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Flipped learning in action: Seven cases from Singapore's Polytechnics

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Abstract

Flipped learning reverses traditional direct instruction by having students complete homework before in-person classes. When supported by technology and data, flipped learning becomes a variant of blended learning, where blended learning refers to the integration of online and in-person learning experiences.

This paper highlights the sector-wide shift to flipped learning in Singapore's Polytechnics. The intent of the shift is to provide opportunities to improve self-directed learning, a critical skill set for the workforce. The authors consider seven presentations of practitioners' early studies of flipped learning in action, all of which were delivered at the e-Learning Forum Asia 2023 conference.

Key themes and takeaways from the seven presentations are considered, including the use of data and learning analytics to improve tailored support for self-directed learning, the value of learning-design models, examples of designing for social interaction during online asynchronous learning, to improve students' confidence in learning and operational challenges such as the need for more time to implement quality flipped learning.

The authors conclude with lessons for fellow practitioners to improve the designs of their own flipped learning efforts.

Introduction

Flipped learning is a variant of blended learning which "flips" or reverses the two-phase order of traditional direct instruction. Traditional direct instruction delivers foundational content to students in person and then leaves them to self-direct their learning with homework. Flipped learning helps students to self-direct their learning of foundational content before meeting peers and lecturers in-person for more personalised support to complete more complex "homework" together. Singapore's Polytechnics have adopted flipped learning in order to develop self-directedness as a key enabler of long-term employability. This article summarises, compares and draws lessons from seven early studies of flipped learning "in action" at four of Singapore's five Polytechnics. These studies were presented at the e-Learning Forum Asia 2023 ("eLFA 2023") conference in October 2023, organised in Singapore by the Singapore University of Social Sciences (Singapore University of Social Sciences, 2023).

Literature review

What flipped learning is: In flipped learning, initially termed the flipped classroom (Bergmann & Sams, 2012), students individually complete assigned homework, including watching pre-recorded lectures, before meeting their lecturers in person with the rest of their class. The "underlying logic" for flipped learning is that it is best – online and asynchronously – "to give students instruction on the content first" followed by "problem-solving, elaboration and mastery" in person (Kapur et al., 2022, p. 2).

Flipped learning is a variant of blended learning: When mediated by online technology, flipped learning is a variant of blended learning, where blended learning refers to various integrations of online and in-person learning experiences (Garrison & Kanuka, 2004).

Flipped learning improves learning outcomes: Compared to traditional direct instruction, appropriately designed flipped learning interventions produce significant gains for learning in higher education across academic, intra- and interpersonal, and satisfaction-related outcomes (Bredow et al., 2021). One reason for this is that lecturers use the data on students' individual progress as they actively self-direct their learning on foundational content to personalise the subsequent in-person learning support when students meet lecturers, peers and others to learn more complex content (Bergmann & Sams, 2023). Such data includes the results of online formative assessment checkpoints.

Blended learning, of which flipped learning is a variant, can develop self-directedness: Blended learning is both impacted by learners' self-directedness (Geng et al., 2019) yet can be designed to develop self-directedness, as recently affirmed by Singapore's own National Institute of Education (Natarajan, 2021).

Self-directedness is a valuable learning outcome: Self-directed learners are better at adapting to change, to learn new skills, to remain employed and to nurture their own long-term career success (Brandt, 2020).

Developing self-directedness has driven Singapore's shift to blended learning, including flipped learning at the Polytechnics: In 2022, Singapore's Minister for Education signalled to the country's education system the importance of continuing to develop self-directed learners coming out of the COVID-19 pandemic. Echoing the past several decades of research on self-directed learning (Brandt, 2020) and building on previous announcements to implement blended learning to further develop self-directed learners (Ministry of Education Singapore, 2020), the Minister stated that blended learning develops "students' capacity for self-directed learning" by allowing students to "learn to manage their time, and to prioritise and exercise initiative in learning outside the classroom… [t]his will be a critical skill for them as they go into the workplace as well - because learning goes beyond the classroom" (Chan, 2022, n.p.).

Singapore's five Polytechnics together enrol about 20000 new students each year for a total enrolment across the sector of about 60000 (Ministry of Education (ESD) Singapore, 2024). The Polytechnics offer 3-year diplomas with hands-on, practice-based learning experiences to prepare 17- to 19-year-olds for careers in the workforce and further education (Ministry of Education, Singapore, 2024). Although the Minister, in his 2022 speech had referred to other Singaporean educational institutions rather than the Polytechnics, the Polytechnics face the same or an even greater imperative to develop self-directedness given their mission as just described, since self-directed learning "will be a critical skill" for Polytechnic graduates "as they go into the workplace". Hence, the sector's adoption of flipped learning as a means to better support students to develop self-directedness in learning.

How flipped learning is implemented is important (details matter): Earlier research into lecturers' perceptions of flipped learning at Singapore Polytechnic shows that, to lecturers, instructional considerations have a significant impact on learning in flipped lessons (Or et al., 2022). The sector-wide shift into flipped learning has contributed to the evolution in the role and required skillsets of Polytechnic lecturers in Singapore, from Alison King's (1993) "sage-on-the-stage" to "guide-on-the-side". As Kapur and others have pointed out: "the nature of the implementation [of flipped learning] … matters significantly" (Kapur et al., 2022, p. 15). Merely flipping traditional direct instruction on students' timetables is insufficient to bring about changes in learning outcomes. All lecturers can take valuable learning-design lessons from the seven presentations featured here.

Flipped learning terminology at the Polytechnics in Singapore: The presentations from Singapore and Temasek Polytechnics employ the term "ALeRT". This term is defined at Temasek Polytechnic as "Assessing Learning in Real Time". It is defined at Singapore Polytechnic as "Assessing Learning Regularly for Timely feedback". ALeRT is not explicitly mentioned in the presentations from Ngee Ann and Nanyang Polytechnics. ALeRT began life in 2020 as an implementation of flipped learning that explicitly required data generated by students' learning activity to become a linchpin or key linkage-point between the two segments of flipped learning.

Initially promoted by Singapore and Temasek Polytechnics, ALeRT as a design concept was piloted and then adopted by all five Polytechnics in Singapore in 2021.

ALeRT is not only defined but also implemented differently at different Polytechnics. For example, Singapore Polytechnic's flipped learning design model envisages two ALeRT checks, whereas Temasek Polytechnic envisages three. Ngee Ann Polytechnic defines ALeRT as "Analytics on Learning for Responsive Teaching" and expects at least two checks. At Nanyang Polytechnic, ALeRT is also a two-check process. However, all ALeRT designs share two key characteristics: 1. the use of formative assessment-checks - typically but not exclusively quizzes - to generate data with which both lecturers and students themselves can evaluate students' grasp of content at various points in the flipped learning cycle; and 2. the use of that data to promptly tailor learning support for identified students or student-groups in subsequent stages of the flipped learning cycle, or in subsequent lessons in the semester, without having to wait for students to fail key summative assessments. The five Polytechnics are also continuing to experiment with effective and efficient ways to implement a third type of ALeRT check: confidence-in-learning. Confidence-in-learning is further discussed below.

Descriptive summary of the 7 eLFA 2023 presentations

Each presentation's conference abstract and slides are attached in the Appendix to this paper. For completeness and to better facilitate comparisons between the presentations, this summary also provides additional information not explicitly mentioned in the abstracts and slides, such as the number of survey respondents and focus group participants. The Polytechnics have adopted Brightspace by D2L (D2L Corporation, 2022) as the sector's Learning Management System (LMS) and all online learning activities occurred in the LMS unless otherwise stated.

Singapore Polytechnic delivered two presentations:

Singapore Polytechnic study 1 ("**SP 1**")

Abstract title (presentation titles may be slightly different): **Choose your own adventure: A pilot data-enabled flipped classroom study exploring learners' autonomy, self-efficacy and inquisitiveness**

Authors (not all authors presented): Zhengping Liow, Keith Yong Tze Tan and Wen Yi Ng

What was studied: Application of learner autonomy (Smith, 2008) to enable differentiated instruction in a data-enabled flipped learning design and its impact on aspects of students' self-directedness - self-efficacy (confidence in learning) and inquisitiveness.

Flipped learning design:

Online Asynchronous Learning: students completed quizzes embedded into content which lecturers analysed to identify "fuzzy points" of confusion.

In-Person: Students first worked in assigned pairs of stronger and weaker students on worksheets - less student autonomy – before stepping into group-based seminar activities and presenting their findings at the end of those activities - more student autonomy.

Research methodology: This study was conducted in one module with five classes and 110 students in the cohort. 72 respondent-students' data was analysed (n=72). T-tests were conducted on respondents'|paired "Type 1" (scaffolding activities with less autonomy) and "Type 2" (activities enabling more learner autonomy) survey items. Lecturers were not subjects.

Key findings: From "Type 1" to "Type 2", students' perception of their confidence in learning improved modestly, and inquisitiveness increased significantly.

Other noteworthy aspects:
This was one of the two SP studies that explicitly surveyed students on the impact of the learning activities on their confidence. SP 1 also explicitly described a scaffolded two-stage learning design and measured the impact of that design between the two scaffolds via a t-tested student survey.

Next steps: The authors hope to develop an active learning tool kit and models for differentiating instruction in flipped learning designs and to use validated instruments for further studies.

Singapore Polytechnic study 2 ("**SP 2**")

Abstract title (presentation titles may be slightly different): **Using data-enabled flipped learning to support differentiated instruction in a digital electronic engineering module**

Authors (not all authors presented): Siew Kee Chong and Mark Wan

What was studied: Lecturers and students' perceptions of Data-Enabled Flipped Learning and how it contributed evidence to differentiate teaching and learning in mixed-ability classrooms. Key reference was Tomlinson (Tomlinson, 2001).

Flipped learning design:

Online Asynchronous Learning: Students engaged in asynchronous lectures and completed quizzes. Quiz results were analysed to prepare for differentiated instruction in class.

In-Person: Differentiated learning experiences: high-performance students were challenged with stretch activities. Low-performance students received interventions to help them improve their understanding of the basic concepts.

Research methodology: This study was conducted in one module with 36 classes helmed by 20 lecturers. 648 students' data was analysed. The authors then conducted a survey of the students (n=203), lecturers (n=12), and separate focus groups with five students and five lecturers respectively.

Key findings: For students, their learning experience was largely positive although a few students queried the value of some of the learning activities. Lecturers obtained more precise insights and gave more targeted feedback to students but were concerned about the time necessary to analyse data and then design and develop differentiated instructions, the relevance of cohort- *vs* class-level statistics and the validity of the data in the LMS.

Other noteworthy aspects: This was one of the two SP studies that explicitly surveyed students on the impact of the learning activities on their confidence. This was also one of the three studies that obtained inputs from lecturers (the other studies were **TP 1** and **NP 1**).

Next steps: The authors are exploring the use of a customised chatbot to supplement learning materials and provide timely support to students.

Nanyang Polytechnic ("**NYP**") delivered one presentation.

Abstract title (presentation titles may be slightly different): **Igniting learner success: Unleashing the potential of the lectorial approach in flipped learning environments** - also known as "Enhancing Learner Engagement in a Flipped-Learning Environment Using the Lectorial Approach under NYP's DEFL Framework".

Authors (not all authors presented): Annie Yin Ni Ng, Shi Ying Cai, Terence Chin, Gia Wen Sim and Jia Ying Yong

What was studied: Implementation of the lectorial approach - which emphasises interactivity even in large lectures (Thalluri & Penman, 2020) in a flipped learning design.

Flipped learning design:

Online Asynchronous Learning: Students engaged with interactive online learning content e.g. online game, scenario-based learning. The content was closely linked to the in-person lessons which followed.

In-Person: Students performed hands-on activities to deepen or apply and demonstrate learning, including building models; interacting with physical items e.g. in laboratories; delivering group presentations and videos of processes.

Research methodology: This study was conducted on six modules in one School. Student survey n=221, 221 students' data was analysed. Lecturers were not subjects. Performance was measured across 3 quizzes, in a pre- and post-test research design - a pre-test before learning commenced, a 2nd test after the online but before the in-person segment, and a 3rd test after the in-person segment.

Key findings: The learning experience was largely positive. Students largely recognised the value of closely linking the online and in-person learning experiences and of interactivity in their learning experiences. Average marks improved quiz to quiz across all modules.

Other noteworthy aspects: The six modules chosen for this experiment were selected from different Diplomas to be representative of the whole School.

Next steps: Students suggested incremental improvements to the learning designs for lecturers' consideration. In response to those suggestions, lecturers committed to implementing improvements to their learning designs including enhancing the variety of activities, allocating more time to view e-materials, and adjusting the pace of in-person tutorials.

Ngee Ann Polytechnic delivered two presentations:

Ngee Ann Polytechnic study 1 ("**NP 1**")

Abstract title (presentation titles may be slightly different): **Learning through scenario in flipped learning context**

Author: Lee Tyng Leong

What was studied: Integrating scenario-based learning (Hussein Ahmed, 2019) into a flipped learning design, using Nearpod and Padlet.

Flipped learning design:
Online Asynchronous Learning: Completed online content including quizzes, games and simple scenarios presented in Microsoft Word.
In-Person: Applied or deepened learning via scenario-based learning.

Research methodology: 472 students experienced the design in one module. Student survey n=370. A focus group was conducted with five lecturers.

Key findings: The learning experience was largely positive. Lecturers found the design effective for facilitating productive in-person discussion provided students came prepared. In this sense, echoing **TP 1,** they were primarily concerned about how to improve self-directedness in students.

Other noteworthy aspects: This experiment used Nearpod for scenario-based learning. Nearpod enabled real-time tracking of student responses to facilitate in-depth discussions. Padlet was used to efficiently collect students' reflections at the end of their in-person lessons. The combination of these 2 tools enabled efficient and effective in-person scenario-based learning.

Next steps: The author identified the use of analytics to provide better support for students to complete their online asynchronous learning and strengthening lecturers' skills to facilitate in-person scenario-based learning, as challenges to address.

Ngee Ann Polytechnic study 2 ("**NP 2**")

Abstract title (presentation titles may be slightly different): **Enhancing engagement and interaction in online asynchronous learning**

Authors (not all authors presented): Kim Sung Lee and Gaik Bee Lim

What was studied: Application of the Community of Inquiry (CoI) framework (Garrison et al., 1999) and Feedback Fruits (Feedback Fruits, 2024) to improve online asynchronous learning experiences by facilitating online asynchronous collaboration.

Flipped learning design:
Online Asynchronous Learning: Students addressed challenges online learning content by discussing the content asynchronously using a 3rd party tool embedded into the LMS, called Feedback Fruits.
In-Person: Lecturer addressed students' online learning challenges as revealed by Feedback Fruits analytics, e.g. through further in-person discussion or practice on related past examination questions.

Research methodology: This study was conducted on one module. 36 students' data was analysed. A student survey was conducted, n=25. Performance in the form of grades in the related summative assessment (the module's final examination) was analysed across three semesters. Lecturers were not subjects.

Key findings: The learning experience was largely positive. There was no change in examinations performance over three semesters – two before intervention, and the semester of the intervention.

Other noteworthy aspects: This experiment used Feedback Fruits for more efficient and effective online asynchronous discussions. Students did not have to learn alone even though they were learning online.

Next steps: FeedbackFruits allows lecturers to seamlessly include model answers within online questions. This provides students with a valuable reference for self-assessment. Students shall be encouraged to better self-evaluate by comparing their responses to the model answers, to gain deeper insights into their understanding of the course content and further develop their self-directed learning skills.

Analysis and discussion

The clearest conclusion from the above is that, across the four presenting Polytechnics, after only one to two years into implementation, students had generally benefited well from flipped learning. Students' positive reception would have been in part due to causes well beyond this pedagogical change, such as the COVID-19 pandemic, the social-distancing impact of which compelled everyone, including students to develop at least some of the skills necessary for home-based and, therefore, self-directed learning – at least to a greater extent than fully-scheduled, in-person, synchronous, instructor-driven classes. However, the seven presentations also suggest the following learning-design themes that would have supported students to successfully self-direct their learning.

Temasek Polytechnic delivered two presentations:

Temasek Polytechnic study 1 ("**TP 1**")

Abstract title (presentation titles may be slightly different): **Enhancing student learning and engagement with data-enabled modified 5E model for flipped learning**

Authors (not all authors presented): Pratima Majal, Maria Teresa Abelanes, Siang Chuei Koo and Irene Chan

What was studied: The impact of the 5E model (Bybee & Landes, 1990) modified at TP for data-enabled flipped learning on a sample of both staff and students.

Flipped learning design:
Online Asynchronous Learning: Students engaged with learning triggers, explored learning content interactively, had foundational content explained, and evaluated their understanding through quizzes and other such checks.
In-Person: Students engaged with the results of the preceding online learning segment, had learning content elaborated upon, and had their deeper learning evaluated.

Research methodology: This study was conducted on three modules in two Schools. 1305 students experienced the designs. A survey was conducted with students (n=878) and lecturers (n=14).

Key findings: The learning experience was largely positive. Lecturers appreciated the impact of the 5E model on making flipped learning (Lo, 2017) more interactive and enabling them to track students' learning. They were concerned about how to improve self-directedness in students.

Other noteworthy aspects: The only cross-School study albeit still within the same Polytechnic. This was one of the three studies that obtained inputs from lecturers (the other studies were **SP 2** and **NP 1**).

Next steps: Lecturers wanted more support for lesson redesign and to develop in-person facilitation skills. Students asked for more practice (self-evaluation).

Temasek Polytechnic study 2 ("**TP 2**")

Abstract title (presentation titles may be slightly different): **A proof-of-concept study on the efficacy of agent-enabled nudge messages on learners' online learning behaviours**

Authors (not all authors presented): Koon Guan Lee, Ren Guo, Paul Cheung and Poh Nguk Lau

What was studied: Nudge theory (Weijers et al., 2021) to enhance viewership of recorded e-lectures and develop students' self-directedness.

Flipped learning design:
Online Asynchronous Learning: Students engaged in learning activities, such as watching recorded e-lectures and completing tutorial worksheets, that generated data in the LMS and video content management system (VCMS) and prompted the automatic sending of nudging messages.
In-Person: Lecturers checked in with students on their status of completion of e-lectures and tutorial worksheets, to reinforce the nudging messages sent through LMS. Details of these and other in-person learning activities were not described in the presentation as they were not the focus of the presentation.

Research methodology: This study was conducted in 1 module with 20 classes. 500 students' LMS and Panopto VCMS data was analysed for trends in:

1. the number of users that required nudging per Brightspace intelligent agent run; and
2. the number and duration of views of videos.

A student survey was also conducted, n=145. The authors also conducted focus groups with a total of ten students. Lecturers were not subjects.

Key findings: Data-triggered nudges helped students to complete online learning activities on time.

Other noteworthy aspects: This study focused exclusively on the online asynchronous learning portion of the flipped learning cycle, in particular the effect of the LMS' built-in "intelligent agent" tool to nudge students to complete asynchronous learning activities.

Next Steps: Based on students' feedback, authors will further optimise the design of the nudging activity by 1) reducing the nudging frequency; and 2) changing the means of delivering the nudging messages from Outlook email to Microsoft Teams.

Theme 1: Flipped learning as such does not work - but *active* flipped learning does

In 2022, Kapur and colleagues published a meta-study and critique of flipped learning, which asserted as follows (emphasis added in bold):

> The focus [of many studies of flipped learning] was more on engaging students in **repetitive, passive activities** — the **same in the pre-class repeated in the in-class**, usually via asking students to pre-review videos of classes, pre-review the PowerPoints then used in class, or listening to a teacher repeat material already exposed to the students. There is no reason to claim these are not worthwhile activities, but **it does not seem to be consistent with the claims of flipped learning for deepening understanding**... Our findings have revealed that such a two-phase model is not any more effective than a traditional model once the nature of implementations is considered. **What matters more is the inclusion of active learning** (Kapur et al., 2022, p. 14).

In the same paper, Kapur et al. proposed an active-learning four-phase alternative to two-phased flipped learning, namely the "Fail, Flip, Fix, Feed" model of productive failure first published by Kapur (2008). In this alternative model, "Fail" means to design a problem-solving trigger to diagnose what students understand and what they do not. "Flip" means to pre-expose students before their in-person lessons to foundational content – but it comes after "Fail". "Fix" means the lecturer in the in-person lesson should correct students' misconceptions as disclosed by "Fail" and ensure "robust" – which would include some aspects of self-directed learning. "Feed" refers to designing for formative assessment, including feedback.

One example of "Fail" might be at NYP, where students who participated in the study sat for a pre-test quiz, prior to commencing their "Flip" online asynchronous learning. This pretest was "productive" as it was rigorous – it revealed the extent to which students lacked knowledge. The pretest was both a diagnostic assessment and a motivational booster for students to "Fix and Feed" their gaps in person, working with their lecturers and each other.

Nonetheless, a problem-solving "Fail" diagnostic trigger was not a consistent key feature of the seven learning designs profiled here. Ironic as it may sound, productive *failure* should be a key feature of active flipped learning design going forward. However, in all other respects, the seven presentations here offer valuable lessons in "Flip, Fix and Feed" to support students' active – and, therefore, in various aspects, self-directed – learning at all phases of the flipped learning cycle. **SP 1** and **SP 2** used quizzes to detect students who "failed" in the online asynchronous learning phase - albeit during or after and not necessarily before the delivery of "Flip" foundational content – so that their self-directed learning issues could be "Fixed" in-person via lecturer- and peer-supported worksheet and group-based seminar activities. **NP 1** implemented simple "Flip" scenario-based learning to match students' self-learning abilities before stepping up into more complex scenarios to be "Fix"-ed collaboratively and in the presence of the lecturer. **NP 2** went a step further to provide students with the choice to seek collaborative assistance even during the "Flip" stage, ensuring that students did not have to wait to "Fix" their learning issues in-person. **TP 1** adopted a superficially different learning-design model (Bybee & Landes's 5E, adapted for data-enabled flipped learning) to marry interactive "Flip" with deeper-dive "Fix". **TP 2** showed how – "Fail" or otherwise – students can be nudged to self-direct their "Flip" for more meaningful in-person "Fix" learning. "Feed" formative assessments were embedded into both phases of flipped learning in all seven designs. None of these designs could be described as repetitive or passive. The point that Kapur, Hattie and their colleagues made in 2022 is accepted, that merely flipping on the timetable is insufficient. These seven designs provide useful examples of how to take advantage of that flipping in the timetable to improve active, self-directed learning.

Theme 2: Tailored support for students

The presentations show how the shift to flipped learning reduced the requirement for students – regardless of individual abilities and motivations – to move in "monkey see, monkey do" lockstep through rigidly-scheduled lessons. This shift allowed lecturers to "tailor" learning experiences in ways that encouraged students to actively construct their own learning, fundamentally by providing more time to students to learn at their own pace, but also by triggering students to plan, actively "do", and then evaluate their own learning. As pointed out in the context of a course designed to develop self-directedness in learners from disadvantaged backgrounds, such tailoring is key to helping students develop self-directedness (Mann & Willans, 2020).

One clear example of Theme 1 can be seen in **SP 1.** Lecturers tailored their support to their students' specific learning needs by designing diagnostic activities to discover what the students' difficulties were with the online content - the first segment of the flipped learning cycle. In-person, lecturers followed up by organising the cohort into "stretch" and "strengthen" groups and pairing different-ability students off to help stretch or strengthen the learning of foundational content via worksheets before the class proceeded to complete group presentations on a relevant topic of their choice. Students, therefore, received tailored support to demonstrate successively higher degrees of autonomy and learning as they progressed towards completing their group presentations.

The following are further examples of Theme 1:

SP 2: As in **SP 1**, the lecturers in **SP 2** grouped students into those who needed more support to achieve the outcomes at the baseline and those who could be stretched. They then followed up with differentiated activities for each group and ended with post-class assessments to gauge the effectiveness of the different interventions and identify areas for (differentiated) follow up: "Overall, the data suggest that students were positive to the various components of the initiative. The provision of variation in the learning activities, challenging goals, timely and helpful feedback, and clear

expectations for learning are all congruent with research on what teaching methods work best."

NP 1: Online, students were scaffolded through relatively easier scenarios, which were followed up in-person by more complex "branching" scenarios. Tailoring occurred primarily in-person, when students engaged in "do" scenario-based learning which the lecturer facilitated in real-time using Nearpod. Students' need-to-know continued to be triggered by linkages to real-life cases and the requirement to individually reflect on the impact of mistakes.

NP 2: The lecturer here drew on the Community of Inquiry (CoI) framework (Garrison et al., 1999) to guide learning from the side without resorting to direct instruction as his only aid. Students who otherwise might have struggled online and alone received help to learn as part of a community of fellow students and the lecturer via an efficient and effective collaboration platform (Feedback Fruits): "The teacher's presence, coupled with timely feedback and addressing student questions, is paramount for an effective online learning experience."

NYP: The online game "Robert's Asthma Journey" triggered both need-to-know and engagement and educated the students. Tailoring occurred when students demonstrated and developed their learning in-person through small-group presentations and student-created videos, for example on how to use inhalers. Students praised some ways in which their lecturers had designed their experiences to suit their needs so that they could better self-learn. Some examples of students' praise: "It was fun and I can understand how to use the different devices other than reading the steps". "I could discuss with my friends [as part of interactions during the lesson]". "I like how the lecturer allowed us to play with the models of atoms for us to better understand our e-materials".

TP 1: Via online delivery, lecturers tailored their support for different student profiles with a variety of age- and ability-appropriate triggers such as current news articles, videos, cartoon strips and questions worded in colloquial Singlish. Students then explored the online learning content using tools such as Padlet to consolidate their learning and evaluated that learning through quizzes. The quizzes generated data for lecturers to identify and address learning gaps on a differentiated basis. Further tailored support, as well as further elaboration or deepening of learning, occurred during in-person triggered activities such as crossword puzzles and through the subsequent small-group discussions leading up to the final evaluation activity.

TP 2: In a similar vein to NYP, students offered praise for their lecturers' design of the nudging messages. These nudges helped students to manage their own time without actually doing it for them (e.g. "The timing of the emails are just nice as we normally would do tutorials 1-2 days before tutorial lesson."). They also encouraged and motivated students to complete their self-learning journeys (e.g. "I had two minutes of great joy after receiving the encouragement email"; "I felt motivated to watch the videos as I thought the lecturer sent the email personally").

Theme 3: Data used to tailor support

As has been pointed out by the Singapore Polytechnic research team (Or et al., 2022, p. 66):

> Research has indicated that learner outcomes will improve if instructors in higher education maximise students' learning experiences by using the implementation data to drive those decisions and effectively shift student accountability for learning using flipped methods (Brewer & Movahedazarhouligh, 2018).

The lecturers in these seven presentations used formative assessment results (e.g. quiz performance, as with **SP 1, SP 2** and **TP 1**) as well as utilisation data from the LMS, VCMS and LMS-embedded 3rd party tools such as Feedback Fruits (e.g. **NP 2, TP 2**) to decide how to tailor their designs to better-facilitate their students' self-directedness. For **NP 1,** the lecturer identified better use of analytics as a challenge to be addressed in future iterations of her design, but also described the use of learning analytics data to develop self-directedness in-person lessons, through Nearpod as a tool to help her monitor individual students' engagement and progress in real-time during relatively complex scenario-based learning discussions. For **NYP**, the researchers described how they used quiz data as part of a pre-test, post-test design to measure the change in learning performance at each stage of their design. For **NP 2,** the researchers also analyzed the module's examination performance data to see if achievement had improved (it had not).

A key takeaway from the above is that what used to be invisible in traditional direct instruction , that is the time, effort and nature of students' activities when they have to learn on their own through technology, is made relatively more visible to lecturers and data-enabled flipped learning. That data should not hurt if lecturers wish to know their students better in order to deliver more tailored or personalised assistance to help them develop self-directedness in learning among many other outcomes, . Of course, it is possible to "flip" the learning without technology (Saichaie, 2020) – and data never tells the whole story and may even mislead (Bulger, 2016) – nonetheless, these seven presentations illustrate how the ideal of personalising the learning for every student is brought closer by data-enabled flipped learning – more so than without it.

In addition to the key themes discussed above, what are some other lessons for learning design from these seven presentations?

Other lessons for learning design from the seven presentations

Find clear models to help improve design: ALeRT, with its explicit reliance on analytics for prompt and tailored in-semester learning support, has been described above as a model for flipped learning across the five Polytechnics. **SP 1, SP 2** and **TP 1** also described their respective Polytechnics' own internal models for implementing flipped learning. In the case of **SP 1** and **SP 2**, the model in question was

DEFL - Data-Enabled Flipped Learning. For **TP 1**, it was 5E - Engage Explore Explain Evaluate Elaborate. **NP 2** referred to the popular Community of Inquiry framework to explain why facilitating efficient online asynchronous collaboration improves learning experiences. NYP used the lectorial concept as a one-word summary for interactive learning design, whether online or in-person regardless of the size of the class. **TP 2** referred to nudge theory, which explicitly admits the value of appropriate reminders to help students successfully complete learning activities on their own. **NP 1** referred to scenario-based learning as an established pedagogical model around which to design flipped learning, from simple scenarios students can individually complete online to more complex scenarios to work through in small groups when they meet in-person. The lesson here is that clear pedagogical models help improve design. These can be institutionally developed based on literature or directly taken from the literature. And they are helpful because they are logical, evidence-based, and like good checklists for any other task, help lecturers to address all relevant considerations. Once lecturers detect gaps in their learning designs whether through students' feedback, fellow lecturers' inputs, LMS and/or academic performance data, they should regard it as time well-spent to conduct some research to find relevant models to address those gaps.

Design to help students make online asynchronous learning social: Social interaction helps students manage complexity as time is always precious (Goodhart, 2019). Social presence is a key element of the CoI framework. The in-person learning segment of the flipped learning cycle is where most collaboration (social interaction) occurs because that is when collaboration is most efficient and the need is greatest due to the complexity of the content. However, **NP 2** offers a good example of a learning design which facilitates asynchronous online collaboration as a means of learning support. Another example is NYP where students collaborated to produce content to share during in-person lessons. A key reminder for readers might be that collaboration is not antithetical to self-directedness, and that self-initiated collaboration is an indicator of self-directedness (Moore et al., 2007). How can lecturers improve their flipped learning designs - especially the online asynchronous learning segments - to help students learn better how to support their own learning through collaboration?

Improve students' confidence-in-learning: Confidence can be described as a "state of being certain about the success of a particular behavioural act". Confidence is "certainly required for success, but high confidence and low accuracy is a problematic combination" and "building confidence where confidence is low is important for academic success" (Atherton, 2015). Confidence-in-learning checks poll students on their self-perceived grasp of the learning content, as opposed to performance data such as their marks from responding to content-related quizzes. As mentioned above, the five Polytechnics are continuing to experiment with effective and efficient ways to implement confidence-in-learning checks. Of the seven presentations discussed here, **SP 1** and **SP 2** studied students' confidence in learning. For **SP 1**, students' confidence in learning seemed to have improved modestly by the end of their flipped learning experience, between the "Type 1" and "Type 2" activities, moving from less to more learner autonomy in the design. For **SP 2**, students were less agreeable relative to other survey items that data-enabled flipped learning gave them confidence in their learning. The authors attributed this to students' difficulties with self-assessing confidence. A simple direct comparison between **SP 1** and **SP 2** is problematic even though both modules studied are within the same Polytechnic. **SP 1** studied architecture students most of whom came into their diploma via Singapore's academic "O" levels route (for background on the "O" levels, see the Singapore Examinations and Assessment Board, 2024) whereas **SP 2** studied electrical and electronic engineering students the majority of whom came into their diploma with educational backgrounds that were vocational. These differences in student demographics alone may consistently yield different confidence ratings. Nonetheless, these two presentations remind readers that confidence in learning is a predictor of academic performance (Atherton, 2015). Designing flipped learning to improve students' confidence in learning is desirable. **SP 1** describes in some detail, a learning design that can build that confidence. **SP 2** contains a more general description of a design that differentiates instructional activities based on data, between different performance profiles.

Summary – Lessons for learning designers

In brief, what are the implications of the above for future flipped learning implementations in Singapore's Polytechnics and similar institutions elsewhere?

1. Design for Failure, as in Productive Failure. Flipped learning, properly designed, should "Fail" and thereby surface students' self-directed learning issues as early as possible for "Flip, Fix and Feed" interventions during the in-person learning phase.

2. Design flipped learning to develop self-directedness through the provision of tailored learning support, especially during in-person lessons, using data from online asynchronous lessons.

3. Clear pedagogical models help lecturers not to overlook key design considerations.

4. Learning is social; self-directedness does not require learners to learn entirely alone. Flipped learning designs would do well to encourage more collaboration, even online.

5. In view of the correlation between confidence and success, design to support students to become more confident about their learning, in addition to a focus on developing content knowledge as such.

We proceed to consider a few key limitations common to many of these seven studies.

Limitations: What could be improved in the designs of the studies presented here?

This segment extracts three common limitations from the seven presentations that would be valuable to address to improve the quality of future similar studies.

Obtain lecturers' inputs: **SP 2, NP 1** and **TP 1** were the three presentations out of the seven considered here that obtained inputs from lecturers on their respective Polytechnics' models for implementing flipped learning. In **SP 2** and **TP 1**, lecturers agreed that the models helped them to design more active learning, build strong linkages between online and in-person learning segments, provide more targeted feedback and effectively "close" the learning for students. In contrast, lecturers expressed concern over the amount of time needed to implement and facilitate good quality flipped learning in accordance with their respective models. **NP 1** and **TP 1** also surfaced lecturers' concerns over motivating students to complete their online asynchronous lessons. Adopting Brookfield's four lenses (Brookfield, 2017; see Brookfield et al., 2019), any future iteration of the other four studies could better inform the sector's learning about flipped learning by also obtaining lecturers' perspectives, as every presentation here already cites literature and provides the students' and authors' perspectives.

Commence trend analyses: All the survey results discussed here were single-point checks – that is, the survey was only conducted once - except for **SP 1**, which implemented a two-point design. Survey responses were very positive. This finding was a key contributor to the statement above with the clearest conclusion from the presentations discussed here is that students had generally benefited well from flipped learning. Going forward, every presentation team proposed the next steps. **SP 1** declared an intention to use validated instruments for further studies as its next step. Once a valid and reliable yet efficient instrument is chosen, repeating measurements with that instrument over time would be valuable to establish benchmarks against which to monitor the progressive impact of changes in students' learning experiences due to presenters' next steps.

Add a focus on the impact of flipped learning on students' academic performance, in addition to the focus on students' learning experience: Of the seven presentations, only **NP 2** and NYP studied the impact of their respective flipped learning interventions on academic performance. NYP measured students' performance in an experimental context using a three-point pre- and post-test design, while **NP 2** analyzed module grades before and after the intervention. Subsequent studies should measure both experience as well as performance for a more holistic picture of impact.

This segment ends by acknowledging that of the seven presentations, only NYP explicitly discussed its study-design limitations. For example, NYP cited among its limitations the fact that the study was limited to one topic per module, and the absence of statistical analysis of the quiz results. Of the other presentations, **NP 1** discussed challenges or "limitations" on the learning design rather than the study design, such as the need (for example) to improve the learning design by improving the tracking of gaps in learning before in-person lessons. The lesson from this for readers would be to remember to address their own studies' limitations, as an aid for others to consider how they might improve the design of their own.

Conclusion

These seven presentations provide lessons in study design and specific examples of learning design to incorporate into professional development programmes for fellow practitioners. As mentioned in the Introduction and Literature Review, the move to flipped learning is intended to provide the Polytechnics with opportunities to better develop self-directedness as a critical skill for employability in today's workplace. The presentations discussed here could be viewed as the initial stages of the sector's action research spiral (Kemmis et al., 2014) into flipped learning to develop such self-directedness.

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Appendix

Name of the Polytechnic Short reference for the presentation	Abstract Title (Presentation titles may be slightly different)	Authors (Not all authors presented)	Abstract and Link to Presentation
Singapore Polytechnic SP 1	Choose Your Own Adventure: A Pilot Data-Enabled Flipped Classroom Study Exploring Learners' Autonomy, Self-Efficacy And Inquisitiveness	Zhengping Liow, Keith Yong Tze Tan and Wen Yi Ng	**Abstract:** Flipped classrooms (FCR) are popular pedagogical strategies in higher education and their success is contingent on the effective use of class time. The 'one-size-fits-all' approach to FCRs' activity potentially led to disengagement among students, as identical activities may not adequately accommodate learners' varying comprehension levels from asynchronous lectures. Therefore, educators can capitalise on students' learning insights from the lecture's knowledge checks and reflections to tailor FCR activities. The experimental 'Data-enabled Flipped Learning' (DEFL) model leverages these data/insights to design differentiated instructional (DI) FCR activities. These activities, anchored by Learner Autonomy (LA), let students choose activities that interest them, potentially heightening their curiosity. Seventy-two first-year architecture students participated in a One-Group Pretest-Posttest pilot trial between two DEFL models. DEFL Type 1 utilises knowledge check quizzes to classify students into stronger and weaker groups. Using the 'Think-Pair-Share' approach, stronger students partner with weaker ones to work on standard worksheets together. These objective exercises are facilitated through hierarchical one-on-one teacher-student interactions and feedback. DEFL Type 2 analyses students' lecture reflections to identify recurring themes and surface as learning gaps to design appropriate DI activities. Students can choose between two tracks: deepening their knowledge through library research or exploring the campus to observe and document construction details. The learning process and environment were differentiated according to learners' affinity and readiness with the topic. A questionnaire focusing on self-efficacy and inquisitiveness was administered after both DEFL activities. The Paired T-test revealed that students' perception of their self-efficacy improved modestly ($p = 0.084$) from DEFL Type 1 ($M=4.076$) to DEFL Type 2 ($M=4.159$), while students' inquisitiveness increased significantly ($p = 0.05$) from DEFL Type 1 ($M = 4.173$) to DEFL Type 2 ($M = 4.263$). DEFL Type 2's collaborative setting may have boosted learning confidence, echoing Anwar's (2016) findings on group discussions' positive effects. Promoting LA nurtures students' inherent interests and curiosity, which is crucial for cultivating self-directed learners (Reio, 2004; Siddiqui et al., 2022), thus addressing the shortcomings of the one-size-fits-all FCR approach. Teaching style affects student engagement and curiosity (Inayat & Ali, 2020). Differentiated activities that align with diverse teaching methods and learning attributes can feasibly boost these traits. This study contributes to a growing body of FCR research whereby students' learning data potentially enhance their learning attributes. Furthermore, Li et al. (2019) reported strong links between self-efficacy and curiosity, paving trajectories for future investigations in DEFL DI & LA pedagogies. https://docs.google.com/presentation/d/1GpH2HtyIJaZs9AZ36EMbcg4ll7y1NFKk/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Singapore Polytechnic SP 2	Using Data-Enabled Flipped Learning to Support Differentiated Instruction in a Digital Electronic Engineering Module	Siew Kee Chong and Mark Wan	**Abstract:** Singapore Polytechnic (SP) is moving towards a digital learning culture where lecturers use data on student performance to customise teaching and learning strategies. This paper presents an evaluation of a pilot study on Data-enabled Flipped Learning (DEFL), an approach that harnesses data in a flipped learning format to support differentiated instruction. The pilot was implemented in a Digital Electronic Engineering Module involving 36 classes, 20 lecturers and 648 students in the academic year 2022/23 Semester 2. The aim was the systematic utilisation of the Learning Management System (LMS), especially the learning analytics features, to extract, collate, and present key learning data on online assessment to allow for the lecturer to prepare for focused feedback and differentiated instructional activities in the face-to-face sessions. The methodology employed a mixed-methods approach, incorporating quantitative and qualitative instruments to gather data from both teaching faculty and students. The study aimed to understand the students' perceptions of DEFL and how it contributed to their learning. Additionally, the study explored how teaching faculty experienced the initiative in terms of their professional role, including their ability to identify student-specific learning gaps, provide effective feedback, and design differentiated instruction. The findings provided valuable insights into how both students and teaching faculty experienced this initiative, identifying the most useful (and less useful) aspect of the instructional approach employed. Overall, the data suggested that students responded positively to the various components of the initiative such as embracing challenging goals, being given clear expectations for learning, appreciating the variety in the learning activities, and the timely and helpful feedback provided by the lecturers. The faculty's response on the potential benefits of implementing DEFL can be described as largely positive as faculty appreciate the ability to customise learning for their students and helping students to understand key concepts more deeply by targeted feedback. In conclusion, this study has demonstrated that learning analytics can enhance the effectiveness and efficiency of providing timely focused feedback and the instructional remediation needed for meeting a wider range of student learning needs. Of equal importance, it is not just the technology provision that is important, but a pedagogy that is evidence-based, utilising methods that are known to enhance learning.

			https://docs.google.com/presentation/d/1dJN_goD8rTyG_yAsXhWXt1taLYD_CLMX/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Nanyang Polytechnic **NYP**	Igniting Learner Success: Unleashing the Potential of the Lectorial Approach in Flipped Learning Environments	Annie Yin Ni Ng, Shi Ying Cai, Terence Chin, Gia Wen Sim and Jia Ying Yong	**Abstract:** This research addresses the challenges of learner engagement in flipped-learning environments by introducing the innovative **Lectorial Approach—a fusion of lecture and tutorial delivery aimed at fostering learner engagement on a large scale.** Over 200 learners from Nanyang Polytechnic's School of Applied Science, ranging from year 0 (Poly Foundation Programme) to year 2, participated in the study. Three quizzes were conducted: **pre-e-learning, post-e-materials, and following face-to-face activities.** Results revealed a remarkable average improvement of over 50% in quiz scores after learners engaged with e-materials, demonstrating the effectiveness of the Lectorial Approach in bridging learning gaps and enhancing comprehension. The learners' pre-e-learning quiz scores indicated that the e-material topics were initially new to most students. However, their scores significantly improved after engaging with the e-materials, showcasing the impact of the Lectorial Approach on knowledge acquisition and retention. Additionally, the post-face-to-face activities witnessed a minimum 10% improvement in quiz scores across **four out of six modules**, reaffirming the approach's positive impact on learner understanding. The interactive and engaging face-to-face sessions effectively complemented the e-learning materials, creating a holistic and immersive learning experience. Learners' **survey responses** expressed enthusiasm and excitement towards the Lectorial Approach, praising its interactive, enjoyable, and easily understandable nature. The engaging face-to-face activities were credited for stimulating heightened interest and motivation in the subject matter. The Lectorial Approach emerges as a transformative solution to elevate learner engagement in flipped-learning environments. By creatively redesigning lesson delivery, it nurtures a profound and immersive learning experience, bolstering learners' academic performance and confidence. As we navigate the evolving landscape of education, this research underscores the **Lectorial Approach**'s **potential to reshape the future of flipped learning**, fostering a generation of empowered and inquisitive learners. By harnessing the synergistic blend of technology and interactive activities, the Lectorial Approach redefines learners' interaction with course materials, fueling their passion for learning and inspiring a lifelong thirst for knowledge. The findings demonstrate the Lectorial Approach's efficacy in enhancing learner engagement, laying the groundwork for future innovations in flipped learning and learner-centered education.
			https://docs.google.com/presentation/d/1SrLCo6nAYMIV7ShnJJO7HNvyc3vBWjNg/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Ngee Ann Polytechnic **NP 1**	Learning through scenario in flipped learning context	Lee Tyng Leong	**Abstract:** **Introduction:** Traditional didactic teaching methods in pharmacology education poses challenges in learning extensive biomedical content with limited opportunities to discuss and apply theoretical knowledge in patient care. This study aimed to assess the effectiveness of using Scenario-Based Learning (SBL) in Flipped Learning (FL) context to address these issues. **Methods:** **Participants.** This study included **472** third-year Diploma in Nursing students from Ngee Ann Polytechnic taking the Integrated Nursing Science 3.1 module in April 2023 semester. **Procedures.** The FL approach required students to do self-paced online asynchronous learning (OAL), including online videos, self-check quizzes and interactive online games to grasp foundational theoretical concepts before in-person learning (IPL) sessions. During IPL sessions, lecturers facilitated discussion of difficult concepts and application of the acquired knowledge through SBL, using real-life scenarios like medication errors and adverse drug events. Simple branching scenarios were developed using Nearpod, allowing live student participation in class and critical decision-making based on the provided scenarios. Nearpod enabled real-time tracking of student responses to facilitate in-depth discussions. Students were asked to explain their chosen nursing action and probed to consider various variables that could alter the outcomes. After the discussions, students reflected and shared their learning on Padlet. **Results and Discussion:** Of the 472 students, 370 (78.4%) completed an online survey to provide feedback. The results showed that more than 84% of the participants strongly agreed and agreed that SBL in FL context promoted active learning; improved critical thinking, raised awareness of medication errors and preventive strategies and prepared them for real-world scenarios. These provide preliminary support for the efficacy of the current design and integration of SBL in FL. The OAL is designed to foster active engagement through interactive learning activities. The SBL stimulates critical thinking, encourages applications and contextualises learning in real-world clinical scenarios. The lecturers found Nearpod and Padlet effective for facilitating productive in-person discussion. It was postulated that students who did not complete the OAL or could not grasp the concepts might struggle during the IPL sessions that demanded higher order thinking. Hence, it is crucial for the students to complete OAL to enable meaningful participation in IPL. **Conclusion:** This presentation reflects on the efficacy of and challenges in the design and integration of **SBL in FL context** to enhance pharmacology education for nursing students and can potentially extend these to other theoretical modules to further enhance student learning. https://docs.google.com/presentation/d/1x6TVtighVzagY6apFyg1nsR76U6fb9Aw/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Ngee Ann Polytechnic **NP 2**	Enhancing Engagement and Interaction in Online Asynchronous Learning	Kim Sung Lee and Gaik Bee Lim	**Abstract:** **Purpose:** Ngee Ann Polytechnic, Singapore, has adopted the flipped learning approach, where live lectures had been converted to online asynchronous learning (OAL) materials, while tutorials take place in person to deepen and apply the learning. The shift is intended to nurture self-directed learners, and provide flexibility to learn at their own pace. However, students learn in isolation, which may result in reduced student motivation and engagement in learning. To address this, interactivity was introduced into the OAL materials, and the impact on learning and engagement was studied. **Methods:** FeedbackFruits Interactive Document and Interactive Video tools were used in a Genomics & Proteomics module taken by final year students of the Diploma in Biomedical Science. Lecturer-generated questions were embedded into the lecture slides and videos. Students could ask questions by annotating the slides or at a timestamp in the video. The lecturer provided feedback and responded to the questions. After 5 weeks of OAL delivery using the interactive study materials, a survey was conducted to assess students' perceptions of their learning experience as

			well as usability and engagement in the module. **Results:** 25 of 36 students responded to the survey. Students agreed or strongly agreed that the interactivity improved their learning in OAL (23/25), motivation to learn in the OAL (20/25), engagement with learning materials (24/25), sense of being a part of a learning community (18/25) and better enabled feedback (22/25). Students appreciated the ability to post questions at specific points within interactive documents for quick clarification of doubts, and view other students' questions. One key finding was that enabling anonymous posts provided students with a safe environment to ask questions. Comparison
			of mid-semester common test results between the fully implemented OAL semester and the preceding two semesters showed no significant difference in mark distribution, indicating that student performance in the flipped learning delivery was not compromised. **Conclusions and future directions:** Although OAL is done as an individual activity, the use of the interactive features enabled and encouraged learner-lecturer interaction and peer learning through viewing other students' responses to lecturer's questions. One critical element was the lecturer's presence in providing consistent feedback and addressing students' queries. Future directions include providing sample answers to lecturer's questions for students to assess their own responses as well as encouraging learner-learner interactions. https://docs.google.com/presentation/d/1DbtrGQbesYi92S_HoKtWagmrOZLqCNms/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Temasek Polytechnic **TP 1**	Enhancing student learning and engagement with Data-enabled modified 5E model for Flipped Learning	Pratima Majal, Maria Teresa Abelanes, Siang Chuei Koo and Irene Chan	**Abstract:** Flip learning has become a widespread pedagogical strategy for educators in the wake of the pandemic. With Flipped Learning, lecturers are faced with the crucial task of ensuring students learn and are engaged online as well as in class. However, engaging students, especially online, can be very challenging (Hew & Lo, 2018). Thus, Lesson design and facilitation become critical to enhancing student learning and engagement. One approach to lesson design involves incorporating Temasek Polytechnic's Data-enabled Flipped Learning model, which integrates the **5E Inquiry model** and leverages Learning Analytics for responsive teaching. This framework is designed to seamlessly integrate both the out-of-class and in-class components of a flipped learning lesson. The 5E model comprises the following phases Engage, Explore, Explain, Elaborate and Evaluate. This model is a well-established active learning inquiry-based model introduced by Bybee (1993) and has been incorporated into Flipped Learning design in recent years (Jensen, Kummer & Godoy, 2015; Svensson & Adawi, 2015; Lo, 2017; Lai & Hew, 2019). At Temasek Polytechnic, the use of Learning Analytics is an integral part of teaching students online as well as face-to-face by incorporating the learning analytics strategy called ALeRT. Thus, the Data-enabled Flipped Learning framework has
			been designed to incorporate the 5E model along with the learning analytics strategy to scaffold faculty in designing effective Flipped Learning lessons. This study focuses on implementing the **Data-enabled Flipped Learning framework** in **three subjects** in the School of Engineering and the School of Business at Temasek Polytechnic. Both the quantitative and qualitative data collection methods, such as **student surveys and interviews**, were used to gain a comprehensive understanding of the effectiveness of this framework in engaging
			the learners. The authors also share the insights gained from the experiences of the teaching teams involved in incorporating the framework in their flipped learning lessons. Through this study, we will share **examples of lessons that have been designed using the Data-enabled Flipped learning framework.** Additionally, we will explore the challenges faced by lecturers during implementation and the strategies they employed to overcome them. Moreover, feedback from students regarding their experience of learning in a flipped format will also be shared. https://docs.google.com/presentation/d/1dqsWU1vm7wJFuDY1WCOkoLvJ1B4AiwXF/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true
Temasek Polytechnic **TP 2**	A proof-of-concept study on the efficacy of agent-enabled nudge messages on learners' online learning behaviours	Koon Guan Lee, Ren Guo, Paul Cheung and Poh Nguk Lau	**Abstract:** As flip learning gains traction in higher education (HE) courses in a post-COVID era, it is critical that instructors are able to monitor learners' learning progress and preparation for in-person classes. A common problem that lecturers at Polytechnics in Singapore face is that learners do not watch the asynchronous lecture videos and complete tutorial worksheets before coming to tutorial
			worksheets before coming to tutorial classes. To counter this problem, a proof-of-concept pilot was implemented to explore how autonomous email messages could nudge learners towards adopting such positive learning behaviour in a flipped learning environment. Three tutorial lessons in a freshmen level microbiology course (n = 487) were selected. Messages were configured using an intelligent agent (IA) tool in the Learning Management System (LMS) to deploy customised emails. Learners who did not watch the lecture videos received a reminder message two days before class. If they did not respond by watching the videos, another reminder email would be triggered one day before the
			scheduled class. To nudge learner action, links to the lecture videos, the tutorial worksheet and time management resources were embedded in the reminder emails. Encouragement emails were sent to learners who viewed the videos to reinforce positive learning behaviour. From LMS analytics, it was observed that there was a general decreasing trend in the number of learners who received reminders (meaning that they watched videos ahead of time) across the three tutorial sessions (from 48% to 42%), with the video analytics data showing a sharp upward spike in video views coinciding with the launch of the study. Post-survey results showed that majority of learners perceived the reminder and encouragement emails to be useful. Interestingly, despite the increased number of video viewers, a McNemar analysis of paired responses in pre- and post-surveys revealed an increased proportion of learners reported that they were not able to watch videos according to the course schedule. This could be explained either by enhanced learners' self-awareness from email reminders or confounding factors from the time of survey. Focus group discussions revealed that adoption of a personal and encouraging tone in the emails, provision of direct links to the learning resources, and strategically timed emails were the key factors in promoting learner actions. Overall, the IA reminders were considered effective as supported by the quantitative and qualitative data, showing the potential of such tools to promote self-awareness and desirable learning behaviour. https://docs.google.com/presentation/d/11pCf4sIojnbRyhlTAcgzwC9eX-NJqiIs/edit?usp=sharing&ouid=104664837057766530115&rtpof=true&sd=true