plays a critical role in learning progression. Following the self-paced learning of the asynchronous learning contents, the first stage in the synchronous lessons, F2F or online, would be to guide the students to assess their understanding of prior learning, examine misconceptions and clarify their learning, before engaging in activities for deeper learning and progressing to other performance tasks. Typical assessment activities for such sessions would include quizzes, summaries, discussion forums and reflections, videos, and peer feedback to these assessment artefacts.

Such activities are critical to help learners make connections with concepts previously learnt online and prepare them for further learning, as well as to emphasise to learners, the importance of active engagement and participation in synchronous learning activities. Results and observations from such diagnostic assessments would provide quantitative and qualitative data to the lecturers/facilitators and enable them to target learning interventions to different students, as well as build self-regulation, learning confidence and efficacy, learner motivation and control, by means of giving and receiving more immediate feedback about their learning (Hostt et al., 2020; Roach, 2014; Shyr & Chen, 2017; Treagust, 2006; Triantafyllou, 2015).

Online Assessments – E-proctoring and Design

Maintaining academic integrity is both key and a challenge when implementing any assessments, conducted online or otherwise. A definition offered on academic integrity is *‘the expectation that teachers, students, researchers and all members of the academic community act with honesty, trust, fairness, respect and responsibility’* (TEQSA). Supervision is thus critical, typically in-person, and with students on campus, being overseen by invigilators or proctors. In the absence of such supervision, assessments rely on an honour system that expects students to uphold that they have attempted honestly, without the help of others or through unfair means.

For online assessments, educational institutions may resort to commercial online electronic or e-proctoring tools which may also be AI-enabled to analyse students’ movements and their surroundings. Factors that deter such use may include cost, possible technical challenges and close monitoring, which are necessarily intrusive (Milone, Cortese, Balestrieri, & Pittenger, 2017). Such intrusion has been argued as possibly giving rise to test anxiety that may affect exam performance, although this effect is not well known (Woldeab & Brothen, 2019).

The workgroup for Singapore’s five polytechnics and the Institute of Education (ITE) suggests that e-proctoring or remote invigilation as one that is *“... conducted remotely and online using Information and Communications technology (ICT). This includes single-camera views of students’ faces, upper bodies and sufficient working/assessment area to ensure students do not receive unauthorised assistance during the duration of the E-Exam, E-Test, or Oral, Viva, or Performance Test”*. This is also described as webcam-monitored exams using live proctors, termed web-based proctor and defined as *“one who utilizes a webcam for video surveillance to observe users and their environment during the online exam session.”* (Hylton, Levy, & Dringus, 2015).

Video conferencing platforms, in addition to surveillance, also allow the assessment proceedings to be recorded. The set-up is relatively easy, affordable and is adaptable to most educational settings, thus eliminating the need for online proctoring providers (Tan, 2020). Another reason for deploying e-proctored online assessment is the need to authenticate students’ identities, although this is somewhat a challenge (Hylton, Levy, & Dringus, 2015). However, in the School, as the staff perform this role, students accept and are accustomed to the practice as a necessary requirement in order to deter cheating by impersonation, and helps confidence in the integrity of the assessments.

To further deter cheating, features such as open-book, duration-limited, no back-tracking, randomised questions and answers, and the use of question banks (Budhai, 2020) (Weleschuk, Dyjur, & Kelly, 2019) (Shamo & Alford, 2021) are incorporated as part of the online assessments. Although students could refer to resources like books and the Internet, they

need to declare the integrity of their attempts. Stern instructional warnings on the consequences of cheating were also included (Vasquez, Chiang, & Sarmiento-Barbieri, 2021). The use of a custom lockdown browser to prevent students from opening other applications or web pages was also considered but was not included in the initial implementation stages, given the overwhelming changes to be undertaken. However, the School has further fine-tuned the remote e-proctoring process to include the use of the lockdown browser as well.

SCHOOL-WIDE STRATEGIES – STAGING AND IMPLEMENTATION

Figure 2 shows the timeline of the key stages of the school-wide structured teaching and learning approach during the two-semester-long academic year. Throughout the semester, teaching staff during the synchronous lessons, discern student learning engagement of the flipped learning contents. This is by monitoring students' completion of the self-reflective quizzes before these lessons. Through students' attempts of the regular weekly bite-sized online quizzes, staff can further ascertain their understanding and learning as they progress through the weeks.

Classes are assigned one of their module lecturers as their personal tutors, who also look into the students' pastoral care and well-being. Through these interactions, personal tutors are thus able to check on their students' overall well-being to cope with the demands of a changed learning environment. During the term, the lecturers also receive training on the procedures of the remote e-proctored online assessments to prepare themselves as well as their students.

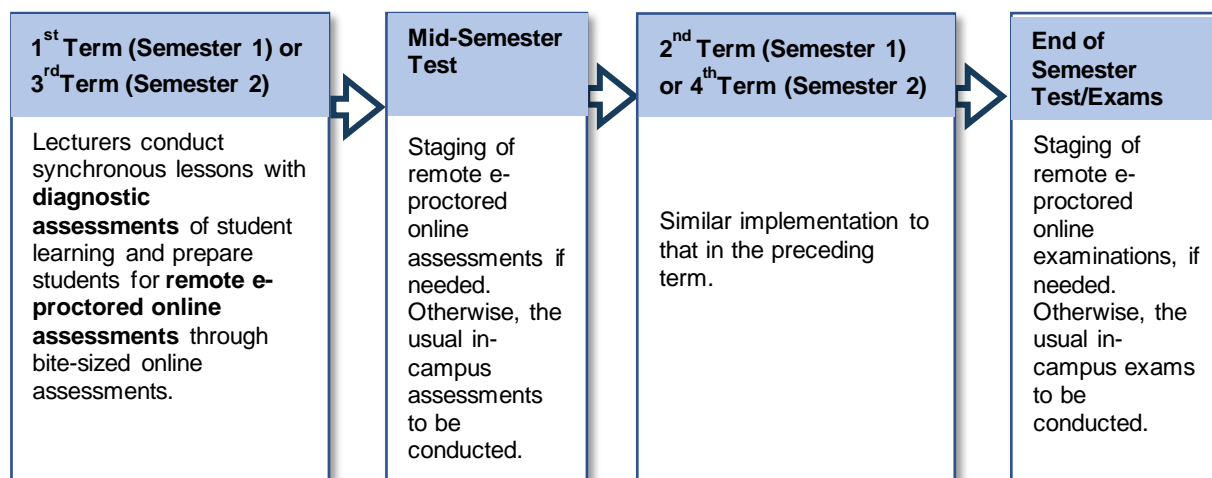


Figure 2. Timeline of Key Stages of Implementation

Diagnostic Assessment

To guide teaching staff for the long term, a structured teaching and learning approach is provided. This helps to establish the quality of effective learning as students move from asynchronous e-learning to synchronous online or F2F sessions. As previously mentioned, all asynchronous learning contents include appropriate knowledge checks that students are expected to complete before proceeding to the subsequent learning contents. This is further supplemented with self-reflective quizzes to enable teaching staff to know if students have learnt with understanding through being able to answer relevant questions correctly.

An in-class student response system (SRS), called ClassPoint, for diagnostic assessment purposes during synchronous lessons was also introduced. It allows teaching staff to include questions as part of the PowerPoint slides they typically deploy during such lessons, on the fly, if needed. This enables them to obtain their students' responses as part of the slides, without switching to other web-based student response platforms. Easy to use, with display of real-time live responses for performance drill-down (to individual students) as part of the slides, they can do in-situ performance analysis, immediate feedback and just-in-time learning interventions. The teaching staff can thus assess their students' prior learning, draw out their misconceptions and help them to clarify learning before deeper learning.

With the pilot run completed in semester 1 of the academic year 2020/21, the School streamlined the use of ClassPoint for diagnostic assessment for synchronous lessons. Enhancements and refinements to the facilitation approach were made and a structured process for the approach, applicable to all modules, help to guide staff. This was to enhance faculty competence in providing integrated and active learning experiences and learning assessment (CDIO Standard 10). For the following semester, close to 2700 students (full-time and part-time), for 88 modules facilitated by 112 staff were involved in the deployment.

The School aimed to achieve the following outcomes with the deployment:-

- To encourage staff to design effective and engaging synchronous lessons
- To prod staff and students along new ways of effective learning
- To promote diagnostic and formative assessment in day-to-day lessons
- To identify and support weaker students at a lesson level and provide early interventions
- To promote the use of real-time learning data for timely assessment for learning and learning interventions
- To ensure that students are prepared for and are engaged in deep learning before and during lessons

Figure 3 shows the structured teaching and learning approach for diagnostic assessment with ClassPoint for synchronous lessons to guide teaching staff. This is needed to ensure that staff who have not already previously conducted any flipped synchronous lessons are implementing consistent facilitation practices for all the students as part of their lessons.

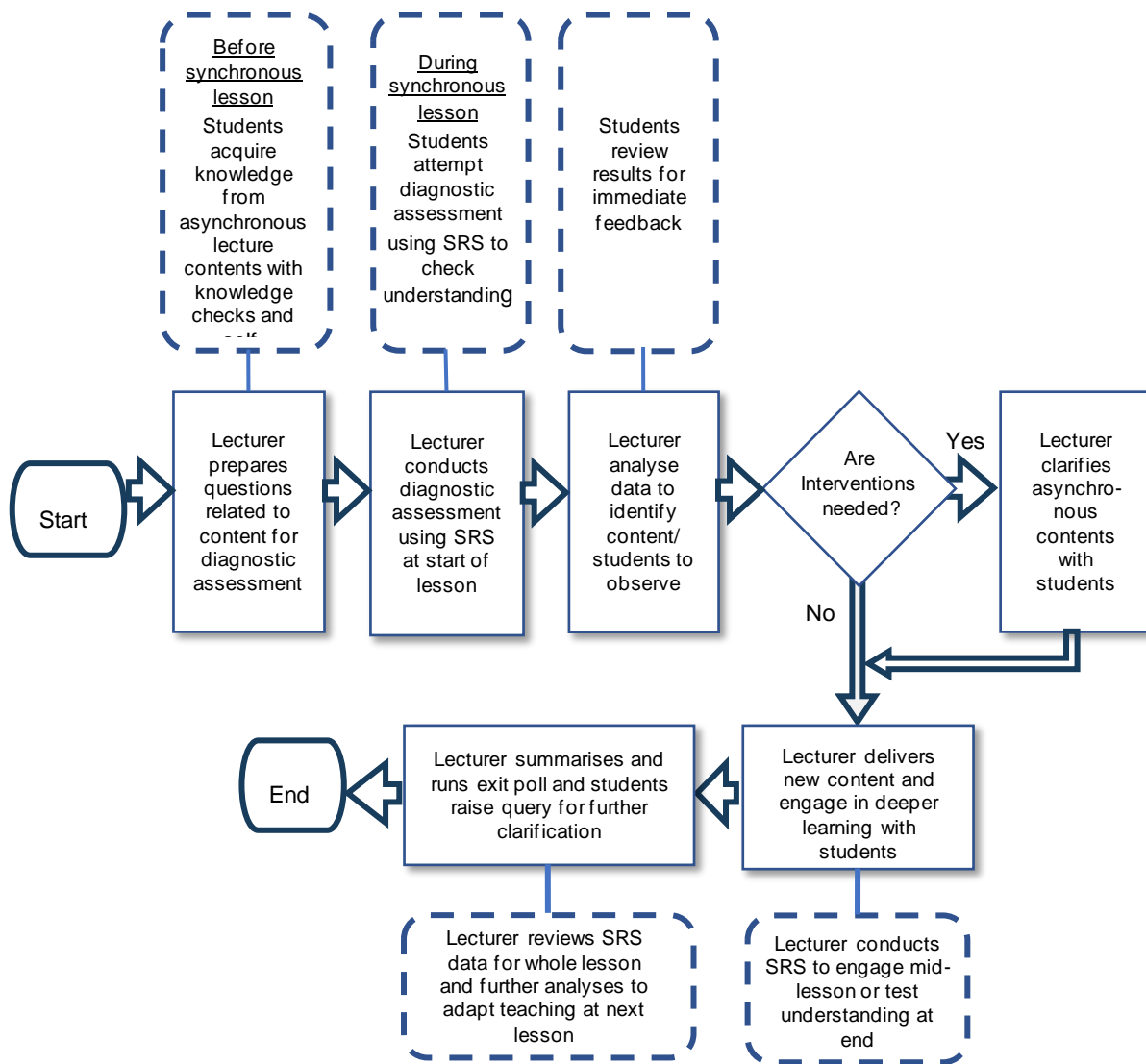


Figure 3. Structured Approach for Diagnostic Assessment for Synchronous Lessons

E-proctored Online Assessment

Figure 4 shows the set-up of the remote e-proctored online assessment. Students are expected to be at their homes. Each requires a laptop with camera, smartphone, reliable network access and a quiet conducive environment. Zoom is used as the virtual space.

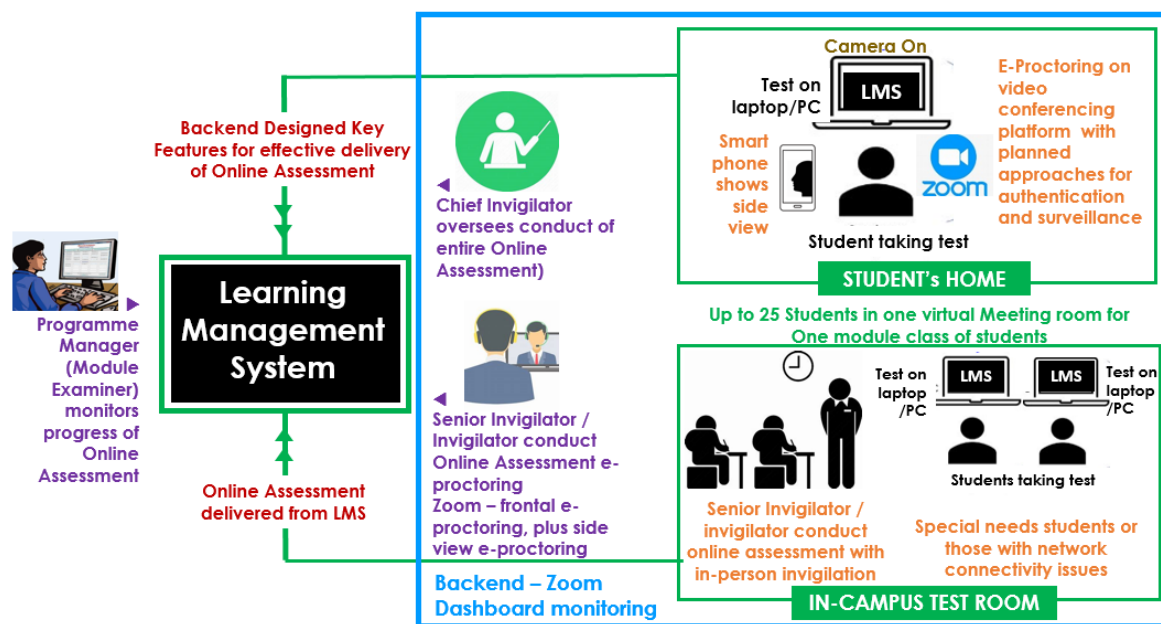


Figure 4. Overall System Set-up of the E-proctored Online Assessment

For the initial online assessments, personal tutors prepared their tutees. That entailed coaching them, looking into whether they had the necessary laptops, devices and smartphones and stable home Wi-Fi access. They also watched out for students with special educational needs, or those who could be uncomfortable with the demands of remote e-proctoring. As they also served as invigilators for their tutees, it was easier to verify students' identities and assure them, which helped to reduce student anxiety, thus smoothing the implementation.

Two staff; a senior invigilator and invigilator preside in the virtual meeting, with the former observing students' laptop camera views in the main meeting, and the latter presides over the smartphone views in the breakout room. This helps ensure that there will always be one invigilator if the other invigilator cannot do so, due to a drop in internet access or for other reasons. Each invigilator screen records the proceedings that can serve as reference for any possible incident follow up.

All IHL's aim to conduct fair and secure assessments of unquestionable academic integrity with a regiment of standard operating procedures (SOPs) and protocol for consistent implementation. Similarly, the students were issued guidelines as "must-reads" to prepare them to abide by the requirements for the e-proctored online assessments (Jeffries, et al., 2017). Common challenges associated with the use of e-proctored online assessments include the following: measures of redress for students when the technology fails and default steps students should take when the Internet fails. These measures were part of the standard announcement made by the senior invigilators before the start of the online assessments, and were similar to the polytechnic's expected SOPs before the start of any in-campus exams.

RESULTS AND DISCUSSIONS

For the conduct of synchronous lessons as part of the flipped learning, the survey aimed to determine the following:

- Staff implementation of the diagnostic assessment to improve student learning

- The frequency of SRS usage for the conduct of their synchronous lessons
- The extent of students' motivation to prepare prior to the synchronous lessons
- Students' views of the use of the SRS in the synchronous lessons

For the remote e-proctored online assessments, the survey aimed to find out students' views on these, vis a vis their learning engagement, and sought their views on what they like and dislike about the implementation.

Survey findings of Diagnostic Assessment in Flipped Learning

These surveys were conducted in early 2021. The implementation of the structured approach meant that staff would need to consciously and deliberately re-design their F2F and synchronous online lessons, creating space and time in each lesson for this, analyse and interpret learning data real-time, apply immediate learning interventions and observe the effects of the approach. The design considerations and staff sentiments on the structured approach, as well as students' learning experience and sentiments were surveyed.

It was found that the broad intents of the structured approach for diagnostic assessment to support flipped learning, after students have acquired knowledge through asynchronous lectures, were largely met. Staff reported that they have used the SRS as intended in all synchronous sessions which followed asynchronous lectures: 85.1% of F2F tutorials, 9.5% of synchronous online tutorials and 5.4% of practical. 65.5% of staff reported using the SRS at the start, and during the lesson, for diagnostic and formative assessment purposes. This is for them to assess students on prior learning of asynchronous contents and engage students during lessons and to assess deeper concepts taught/learnt.

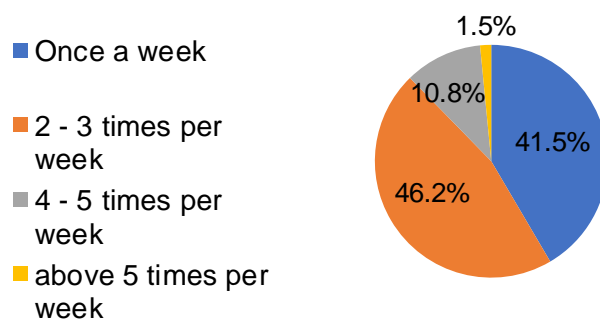


Figure 5. Frequency of ClassPoint Activities (per week)

It was observed that 87.7% of staff used the SRS one to three times a week. This corresponds with the use of SRS approach for the intended diagnostic assessment for tutorials minimally, and the occasional use of the approach for formative assessment purposes and other lesson types, i.e. practical, as shown in Figure 5.

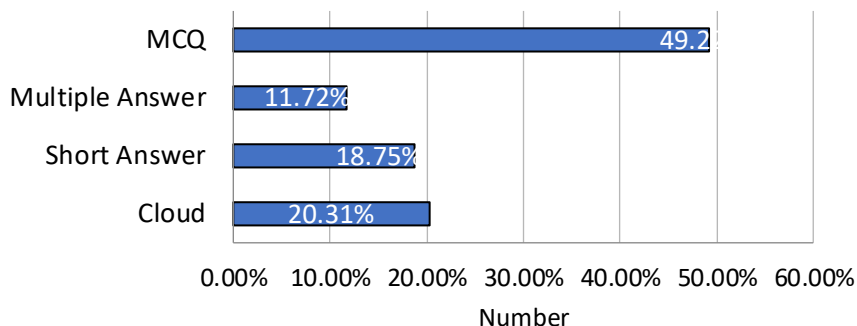


Figure 6. Types of ClassPoint Questions / Activity

As observed in Figure 6, staff explored the features of the SRS through the use of a variety of question types and activities to engage learners, ranging from objective questions like multiple-choice questions and multiple answer questions, which would facilitate quick compilation of live responses for real-time analysis of learning/performance data, to qualitative activities such as short answer questions and word cloud activities which would allow for deeper reflections and discussions.

The inference that staff were competent to adopt the structured approach efficiently was by means of examining time spent to design and conduct, and their sentiments on ease of use. The data was further analysed to determine staff's sentiments on various benefit statements. Responses (Fully Agree and Agree) to each of the benefit statement was compiled, ranked and normalized within each statement's using the % of responses as the base (Figure 7) to determine the extent of positive (Fully Agree & Agree) and negative Sentiments (Fully Disagree & Disagree) in each statement.

Stacked Bar Chart Normalised with % responses for each statement as base
Staff Sentiments on Benefit Statements of the Structured Approach for Diagnostic Assessment using ClassPoint

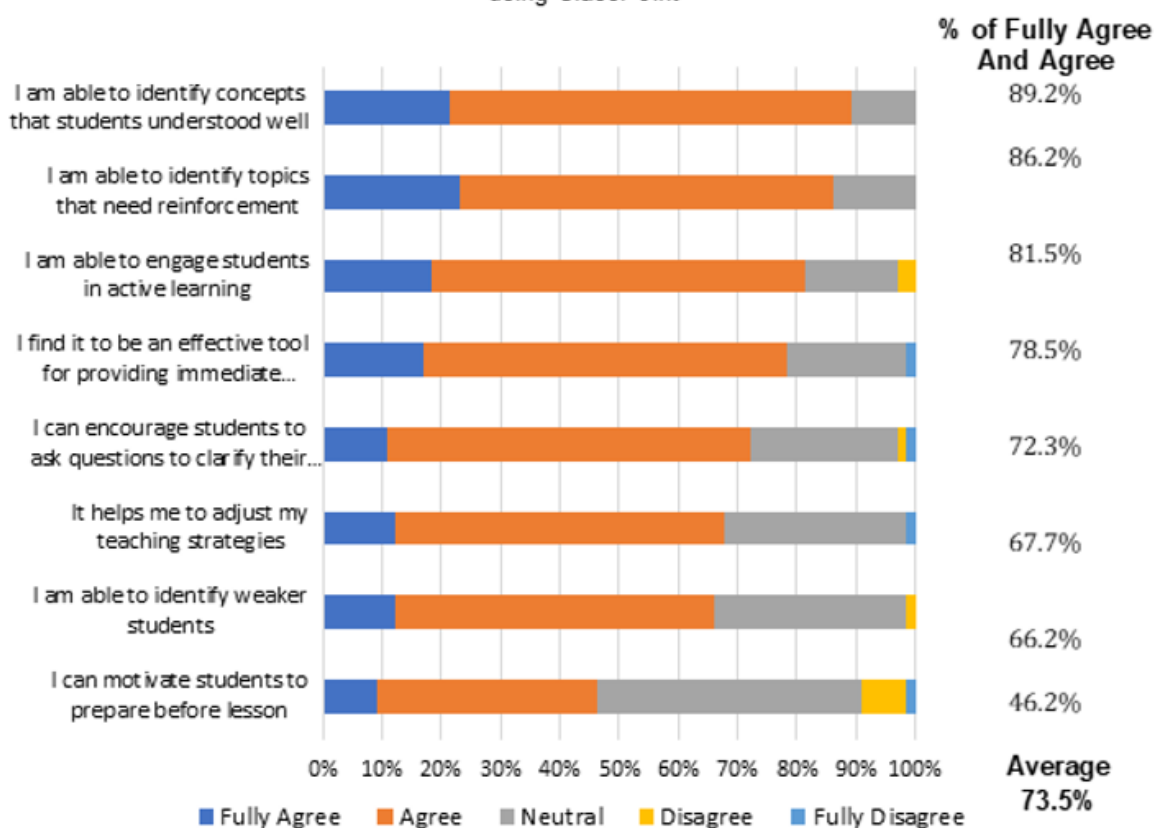


Figure 7. Staff Sentiments towards benefit statements

The top ranked benefits statements (sentiments of 75% and above) were aligned to the intended objectives of the structured approach for diagnostic assessment in tutorials (or practical) using an SRS that provided real-time learning data for adjusting learning interventions.

The students' sentiments towards the various benefit statements are compiled in Figure 8. The top two benefit statements with higher positive sentiments (Fully Agree & Agree) were aligned to the intended objectives of the deployment, which was to support student learning through diagnostic assessment. Namely, this is to check their understanding of pre-lesson learning and providing immediate/real-time feedback. It was observed that students most valued the ability to obtain immediate feedback on their learning using ClassPoint, with 77.3% of respondents providing positive sentiments (Figure 8). The overall percentage responses with positive sentiments for the benefit statements for students was an average of 65.6%, as compared to that of staff of 73.5%.

Discounting staff ambivalent "Neutral" responses, the lower ranked statements with higher negative sentiments (Disagree & Fully Disagree) were related to the theme of motivation, namely, motivating/encouraging students to prepare ahead of lesson and ask questions to clarify understanding. These were triangulated against findings from the student survey data, which revealed that motivation also ranked lower. Consistent with the observation from the

staff survey data, the items on motivation to prepare ahead of lesson and raise queries, for students are at 57.1% and 51.6% respectively.

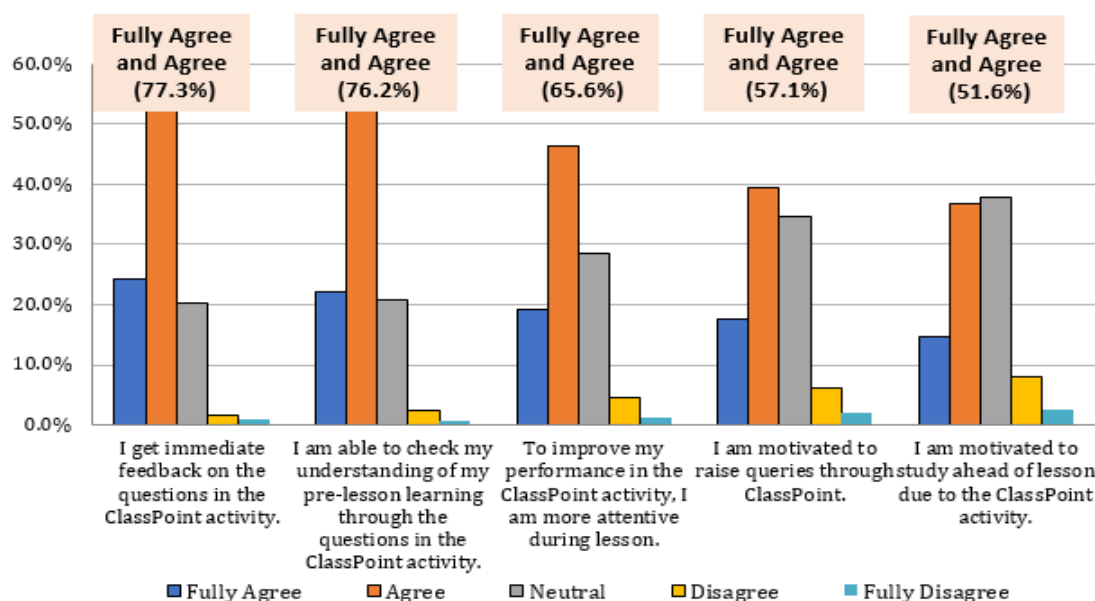


Figure 8. Students' Sentiments towards benefit statements - % Responses on Likert Scale

As this approach was still in the early stage of implementation against the background of tremendous changes occurring simultaneously, the results obtained were deemed remarkable. Still, on-going efforts are in place to help students to be more engaged to seek clarification in synchronous sessions, and to help students to understand the purpose of their learning and to be motivated to prepare ahead of such sessions.

For an approach to have pedagogical impact, it should be regular and pervasive. The School's teaching and learning team further studied if too much of an assessment load, whether diagnostic, formative or summative assessment, could be demanding cognitively on the students. To manage any negative sentiments, the team also explored if there was a "sweet spot" on the frequency of diagnostic assessment using ClassPoint against the sentiments towards the benefit statements.

Table 1. Students' Positive Sentiments on Benefits vs Frequency of ClassPoint Activity

Benefit statements against % of Positive Sentiments	Once a week	2 - 5 times per week	6 - 10 times per week	Above 10 times per week
Average (% of Positive Sentiments)	68.4%	68.9%	87.9%	86.1%

It was observed that students who have encountered ClassPoint 6 to 10 times per week selected more positive responses towards the various benefit statements (average of positive response - 87.9%). For 6 to 10 encounters with ClassPoint weekly, it was likely that ClassPoint was used not just for diagnostic assessments, but also for formative assessment and engagement for active learning.

Remote E-proctored Online Assessments

From the student survey in semester 1 of the academic year 2020/21 conducted to gauge students' views of the remote e-proctored online assessments (Figure 9), the majority of students strongly agree or agree that the online assessments engage them in their learning, and help them to know how well they have learnt (strongly agree from 26.3% to 28.7% and agree from 61.2% to 59.8%). On the statement that doing preparatory small-stakes online quizzes (termed as "cFA") prepare them for the online assessment (termed as "cMST"), the majority of the students agreed (strongly agree- 23.4% and 59.8% agree). The results suggest that the School has prepared the students well for the online assessments.

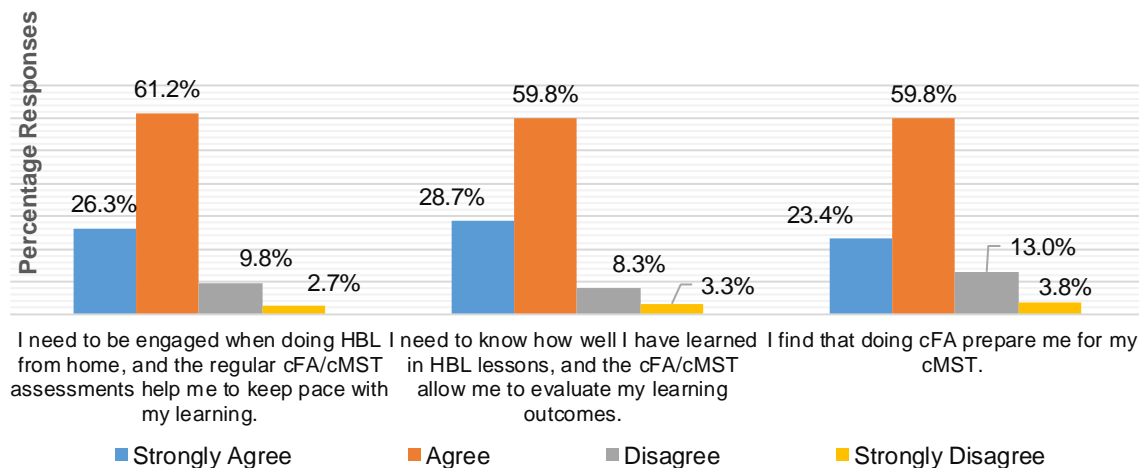


Figure 9. Students views of online assessments vis a vis their engagement in learning, learning outcome evaluation and online assessment preparation

The survey also included three open-ended questions on what students like or dislike about the online assessments, and what could have been done better for the online assessment to help their home-based learning. The five favourable factors ranked by students from the highest to the lowest were: open-book online assessment, convenience, helpful in learning engagement, motivation to study and the experience was not stressful. The results were as expected. For instance, students appreciated the open-book feature as they were able to refer and look up for information. Being at home was convenient without the need to be in campus for the online assessment. They were motivated to learn as they needed to prepare for the online assessment.

Students cited lack of time, no backtracking of questions, the need to upload images of their hand-written solutions, stress and connectivity issues as their top five dislikes. As expected, lack of time was a top grudge for students for all assessments. The need for no backtracking was perhaps not fully appreciated by students. This feature was incorporated so that there was a degree of authenticity of student assessment, as it tested the student's ability to apply learnt knowledge at that point in time. The upload requirements similarly were needed to provide solutions to questions which were based on higher order thinking skills, which could not be adequately assessed perhaps through multiple-choice questions alone. As expected, the responses received for the third open-ended question were mostly suggestions to address what were the top-ranked dislikes, such as asking for more time, to allow for backtracking and to not have uploads of images of solutions.

Overall, it could be summarised that students had positive views of the online assessments and appreciated how these helped them to be engaged and also to gauge their learning. This

also pointed how the School was able to stage the remote e-proctored online assessments and prepare the students for a different form off assessments.

Students' Overall Academic Performance – Observations and Comparison

A key concern that the School has, possibly shared by other IHL's as well, is whether the overall academic performance of students are affected by the switch to full flipped learning for all modules previously conducted through face-to-face lectures. Measures were put in place to guide staff to help students in their self-directed learning through knowledge checks and self-reflective quizzes, while teaching staff facilitated students' learning during synchronous sessions. The entire school had experienced the remote e-proctored online assessments conducted in place of the usual mid-semester test for the academic year of 2020/21.

The School noted that despite these changes, the overall academic performance passing rates of the students do not show any significant variations, before the full switch to flipped learning, and after the switch to full flipped learning, coupled with the implementation of the remote e-proctored online assessments. This suggests negligible impact on the students' academic performances, attributed to the well-executed implementation of the school-wide teaching and learning strategies.

CONCLUSION

Key stages of the structured teaching and learning approach to support the fully flipped learning environment and remote e-proctored online assessments were drawn up. The school-wide strategies for the re-design of teaching and learning practices, from the incorporation of knowledge checks in the asynchronous learning contents, to students' attempts of self-reflective quizzes and tutorials and the use of an in-class student response system to further help student learning, has been deployed by the School to facilitate student learning through diagnostic assessment. The benefits of deploying the student response system for diagnostic assessment - giving staff and students real-time performance data analysis and immediate feedback, helping to check understanding to determine areas learnt well, areas needing reinforcement and to adjust learning interventions, are generally positively received.

The School was able to mount large-scale remote e-proctored online assessments for both semesters of the academic year 2020/21. The set up was designed to replicate to some extent, similar requirements and roles to those of tests conducted in-person on-campus that the staff and students were already familiar with. However, this also required innovative re-thinking for the transformation of the usual assessment procedures and processes to ensure both staff and students were prepared adequately for a different form of assessment. The experience garnered from staging two rounds of remote e-proctored online assessments on a large scale put the School in good stead should there be a need to implement similar assessments at a short notice in future. Going forward, further work will be required should the e-proctored online assessments continue, given the migration to a new learning management system in April 2022.

In the initial stages of the capricious climate of the pandemic, the overarching driving goal was ensuring that the learning engagement of students was not compromised, however the tide might turn under such unprecedented conditions. All the necessary effort and work invested by the School to ensure this has paid off. With the benefit of hindsight, the School is confident that both staff and students are prepared for the challenges in the new norm in the teaching

and learning landscape. Overall, the School has been able to deploy school-wide strategies for delivery of its engineering diploma courses that engage students in their learning.

FINANCIAL ACKNOWLEDGMENTS

The author(s) received no financial support for this work.

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BIOGRAPHICAL INFORMATION

Ser Khoon Toh: is the Director, SEEE, SP. Under his leadership, the School continues to be a strong advocator and practitioner for CDIO, Design Thinking and FabLab-based curriculum for the Engineering diploma programmes. His current focus is on nurturing and preparing learners to be self-directed and work-life and world-ready. In the area of teaching innovation, the emphasis is on Edutech use and applying learning analytics for engineering education.

Chow Leong Chia: is a Deputy Director at SEEE, SP. His current portfolio is in Course Management and Student Development. He oversees the planning, development and implementation of full-time courses and continuing education & training (CET) courses in his school. He has a strong interest in conducting action research to enhances students' learning and strengthen staff pedagogical competence. He also plans programmes to nurture students and develop them to become self-directed learners.

Safura Anwar: has been teaching in Singapore Polytechnic since 1986. After serving in various portfolios, she presently leads a team of highly experienced and dedicated staff in SEEE's Teaching Innovation Unit who share a common passion to work with colleagues and students alike, so that they become better self-directed learners in all aspects in their own capacities.

Andy Ngai: is an Academic Mentor at SEEE, SP and has been with SP since 1998. His key area of focus is on the use of Edutech tools for effective and engaging teaching and learning. Interested in programming and applying data (learning) analytics to help colleagues to better design learning interventions and to support students requiring more help, he also encourages students in evaluating their own learning process and become better self-directed learners.

Hua Joo Tan: joined SP in 1991, serving in various portfolios such as Academic Resource & Development Manager, Course Manager and Head of Teaching & Learning (T&L) Unit. His interest is in T&L matters, particularly in nurturing and developing students to become independent learners. He is also passionate about using Edutech tools in his teaching to help the students in their learning.

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