Collaborative Active Learning

Practical Activity-Based Approaches to Learning, Assessment and Feedback

Edited by
Chan Chang-Tik
Gillian Kidman
Meng Yew Tee

palgrave macmillan

Collaborative Active Learning

Chan Chang-Tik · Gillian Kidman ·
Meng Yew Tee
Editors

Collaborative Active Learning

Practical Activity-Based Approaches to Learning, Assessment and Feedback

palgrave
macmillan

Editors
Chan Chang-Tik
Monash University Malaysia
Subang Jaya, Malaysia

Gillian Kidman
Monash University
Clayton, VIC, Australia

Meng Yew Tee
Universiti Malaya
Kuala Lumpur, Malaysia

ISBN 978-981-19-4382-9 ISBN 978-981-19-4383-6 (eBook)
https://doi.org/10.1007/978-981-19-4383-6

This Palgrave Macmillan imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Foreword

The book in front of you takes learning seriously. It puts learning at the centre. Only if we grasp how learning happens, we can start to create environments that nurture this learning. Key to this is acknowledging that learning is fundamentally social. Learning is participating in communities, learning is engaging in collaboration and trying to make sense of the multiple perspectives confronted with, learning is receiving feedback, learning is seeking help, learning is providing help, learning is looking to the models you encounter.

This understanding fuels the design of powerful learning environments. How to design an environment that triggers and supports learning processes, harvesting the learning opportunities that are created by cooperation and collaboration? This book presents a range of concepts and practices that may guide your thoughts and trigger new approaches. The learning philosophy in this book encourages us (students, lecturers, staff developers, managers) to rethink the way we organise learning. Importantly, this book stands out in providing a comprehensive account of what it takes. It deals with didactics, assignments, assessment, facilities, technology, management, …. To build success stories we need to align all those elements.

I want to touch upon two aspects, tackled in this book, that exhibit the profound perspective that is taken. First, in creating collaborative learning environments, we too easily assume that students are proficient in navigating this sometimes complex social situation. Or that they will learn it by doing. There is increasingly evidence that we cannot rely on that. We need to explicitly make time to develop these collaborative competencies and provide guidance through feedback and opportunities for reflection. This will only set an accelerator to collaborative learning, and help to grow the team-players that our programs increasingly set as an important goal. Second, the book does not forget the learning that needs to happen at the side of all those involved in organising. Think about lecturers, assistants, staff developers, program chairs and managers. In changing and continuously innovating their courses and programs, they all need to engage in a learning journey. And also this one is surely active and necessarily collaborative. This book supports this by providing a platform for a diverse group of lecturers and researchers, with both a sensitivity for disciplinary and cultural differences, giving insight into their practices and thinking. As such, it is valuable for all those who are curious, who are implementing, or who are looking to innovate their educational practices.

This book provides a range of ingredients and offers food for thought to a community developing these practices. I applaud the editors and all the contributors, and encourage the reader to find inspiration.

Prof. Dr. Piet Van den Bossche
Faculty of Social Sciences
University of Antwerp
Antwerp, Belgium

School of Business & Economics
Maastricht University
Maastricht, The Netherlands

Preface

Higher education is facing a paradigm shift from teaching to learning. This book will address the question of how lecturers, students and university administrators need to conceptualise and rethink the use of formal and informal learning spaces, learning technologies and activities to facilitate learning for students in the twenty first century. In other words, using active learning classrooms (ALCs) enhanced with technologies would not necessarily lead to a positive learning process. To achieve effective results in educational processes that include ALCs with technologies and learning activities, interaction among all elements (lecturers, students and university administrators) should be structured effectively and a structured mechanism should be implemented. Therefore, in this book hospitable learning space (HLS) is employed with the aim of developing an effective learning community to ensure and support student learning. In this context, HLS is able to offer the three elements mentioned in five dimensions in a learning space: institutional, physical, cultural, social and psychological. In relation to that, it is our belief that this book will serve the purpose of assisting lecturers in the transformation from direct teaching to facilitating learning.

To make the transition from teaching to learning, richer definitions of assessment and feedback are required. In this respect and in line with the paradigm shift, in this book assessment takes up a new role of supporting learning. Specifically, while students interact with the learning activities they are being assessed. Likewise, during the assessment process they learn through peer participation. As such this new role is known as assessment for learning. In what follows, feedback is not solely to correct mistakes and to provide correct answers. It is used to assist students to close the learning gaps identified from the learning evidence observed during the peer interactions. The power of peer learning and peer instruction as well as socio-constructivist feedback provided by the lecturers are all tailored to assist learning. Therefore, the new role of feedback is more appropriately known as feedforward or feedback for learning. According to these perspectives, assessment and feedback for learning have great potential to facilitate learning experiences, and that potential should be utilised within the context of HLS. Since assessment and feedback are already—and will continue to be—used in universities, lecturers should adopt their new roles into education with a pedagogical basis. This book will offer lecturers useful information regarding the use of assessment and feedback for learning.

It is noteworthy that the term active learning is confusing and it is loosely used by lectures to indicate anything that students perform to be active learning. To illustrate, students sharing ideas with friends, taking notes, answering questions in class, participating in forums and even listening to talk are all considered active learning. Literally, it is taken to include anything which is directly opposite of passive learning. In this book, active learning and for that matter collaborative active learning (CAL), involves self-reflection, social interaction and cognitive conflicts happening in HLS with technologies that serve an intentional functional means in student learning. Further, students are more inclined to accept CAL if they are equipped with the necessary collaborative skills and are better informed about the attributes, challenges, strengths and opportunities of CAL as well as possible resistance. It is for these reasons this book is written to avoid the negative teaching and learning experiences in CAL which may be the consequences of the failure to comprehend its true nature. Moreover, this book will provide insights and support lecturers in the design and implementation of CAL in both STEM and non-STEM disciplines.

The book is divided into three parts: Part I: Theoretical Perspectives of Collaborative Active Learning; Part II: Practical Activity-based Approaches in Different Disciplines; Part III: Conceptual Framework and Pedagogical Perspectives. The target audience of this book will be composed of professionals and researchers working in the field of higher education (e.g., university academic staff, educational designers, academic developers, teaching and learning centre staff, online teachers, department heads, faculty deans and university senior management staff). To this end, for readers who wish to jump straight into the design and implementation of the CAL strategies, they can refer to Part II and choose from a wide range of disciplines such as gender studies, finance, engineering, psychology, audit, information technology, statistics, education and medical sciences. Moreover, readers who want to be convinced that CAL works and it is substantiated by research findings and tested practical ideas, they are encouraged to read Part I. In this section, there are three chapters that provide conceptual understanding of CAL from the perspectives of the strategies, assessment and feedback. Additionally, it also touches on a systematic review of CAL for the past two decades and finally student collaboration through peer instruction. Lastly, to obtain a conceptual framework of the different disciplinary CAL approaches used in this book, readers can refer to Part III. Furthermore, in this section there is a chapter on the technologies and learning spaces for CAL.

Subang Jaya, Malaysia — Chan Chang-Tik
Clayton, Australia — Gillian Kidman
Kuala Lumpur, Malaysia — Meng Yew Tee

About This Book

Collaborative active learning (CAL) or, by and large, students' active engagement in learning appears to be a common practice in higher education. Numerous studies on CAL have increased in recent years, but focus primarily on the Western context. Very little attention is given to the CAL methodologies, issues and problems in the Asian environments. This edited book is rooted in the practical activity-based approaches carried out by lecturers from the STEM and non-STEM disciplines. The contributing authors shared their experiences and the students' reactions, the physical-virtual and formal-informal learning spaces together with technologies utilised in the approaches, as well as problems and issues in the methodologies. This book demonstrates how theories and research findings are applied in the CAL strategies, assessment and feedback, which would lead to more informed understanding of the practices. Accordingly, it would be beneficial to provide a conceptual framework of all those methodological approaches from the lecturers, thus providing us with more evidence-based and richer insights into the future application of the CAL strategies. Moreover, as a book to facilitate active learning among students and between the lecturers and students, it is crucial a chapter is dedicated to students in order to get them ready for CAL, which may allow them to understand and internalise the concepts of collaboration in active learning.

Contents

Notes on Contributors

Abaei Golnoush is a software engineer and experienced data scientist in solution innovation and designing models who is interested in dealing with real-world applications. She is a Lecturer at the School of Information Technology, Monash University Malaysia. Her Research consisted of experiences like machine learning, fuzzy logic, soft computing and Optimization. She mainly focuses on Software Testing (Software Fault Prediction, Test Case Prioritization, and Test AI Products), Correction of INS/GPS Navigation System. Through years of experience, she has developed excellent problem-solving skills along with good published papers.

Chakraborty Deya is a Teaching Associate and Casual Research Assistant at the Faculty of Education, Monash University, Australia. Her research interests include curriculum, pedagogy and assessment of science and STEM Education in primary and secondary years. She received her doctoral degree from Monash University in Science and Mathematics Education and is the recipient of the prestigious Postgraduate Publications Award (PPA) from the Faculty of Education. She has experience in working in Bangladeshi and Australian schools as teachers and administrators and volunteered with several non-profit organisations both in Bangladesh and Australia.

Chang-Tik Chan is a Senior Fellow, Higher Education Academy and an Adjunct Senior Lecturer at Monash University Malaysia. His research interests are in the areas of collaborative active learning focusing on feedback and assessment for learning, particularly in the formal and informal learning spaces. To this end, it includes the synergy between pedagogy, space and technology. He has more than 30 years of teaching experience from the secondary to the tertiary level. He has designed and conducted numerous online and face-to-face professional training programs for lecturers—a few were given recognition by the Human Resources Development Fund (HRDF)—a training centre established under the Ministry of Human Resources, Malaysia. He has more than five years of research experience and he has published a book chapter and many articles in peer-reviewed journals. He was shortlisted for the Bett Asia Award 2020, collaboration category.

Dharmaratne Anuja is a lecturer with extensive teaching and research experience and she is the Associate Head (Education) of the School of IT, Monash University Malaysia overseeing all the educational activities. She supervises research students working in the areas of Image Processing, Computer Vision, Game-based education and ICT for Health & Education. She is particularly interested in the topics that explore students' affect state analysis, correlation between students' emotions and prior knowledge, transformation of traditional classrooms to active learning sessions and medical image processing. She has produced several research publications in various peer-reviewed journals and conferences.

Ee Von Lau is a Senior Lecturer in Mechanical Engineering who is enthusiastic about innovations in teaching technologies to enhance students' engagement in higher institutions. She has been implementing and practising various active learning strategies in her teaching for the past 10 years which has been awarded several Education teachings grants and recognition awards from Monash University.

Fung Ting Fung is a lecturer at the School of Information Technology, Monash University Malaysia. Her recent research work has received the 2020 WSIS (World Summit of the Information Society) Prize in Switzerland as a champion project. One of the research studies that stands out is her publication in Expert Systems with Application, 'Convolutional Neural Network Improvement for Breast Cancer', where she conducted in-depth research on classification and segmentation of breast cancer lesions through deep learning. Her primary research interests are in deep learning, expert systems and biomedical engineering.

Goh Joseph N. is a Senior Lecturer in Gender Studies. He holds a Ph.D. in gender, sexuality and theology, and his research interests include queer and LGBTI studies, human rights and sexual health issues, diverse theological and religious studies and qualitative research.

Gopalai Alpha Agape is a firm believer of student-centred learning/teaching. His focus of university education has always been centred on the students' ability to absorb what is being taught and to apply what was learnt and to further develop this knowledge—to aspects of life with higher and increasing complexities.

Jambaya Raymond is an experienced Industrial Psychologist, VILT Trainer/Coach and Tech advocate and an HR practitioner and trainer in behaviour change programs through a mobile reinforcement app. His experience spans both public and private sector firms in Asia and Africa and currently he heads the design and implementation of training reinforcement platforms across various global firms. His research work specialises in technology driven Organisation Redesign, Knowledge and Change Management as well as Business Process Re-engineering.

John Shiney has been teaching mathematics and statistics to university students for the past 24 years. Her research interests are focused on the relationship between teaching and learning practices in higher education.

Kidman Gillian is an Associate Professor from Monash University, Australia. She is passionate about science and mathematics education. Her teaching and curriculum design in inquiry-based learning and teaching in the sciences is award winning. She has research interests in the integration of science and mathematics, especially the disciplinary and transdisciplinary thinking of STEM and STEAM. She is well respected throughout South East Asia, working extensively in STEM education with the South East Asian Ministries of Education, and the Regional Education Centre of Science and Mathematics (RECSAM) in Penang, Malaysia. She is a highly sought-after Keynote Speaker as she focuses her presentation to the local context. Gillian is the co-editor for the International Journal of Geographical and Environmental Education (IRGEE) and is a member of the IGU CGE Steering Committee. She has also researched topics in the Humanities, higher order thinking skills (HOTS), ICT, STEM, biotechnology education, Indigenous underachievement and teaching in and out-of-field. She is particularly interested in inquiry forms of teaching and learning and the potential inquiry has in terms of the integration of science and mathematics. She is currently working on the interpretation of 'inquiry' and STEM Makerspaces in terms of disciplinary thinking.

Nguyen Minh Nguyet completed a Ph.D. in the areas of academic mentoring policies. She has been teaching higher education subjects in teacher education and language teaching. Her research interests include active learning, curriculum development, sociolinguistics, critical discourse analysis and higher education policies. Her recent projects have focussed on supervising international doctoral students, mentoring early career academics, youth agency in public diplomacy, teaching scholars' development program and international education.

Ortega Adriana is an experienced Applied Psychologist, with wide-ranging work experience in areas related to student centre-education, adult learning, action research and coaching. Currently, she is working at the Department of Psychology at Monash University Malaysia and conducting research on organisational learning and performance.

Peranginangin Yessy is a Senior Lecturer in Finance at Monash University Malaysia with fifteen years of international teaching experience in Indonesia, Australia, Singapore and Malaysia. He was one of the recipients of the School of Business teaching awards (the Blue Letter) in 2020 and is passionate about implementing active learning techniques in the different areas of finance. He enjoys freshly brewed coffee.

Sagadavan Revathi is an experienced senior lecturer in the areas of mathematics and statistics. She graduated from University of Technology Malaysia with a Ph.D. in Mathematics. She supervised and co-supervised students in Ph.D., M.B.A. level and Professional M.B.A. for their research projects. She has experience in leading various employer projects from Malaysia. She has completed a research grant with the project in teaching and learning scope from INTI International University Malaysia. Her research interests include multivariate statistics, statistical process control, data analytics, business analytics and teaching and learning process.

Samuel Shyamala Dhoraisingam is a Fellow member of the Association of Chartered Association of Certified Accountants (ACCA) in UK and a Chartered Accountant with the Malaysian Institute of Accountants (MIA). She is also an associate member of the Institute of Internal Auditors (Malaysia). She holds a Ph.D. in management, and her research interests include capital market behaviour, sustainability, auditing and assurance; and corporate governance.

Selvaratnam Lakshmi has served as a clinical anatomist and medical educator for three decades, and is currently an Associate Professor of Anatomy at Monash University's Malaysia campus. As foundation Anatomy Coordinator for its new Medical School, she established a non-dissection, clinical anatomy curriculum and helped create the futuristic MAPEL E-Learning Lab; with multi-awarded, networked ecosystem of teacher and student collaborative Smart Tables and with a research focus on technology-enhanced practical learning. She has authored a popular anatomy text/workbook series and advocates educator development and postgraduate surgical training. She champions collaborative active learning supported by current technologies as the way forward in STEMM & healthcare education.

Sen Arkendu an anatomist/ophthalmologist by training, is an Associate Professor, JC School of Medicine, Monash Malaysia, a Foundation Fellow, Monash Education Academy and a Senior Fellow, Higher Education Academy (UK). Holding a Ph.D. in Technology Enhanced Learning (TEL), he has researched/designed cutting-edge TEL innovations, including the MAPEL lab. He has received research grants and numerous recognitions, including a Best Paper, Australian Government (OLT), Vice Chancellor's, Faculty Dean's Teaching Awards (twice) and the International RH Innovation in Medical Education Award (twice). He holds a joint patent and ITEX medal on Smart table Learning ecosystems and is now researching Augmented/Virtual reality education tools.

Subramaniam Ravichandran holds a professional accounting qualification, CPA (Aust.), including an M.B.A. in (Accountancy) and a Doctorate of Philosophy in Finance from University Malaya (UM). His research interest is widespread in the areas of Corporate Governance, Behavioural Finance, Corporate Social Reporting, Auditing, Financial Technology and Banking, with a particular focus on regulation & risk management.

Tee Meng Yew is a Senior Lecturer at the Faculty of Education, Universiti Malaya. His multidisciplinary academic and professional experience—in education, management, journalism, technology and psychology—cultivated his interest in researching construction of knowledge that cannot be learned merely through direct instruction. He also researches teachers' classroom practices, how people learn and construct knowledge, teaching and learning in collaborative settings as well as education systems. His research also extends into designing instruction and technology for the improvement of learning. His publications include *Education in Malaysia: Challenges and Developments* (2017, co-edited with Moses Samuel and Lorraine Symaco), published by Springer. He has published in the *International Journal of Computer-Supported Collaborative Learning* (ijCSCL), *Australasian Journal of Educational Technology*, *Journal of International and Comparative Education*, *Espacio, Tiempo y Educación*, *International Journal of Educational Development* and *The Journal of Asia TEFL.*

List of Figures

List of Tables

PART I

Theoretical Perspectives of Collaborative Active Learning

CHAPTER 1

Introduction: Collaborative Active Learning—Strategies, Assessment and Feedback

Chan Chang-Tik

Student engagement is the product of motivation and active learning. It is a product rather than a sum because it will not occur if either element is missing.

Elizabeth F. Barkley, 2009

Introduction

The last decade saw rising interest in the way universities employ active learning pedagogical strategies. It has been suggested that active learning promotes higher-level cognitive skills such as critical thinking (Wiggins et al., 2016) and enjoyment of or engagement in activities (Muehlenkamp et al., 2015). Additionally, pedagogies that focus on student learning

C. Chang-Tik (✉)
Monash University Malaysia, Subang Jaya, Malaysia
e-mail: chan.chang.tik@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_1

increase the level of collaboration with peers and connect students to an emerging global network (McLoughlin & Lee, 2008). If so, this opening chapter attempts to make a case for active learning as practised by lecturers in the classrooms or outside in the informal learning spaces. Specifically, given the popularity and numerous definitions of active learning in research and practice (Schneider & Preckel, 2017), it is important to critically check the attributes of active learning. To this end, this chapter provides an overview of the socio-constructivist framework for active learning that opens up group-based learning of which collaboration is the nexus.

There remains, however, a degree of uncertainty regarding how students collaborate in a group-based learning environment. Since collaboration is already—and will continue to be—an integral part of group-based learning, lecturers should consider integrating collaborative skills into the assessment component with a pedagogical basis. Further, collaboration plays an essential role in propagating higher levels of participation among group members since it encourages negotiation of shared meanings as well as enhancing elaboration through mutual explaining and reasoning (Hakkinen et al., 2004). Therefore, in this chapter and subsequently in the book, active learning is discussed in the context of a group of students who collaboratively engage in purposeful discussion and reflection in order to attain co-constructed mutual understanding. Henceforth, active learning is synonymous with collaborative active learning (CAL).

In what follows, this chapter provides a description of CAL attributes and strategies to gain more insights into the process of student learning thereby the focus has been consistently on the nature of assessment and feedback for learning. If so, according to Zimmerman (2013) self-assessment is an important element in two phases (i.e., performance and self-reflection) of the student self-regulated learning (SRL). To this end, Panadero and Alonso-Tapia (2013) concur that students need to monitor and evaluate their progress in order to regulate their work, therefore, self-assessment plays an integral part in SRL. In order to support self-assessment, students use rubrics to obtain information from dialogue, demonstration and observation in ways that enhance their assessment for learning practices. In relation to that, rubrics bring the transparency of the assessment criteria to the students, thus they are more likely to have positive perceptions of the assessment tasks leading to positive impact of their learning (Jonsson & Panadero, 2017). According to this perspective, self-assessment has great potential to facilitate learning experiences, and that potential should be utilised even though it is not a common practice, to form a staff-student partnership through the co-assessment initiative. According to Deeley and Brown (2014) this partnership may result in students becoming more active and self-regulated learners.

It is noteworthy that many universities are pushing ahead with online teaching and learning not because of COVID-19 but more so due to the course suitability of being developed into an online delivery mode and also there is a growing acceptance of this mode of teaching by the students and lecturers. Further, in line with the assessment for learning practices, students are placed in small groups or Zoom Breakout Rooms to collaborate and to peer instruct. For students who are too shy to talk they can use Wiki or Chat to provide peer feedback that can be either audio or video recorded so that students can revisit as many times as necessary because they perceive digital recordings as detailed, personalised and usable (Ryan et al., 2019). In what follows, given the plethora of technology available, lecturers have to acquire both technological and pedagogic knowledge so that they can pick the right technology to enrich student learning experience (Avidov-Ungar et al., 2018) and also be wary of the promises of potentiality that surround the technology. In this context, Dawson and Henderson (2017) conclude that technology interventions need to be guided by clear goals, need improvements in assessment and feedback designs, and need to address organisational matters.

In spite of all the strengths and opportunities of CAL, there remain challenges in terms of student resistance and to a certain extent, lecturer resistance too which are discussed in detail in Chapter 3 (Chang-Tik, this volume). Indeed, today's learning environment in general—CAL in particular—is facing many challenges like the physical layout of the classroom, class size, social web platforms and even the lecturer's authority. Therefore, this chapter begins with an examination of the attributes of CAL, followed by the strengths, opportunities and challenges of CAL. Subsequently, the author discusses the socio-constructivist theory and CAL strategies, assessment and feedback. Finally, the chapter concludes with the design and implementation of CAL lessons.

Attributes of Collaborative Active Learning (CAL)

The term active learning is used very loosely by lecturers who believed they practised it in the classroom. The following are verbatim of what lecturers think active learning entails:

- Active learning is a technique where students engage in some activities like writing, reading, discussion and problem solving.
- Active learning techniques being practised are demonstration, discussion, oral presentations, formative quizzes, problem-based learning and case-based learning.
- I apply a variety of active learning methods to enhance learning and teaching experiences. They are think-pair-share, muddies-point, fishbowl, role playing and student presentations.

According to Schneider and Preckel (2017), there are many definitions of active learning but they all agree on getting students to learn by doing something to manage and develop their learning (Fu et al., 2009) other than passively listening to recorded lectures, watching videos, readings, homework and even tests (Johnson & Aragon, 2003). The key words here are 'doing something' and based on the verbatim above, the students are doing something, but are they into active learning? It is important to take a look at especially theoretical counter-arguments against this definition of active learning. For instance, the theory behind active learning is socio-constructivism that posits people build knowledge by acting on the world around them and reflecting on their experiences (Wright et al., 2019). Additionally, Niemi and Nevgi (2014) state that in the context of active learning, constructivist, self-regulated and collaborative processes are crucial to support learning. Further, active learning requires a high degree of student engagement in the learning process and not just simply to read, listen to and review the didactic materials (Hamouda & Tarlochan, 2015). To illustrate, the construction of knowledge begins with self-reflection of the situations in order to mentally construct meaning based on their prior knowledge. This mental image is then presented to the peers for their feedback and comments. It is through the processes of arguments, challenges, elaboration and negotiation that they co-construct from the ones presented earlier. If they can agree on the shared co-constructed meaning, then it gets accommodated and changes their knowledge and understanding of the situations and information. Otherwise, the shared meaning is assimilated, that is, the new information is integrated into the prior knowledge but it does not contribute as new knowledge (Cress & Kimmerle, 2008). Therefore, back to the term of 'doing something' and the examples presented in the verbatim, it is reasonable to state that the lecturers are not practising active learning. This is because there is no evidence of collaborative activities being used to co-construct knowledge in the majority of the methods or techniques. In the similar vein, if self-reflection existed in the methods mentioned, then it could be very minimal.

Unfortunately, active learning methods that carry the same names are implemented in different ways by different lecturers and even researchers (Turpen & Finkelstein, 2009). They may differ on variables like size, individual accountability, degree of interdependence, and duration. Accepting this 'infidelity of implementation' problem, Chi (2009) highlighted the need to classify the active learning methods and Stains and Vickrey (2017) called for a standardised system to measure how faithfully the principles of active learning methods are followed. To this end, Chi (2009) classifies the methods as passive, active, constructive or interactive. Specifically, passive means students do nothing more than listen to a lecture without taking notes. However, once students start to take notes on lectures, then it is classified as active. In this regard, there are many methods in the verbatim that fall under these two classifications. Consequently, constructive and interactive methods are more in line with socio-constructivist theory. After all, the constructive method requires students to create new knowledge by building meaningful mental models based on their prior knowledge. They count on the shared mental models to share-regulate themselves to achieve group goals using common strategies to control challenges together (Hadwin et al., 2010). It follows that the interactive method needs two or more students to co-construct knowledge together. Given all the insights above, the distinction between active learning and 'actively learning' or what is known as active method under Chi's classification, is much clearer now.

Theoretically speaking, socio-constructivism that provides the framework for active learning opens up group-based learning of which collaboration is the nexus. According to Arvaja et al. (2007), collaboration is defined as a shared knowledge construction where participants build on others' ideas and thoughts and not just accumulate them Mercer (1996). The main activities of collaboration are negotiation of shared meanings, elaboration, mutual explaining, and reasoning. In this respect, Dillenbourg and Jermann (2006) design structures known as collaboration scripts (micro and macro) to facilitate and engage students' knowledge construction in interactive collaborative activities. The micro-scripts give students detailed guidance to achieve the collaborative activities outcomes, whereas the macro-scripts focus more on the general ideas of setting up environments conducive for collaboration. It is important to note that collaboration scripts are instructional sequences and they are not designed to interfere with interactions which are too complex to be regulated with predefined scripts (Stahl, 2006).

It is believed that challenges and even conflicts are unavoidable in human interactions and thus also in collaborative active learning (CAL). During collaboration, students negotiate for shared meanings through arguments, challenges, reasoning, debate and elaboration. These activities may lead to socio-cognitive conflicts which are advocated as essential for the cognitive growth of individuals (Buchs et al., 2004). In this regard, Van den Bossche et al. (2006) justify that it is the collaborative activities that students used to elaborate different viewpoints made visible through the conflicts that facilitate learning. However, the academic low achievers tend to avoid socio-cognitive conflicts in order to attain a cordial learning environment (Chang-Tik & Goh, 2020). In what follows, they argue less and agree more, they ask questions for clarifications and not elaborations and they seldom challenge one another. However, in most circumstances, when students are challenged out of their comfort zones, socio-cognitive conflicts are likely to give rise to socio-emotional conflicts (Naykki et al., 2014) and students have to learn how to regulate these conflicts. This is because these forms of conflict can be destructive for effective interaction and learning due to off-task disagreement within groups (Garcia-Prieto et al., 2003).

Furthermore, to develop richness of knowledge elaboration in groups, Curseu et al. (2017) provide empirical evidence that minority dissent and social acceptance are positively associated with group cognitive development. Specifically, it implies that minority dissent is the driving force for cognitive differentiation that stimulates divergent thoughts and triggers cognitive conflicts (Nemeth et al., 2001). Eventually, social acceptance establishes the links for knowledge integration in the group. Therefore, it is important to have an open and accepting group climate that allows for minority dissent.

In summary, the pertinent features of CAL are as follows:

- Self-reflection to mentally construct meaning based on prior knowledge
- Social interactions to construct shared meaning through collaborative activities
- Socio-cognitive conflicts, minority dissent and regulation of socio-emotional conflicts.

Collaborative Active Learning Challenges, Strengths and Opportunities

The perceived challenges to implement active learning in large classes are well-documented, they are among others, insufficient class time and strategy to effectively implement active learning (Miller & Metz, 2014). In addition, socio-emotional challenges can act as obstacles in different phases of collaboration (Jarvenoja & Jarvela, 2009). Generally, lecturers complain it takes more time to teach using active learning strategies than the traditional lecture style. This is because students are not used to group-based learning. As a result, even to get them into groups may take a while, let alone to participate in the learning activities. Consequently, lecturers are worried they may need more time to complete the course syllabus. Beebe and Masterson (2003) agree it takes longer to work in a group than to work alone, but the time spent usually results in better outcomes. If so, some creativity and innovations in the delivery may ameliorate the problem. First, reorganise the course learning outcomes as students can achieve some of them through carefully designed group-based graded assignments posted as post-class activities. Second, spend some time and effort to design pre-class activities that are captivating and engaging as well as dangle a carrot (marks) to catch students' attention. Once they come prepared for the in-class activities the lesson will progress smoothly and effectively. Of course, it implies that the pre-class and in-class activities have to complement each other and in coordination with the assessment components.

In terms of the implementation of CAL strategies in large classes, the author discusses the challenges in conjunction with the physical layout of the classroom. To this end, lecturers rightfully claim there are physical hindrances, like the room is too small to conduct group-based learning which is ubiquitous in CAL. According to Carvalho et al. (2021), the layout of the classroom, high number of students per class and lack of resources are the main barriers to the successful implementation of active learning strategies. Still though, what matters most here is student learning which can take place outside the classroom. Therefore, to mitigate the problem of classroom physical layout and size that may impede the implementation of CAL strategies, lecturers can conduct the lesson in the informal learning spaces for more than 150 students. According to Harrop and Turpin (2013), informal learning spaces are non-discipline specific and they are used for self-directed learning activities. Specifically, they are physical spaces like café, library collaboration spaces, concourses and any other conducive spaces spread across the campus. On top of that, lecturers can post the learning materials to the virtual spaces like Moodle and aided by other learning technologies like HTML5 Package (H5P), Video Essay, Google Doc. and live Google Chat. The catch here is in the design of the learning activities to support CAL, and the cognitive support for the academic low achievers, particularly in self-regulation and collaborative skills (Chang-Tik & Goh, 2020).

Furthermore, in small classes there are different types of challenges in executing active learning. For instance, the class size may drop to below 10 due to students dropping the class midway through the semester and other reasons, when it happens then it will be difficult for students to engage and interact in group-based collaborative activities. In addition to class size, there is another significant problem related to classroom dynamic. When the group is small, any issues positive and negative may get magnified turning them into incidents that may disturb the emotional climate in the classroom. For example, a few talkative students interfering with the flow of discussions, overzealous social interactions leading to emotional conflicts, and extremely shy students holding up their contributions to the group work. According to Naykki et al. (2014), a proper balance in the emotional expressions is required to sustain engagement in collaborative learning.

From the lecturer authority perspective, CAL which allows students space to reflect and challenge their peers' views including that of the lecturers' may lead to a negotiation of new roles for all members of the classroom community (Weimer, 2002). This new challenge in the lecturers' authority may result in them publicly acknowledging that learning is a joint constructive endeavour between students and the lecturers. To this end, Frykedal and Hammar Chiriac (2018) argue lecturers should refer students to their group for cognitive support, instead of coming to them directly and bypass the group. In consequence, students will be granted authority to collaborate and to take greater responsibility for the group collective work. In other words, the students' roles have changed where the onus of learning is now on them. To this end, the role shift for students may result in disdain for collaborative learning, particularly, when students still see lecturers and texts as the sole sources of authority and knowledge (MacGregor, 1991). Additionally, students' learning styles and personalities may affect their contributions to group work as some students prefer to work alone rather than in group. According to Nicol et al. (2018), students with different knowledge and learning style may engage with the material at a different pace and therefore, working in a group may not be conducive for them. Furthermore, evidence from cultural psychology has identified learning style (Joy & Kolb, 2009) and thinking style (Lun et al., 2010) as individual learning differences in terms of motivation and cognitive processes (Millar et al., 2013) as well as the ways in which individuals process information (Evans & Waring, 2009).

From students' learning perspective, collaborative active learning requires them to acquire collaborative skills, which incidentally are assumed even though they are not self-evident (Kirschner et al., 2006). According to Johnson and Johnson (2002, 2013), in order to maximise the collaborative potential of groups in accordance with the Social Interdependence Theory, there is a necessity for (a) positive interdependence, (b) individual accountability, (c) face-to-face promotive interaction, (d) interpersonal and small group skills, and (e) group processing. Lacking in any one of these elements may result in students failing to reap the benefits of collaborative learning. They do not build on each other's views, but they accumulate them. In other words, they tend to cooperate rather than collaborate. According to Hammar Chiriac (2014), they work *in a group* and not *as a group*. Even though lecturers develop active learning strategies to promote students' interaction and engagement, if they are not taught how to carry out collaborative activities and to accept that conflicts (cognitive and emotional) are inevitable in collaboration, they will continue to work *in a group*.

In order to achieve a more balanced view of the challenges students face in CAL, it is noteworthy to consider collaboration in the social web platforms (e.g., Blogs, Wikis, forums, virtual communities and social networks). Nevertheless, in an online environment according to ChanLin (2012), students have to spend more time and effort helping the learning community and to self-manage the learning activities. In addition, there is a lack of personal contact and interaction among classmates and the lecturer (Nam, 2014). To add to the problems, students may perceive an asymmetric collaboration in the online environment, leading to frustration and lower levels of engagement and performance (Capdeferro & Romero, 2012). Given all the insights above, it is reasonable to state that lecturers have a key role to play in the online environment. They can use the social web tools to facilitate interactions with the students, to provide technical support and pedagogical guidance (Lee et al., 2011) and to help group members work in harmony, have fun as they learn and to avoid internal tensions (Molinillo et al., 2018).

In terms of the strengths and opportunities of CAL, the results are mixed. On one hand, active learning can improve students' performance in every subject and at every academic level from grade school to graduate school, and it has special benefits for the academically weak students (Haak et al., 2011). On the other hand, there are concerns about extra time involved in learning new strategies and redesigning courses, student resistance, violating departmental norms and the strategies may not work as advertised (Kober, 2015). Nevertheless, four meta-analyses of hundreds of studies point towards significant increases in the average grades of STEM students who participated in any kind of active learning (Freeman et al., 2014). Other studies indicate that active learning is beneficial for students with high cognitive ability, better preparation and good prior knowledge (Thomas & Philpot, 2012), including no overall gender differences (Haak et al., 2011). In conclusion the strengths of CAL approaches in small classes include among others, greater use of active learning strategies, more oral feedback, more prompt responses to students' written work, and inclusive teaching to be attuned to student diversity (Wright et al., 2019).

Socio-constructivist Theory and Collaborative Active Learning (CAL) Strategies

The theory behind active learning is based on the socio-constructivism that posits students construct meaning by acting and reflecting on the learning activities. Subsequently through social interaction, they co-construct meaning by analysing, synthesising and evaluating collaboratively. This interaction results in deep learning, deep understanding, and eventually conceptual change (Bereiter, 2002). Furthermore, social interaction is the key factor that influences CAL. Within the context of interactions, it is important to consider the effect of social presence (Fu et al., 2009) in the Community of Inquiry (CoI) framework developed by Garrison et al. (2000). To illustrate, the first component of social presence is open communication. In a group where students do not know one another, the element of trust may be missing, which consequently may impede open communication. Therefore, one possible way out of this predicament is to allow students to choose their group members. Alternatively, lecturers can assist, if it is not already initiated by the students, by introducing popular social media like Facebook, YouTube, Instagram, Messenger, WhatsApp, WeChat, and Discord, to the students. The main purpose is to promote social interaction, getting to know one another and to build friendship.

The second component of social presence is group cohesion. In this regard, the task-related and team-related models may hold the key to support and coordinate group-based activities. Specifically, the task-related model comprises information on materials and strategies required to successfully complete the task (Fransen et al., 2011). Meanwhile, the team-related model focuses on the team functioning as a whole and the expected behaviours of individual members. To this end, in terms of group cohesion and social interaction, students share their responses to the activities in Padlet, Google Jamboard or other collaborative devices. This is because the social constructivist theory states that learning is a social phenomenon that requires sharing with and teaching to others (Powell & Kalina, 2009). It may be worthwhile to note that socially oriented anxiety may negatively affect students' engagement with the active learning environment due to their weak sense of self-efficacy (Hood et al., 2021). Therefore, there is a need to have a hospitable learning space which is a psychological safe space for lecturers to challenge and support students in their learning and also for students to feel curious and inquire without the risk of being judged (Kolb & Kolb, 2017).

Consequently, it is appropriate to discuss two promising CAL strategies that are suitable for a majority of disciplines presented in this book. The first strategy is known as the Team-based Learning (TBL) which is a defined interactive instructional method by Sweet and Michaelsen (2012). The procedures begin with the students completing a brief quiz known as an Individual Readiness Assurance Test (iRAT). Based on the outcomes of iRAT, students are placed in teams of five to seven students. Subsequently, in a team, they negotiate to reach a group consensus before answering the same quiz questions again (Team Readiness Assurance Test, tRAT). Upon completion of tRAT, the students receive immediate feedback to which they can make an evidence-based appeal to the lecturers if they think they have a case to defend for responses the lecturer considers inadequate. Following the readiness assurance process, students move on to the concept application stage where they are provided opportunities to apply the knowledge and to address significant real-world problems.

In the next CAL strategy, collaborative learning is shifted to outside the classroom, that is, to the informal physical and virtual learning spaces. After all, according to Roberts and Weaver (2006, p. 97) learning is "leaving the classroom". To illustrate in a study conducted by Chang-Tik and Goh (2020), students interact with the learning activities in spaces such as the 'Lepak' Café, Library Collaboration Space, the Hive, and the Idea Link. The activities are also posted to Moodle and aided by other learning technologies like HTML5 Package (H5P), Video Essay, Google Doc. and live Google Chat. This CAL strategy is known as the Collaborative Learning in Informal Spaces (CLIS), (Goh, Chapter 5 this volume) and it is suitable for a large cohort of students (more than 150 students). There are three phases, namely pre-CLIS, CLIS session and CLIS presentation. This strategy runs in a cycle of two weeks, that is, one week each for the pre-CLIS and CLIS session (in informal spaces) and another one for the presentation (in a tutorial room). It is recommended to implement it for at least two cycles.

In the pre-CLIS session, students interact with the learning activities individually outside the classroom. Based on the research findings (Chang-Tik & Goh, 2020), the academic low achievers need extra assistance from the lecturer (live chat on specific days and times) and they should work in groups rather than individually so that they can mutually corroborate one another's understanding. During the CLIS session, students gather in the predetermined informal learning spaces to collaborate on their pre-CLIS responses. Consequently, they are provided with collaborative macro-scripts to set up conditions to negotiate a co-construction of knowledge. Specifically, they should feel free to speak up, have opportunities to openly discuss and challenge, lack fear of making mistakes, and do not take offense when challenged. After all, according to Hailikari et al. (2021) lack of challenge may result in students adopting an unreflective approach to learning and they added that constructively aligned teaching has the potential to support and encourage these students to take an active role and to challenge themselves to reach higher levels of understanding. Most importantly, students should accept that conflicts are ingrained in CAL, they have to embrace cognitive conflicts and regulate emotional conflicts. Finally, at CLIS presentation a maximum of five groups of students (six students per group) gathers in a tutorial room at one time to share their group findings derived from the CLIS session. Each group is allocated five minutes to present and after that, it is opened for intergroup debates and deliberations. The lecturer will step in to sum up and conclude the discussions.

Collaborative Active Learning Assessment and Feedback

Traditionally, assessment is used primarily to evaluate the effectiveness of teaching with heavy emphasis on grades and to a lesser extent on student learning. However, in the context of CAL, the focus is shifted to how to use assessment to provide evidence for use by students and lecturers to improve learning, particularly, to identify the learning gaps and how to narrow them. To achieve this new focus on assessment, lecturers have to learn how to guide the learning towards the intended goals using activities that also function as forms of assessment (William, 2011). In other words, while students attempt the activities, they are being assessed and the assessment itself is part of learning. Specifically, this form of active learning assessment is known as assessment for learning, which according to Klenowski (2009), is part of everyday practice by students and lecturers to enhance ongoing learning process through information obtained from dialogue, demonstration and observation. If so, then it is theoretically plausible to embed in the assessment processes co-assessment of students' oral presentations, where each student self-assesses his/her own presentation before agreeing on a final grade with the lecturers after critical discussion (Deeley, 2014). In order to assist them in self-assessment, Echo360 or Panopto is used to record the oral presentations. According to Murphy and Barry (2016) the recordings are helpful for students' self-assessment and conducive for co-assessment with the lecturers.

Using assessment for learning alone as a means of teaching would not necessarily lead to a positive result in the learning process. To achieve effective results in the CAL environment, there is a need to utilise feedback as a process to acquire evidence to close the learning gaps rather than as a tool to point out mistakes and to provide correct answers. But research has shown that students do not always use feedback to impact subsequent work (Sadler, 2010), some may not retrieve written feedback at all (Sinclair & Cleland, 2007) while others focus solely on the grades (Weaver, 2006). To this end, Crooks (2011) recommends allowing students another chance to resubmit their work if it does not meet the desired standard initially. In doing so, students are likely to act on the feedback provided in order to improve. In the context of assessment for learning, it is a positive move as it enables students to reflect upon and act on the feedback and thus enhances learning. In terms of technology, lecturers can use Camtasia, a software for audio–video screen casting to provide socio-constructivist feedback on students' written group-based assignments. Consequently, they are given some time to collectively act on the feedback and resubmit their work indicating how they use the feedback for improvements.

Accepting the collaborative active learning perspective, it is reasonable to introduce socio-constructivist feedback in the group-based CAL environment. This variant of feedback is independent of academic disciplines and the lecturers' choice of feedback model depends on the instructional approach used. Lecturers who favour a student-centred approach tend to pick socio-constructivist feedback instead of cognitivist feedback. To achieve student learning, lecturers provide constructive epistemic and suggestive feedback (Alvarez et al., 2011) to a small group of five students to act as a stimulus for them to collaborate and collectively construct a shared understanding. Specifically, this model of feedback known as feedback for learning is more sustainable than the one that requires lecturers to continually generate information to meet the learning needs of the students. According to Boud and Molloy (2013), the focus of the sustainable feedback, which is very much in line with the CAL milieu, is on the design of learning environments to sustain interactions with and between students and lecturers through a sequence of tasks developed over time. Further, constructive feedback plays an essential role in enhancing student self-efficacy which helps to reduce social anxiety in group interactions (Hood et al., 2021). Additionally, according to Yildiz Durak (2022), group studies and group dynamics may contribute positively to the development of academic self-efficacy during learning activities with the support of group members. In conclusion, lecturers have to provide opportunities for them to engage in dialogue about monitoring their own work, plan their own learning (Carless et al., 2011) as well as negotiate and mutually explain task-related information by building on one another ideas and formative feedback.

Collaborative Active Learning (CAL) Lesson—Design and Implementation

The purpose of this section is to provide general guidelines on the design and implementation of a collaborative active learning (CAL) lesson. The author hopes to provide the readers a sense of theoretical and empirical assertions (as discussed in the earlier sections) supporting these guidelines from two perspectives. The first perspective addresses the preparation procedures that include the design of learning activities, feedback and assessment. The second perspective deals with the implementation procedures touching on the facilitation, and student cognitive and social interactions.

CAL Preparation Procedures: Design of Learning Activities

- Apply the Explanation strategies (DeMonbrun et al., 2017) to explain the purpose, the course/unit expectations, and the activity expectations. Lecturers can either explain the purpose and expectations directly to the students or engage them in reflection and discussion in order to discover for themselves. According to Tharayil et al. (2018), this strategy resulted in greater participation, less distraction and more positive course evaluation.
- Make sure the activities are interdependent to encourage engagement among students either in the online or offline mode. If it is a blended learning strategy, then ensure these two modes of activities are blended and not run concurrently. Specifically, provide students with detailed collaboration micro-scripts to guide them through the activities by asking thought-provoking questions or constructing arguments to achieve the expected learning outcomes (Hamalainen & Hakkinen, 2010).
- Apply the collaboration macro-scripts to set up conditions in which collaborative activities such as mutual explanation, elaborative questioning, and analytic reasoning can occur either online or offline. The focus of the macro-scripts is on the interaction process that relates to the mutual engagement and shared knowledge construction (Lipponen, 2001). To this end, it is crucial to note that the scripts are instructional sequences and they do not interfere with detailed interactions, which are too complex and unpredictable to be regulated by a predetermined script (Stahl, 2006).

- Outline any problems you face in the preparation stage so that it can be recorded for analysis and improvements. To illustrate, discuss in detail
  - The nature of the problems (time constraint, strict curriculum requirements, physical and virtual layouts, etc.).
  - The cause of the problems (lack of skills and training, support from the management, recognition of effort and work done, etc.).
  - All other related issues.

CAL Preparation Procedures: Student Feedback

- In the process of designing learning activities, bear in mind that feedback is also a form of activity that supports collaborative active learning. In this context, the nature of feedback is not to correct mistakes, but to induce social interactions resulting in shared construction of knowledge. The main purpose of feedback is to stimulate students' self-regulation as a means to increase their capability in making judgments and acting upon them. Therefore, at this preparation stage, it is pertinent to decide how to provide feedback to students in group-based activities. According to Wiltbank et al. (2019), students deemed feedback as 'helpful' on three conditions, (1) when they get alerted to their perceived knowledge gap, (2) when they are assured of their existing state of knowledge and (3) when they acquire new information.
- It is noteworthy that peer formative feedback can be beneficial to students as it requires them to actively consider the assessment criteria (Huisman et al., 2019). In addition, peers may introduce students to ideas and arguments from different perspectives and expose them to an array of alternative approaches (McConlogue, 2015). This form of feedback is particularly useful for a large cohort of students as peer feedback can be available in greater volume and with greater immediacy compared to lecturer feedback (Cho & MacArthur, 2010). However, students need training on how to provide effective peer formative feedback (refer to Chang-Tik, Chapter 3 this volume for details). Hence, it is advisable to seriously consider how to incorporate peer formative feedback in the course design.

- Consequently, in online settings the effectiveness in formative processes requires feedback to take the form of constructive dialogue (Gikandi & Morrow, 2016). In other words, it implies that students have to construct their own meaning from the feedback received. In this context, students are expected to play an active role in their learning, to self-regulate and to take responsibility for their learning. On the other hand, lecturers can guide them on how to engage constructively, and reinforce peer formative feedback to stimulate their thinking and foster uptake of peer feedback (Gikandi & Morrow, 2016). Consequently, in an online environment, lecturers have to exchange ideas with students in order to get the feedback message across. Additionally, they can weave the online discussion threads in ways that enriched the discourse with feedback in the forms of ideas, examples and summaries.

CAL Preparation Procedures: Student Assessment

- In the context of CAL, assessment and learning are blended, that is, students are assessed while they learn and the assessment components can also function as learning activities. Therefore, it is practically plausible to expect assignments designed as learning activities. In doing so, there is an added advantage of encouraging students to attempt the activities as marks are awarded for the assignments. In what follows, it is important to tie these activities with socio-constructivist feedback to enhance ongoing learning. According to Swaffield (2011), lecturers developing assessment for learning should carefully interpret students' responses and misconceptions, frame questions to support learning and decide how best to help students move their learning forward.
- It is evident that self-assessment is a key component of student self-regulation, which in turn is an essential element of CAL. Self-assessment refers to students making judgments about their work in relation to established standards to determine their stance (Boud, 1986). Lecturers can assist students learn self-assessment through models of exemplary performance, reflection, feedback from others and self-questioning. Therefore, it is reasonable to develop students' self-assessment skills that serve as a link between lecturer feedback and students' actions to improve their work.

- The concept of assessment for learning can be extended to the online environments. Specifically, lecturers can utilise the online quiz as a learning platform by setting higher-order questions that reflect future lessons. The focus here is to draw students into mutual explanations, arguments, elaborations and negotiation for shared responses to the questions. In other words, students are engaged in knowledge construction activities that are deliberately designed to facilitate collaborative social interactions.

CAL Implementation Procedures: Facilitation

- Apply the Facilitation strategies (DeMonbrun et al., 2017) to promote engagement and to keep the activities running smoothly in a face-to-face classroom. These strategies include:
  - Walk around the room—walk and stop to check on students' work, to ask them questions, and to help them get back on the right track and on task.
  - Approach non-participants—to understand why students are not participating and offer assistance for them to move forward.
  - Assume an encouraging demeanour—develop a classroom climate that makes students feel at ease and comfortable to ask questions and to make them understand that assistance is available if they ask.
  - Invite questions—strongly encourage students to ask questions even when the questions may seem bizarre. Lecturers have to create this 'safe' environment so that students know they will not be laughed at.
- Effective online facilitation starts with the design of a course that engages students with authentic learning activities (assessment and feedback are activities too) and with relevant tasks based on measurable learning outcomes. Importantly, do not simply convert a teacher-centred course and deliver it online using video recordings of lectures, online readings and quizzes. According to Merrill (2003), online facilitation includes the following strategies:
  - Online cognitive interactions
    - Always maintain a student-centred approach and post relevant guiding questions

    - Engage students in their learning and support them with constructive feedback
  - Online social interactions
    - Create a safe learning environment that supports interactive group discussion and collaboration
    - Empower students by encouraging peer and self-learning
  - Course management
    - Share with students the entire course organisation and point to them appropriate resources
    - Develop clear assignment guidelines and assessment rubrics
    - Pace learning and assessment tasks appropriately to avoid overload
  - Technical issues
    - Provide assistance to students on technical issues related to tools and features of the LMS
    - Interact with students using a variety of communication techniques and media (text, graphics, video and audio).

It is important to take a look at peer facilitation in online forum discussions, which according to Szabo (2015), positively improves student forum participation. However, to increase the quality of discussion, lecturers have to monitor the initial discussion prompts. In what follows, students need training to equip them with skills and knowledge to conduct peer facilitation.

CAL Implementation Procedures: Students' Cognitive Interactions

From the lecturer's perspectives based on observations and from the students' perspectives based on focus group interviews and questionnaire, describe the following:

- restriction to speak freely
- opportunities to discuss openly
- take offence when challenged
- negotiate of shared meanings
- mutual explaining and reasoning
- agree more than argue in discussion
- ask questions for clarifications rather than elaborations.

CAL Implementation Procedures: Students' Social Interactions

From the lecturer's perspectives based on observations and from the students' perspectives based on focus group interviews and questionnaire, describe the following:

- climate for collaborative learning
- dominance or intimidation
- outperforming each other
- ability to regulate emotion
- personality clashes and frustration
- overly polite and not willing to challenge misconceptions
- certain degree of trust (group formation)
- distribution of group tasks
- norms and guidelines to engage socially and emotionally.

Conclusion

In this book, the term collaborative active learning (CAL), which is based on the socio-constructivist theory, is taken to begin with students' self-reflection in order to mentally construct meaning based on their prior knowledge. Subsequently, through social interactions they co-construct shared meaning. These collaborative interactions together with minority dissent constitute socio-cognitive conflicts, which are encouraged as they support learning. However, there is a need to regulate socio-emotional conflicts that inadvertently may happen. Further, student self-regulation plays an essential role in the active and collaborative group-based participation because it encourages group peer learning. Even so, the less effective learning group students tend to cooperate in search of answers rather than collaborate to co-construct knowledge (Chang-Tik & Dhaliwal, 2022).

There are many challenges impeding the implementation of CAL ranging from the physical layouts of the classroom to social interaction among students where the effect of social presence is paramount. Nevertheless, these impediments create opportunities for educational innovations that move both the students and lecturers away from their comfort zones in search for effective learning and teaching strategies aided by technologies. In other words, the new paradigm for undergraduate education is to move from teaching to learning. Therefore, the focus is not instruction but rather that of producing learning by whatever means work best (Hunt et al., 2012). In a similar vein, McLoughlin and Lee (2008) spell out the principles of pedagogy 2.0 that integrates Web 2.0 tools to support peer-to-peer networking, sharing of knowledge, and greater learning autonomy through the socio-constructivist approaches.

In the context of CAL, it is reasonable to accept assessment and feedback as learning activities. Specifically, while students are interacting with the activities they can be assessed and lecturers can easily convert assignments into learning activities. At the same time, during collaborative interactions, socio-constructivist feedback is the key to enhance learning and it is an important learning activity that should not be overlooked. Similarly, lecturers can use educational technologies to assist them in providing constructive feedback and the students can use them to enhance peer and self-assessment.

Further, to facilitate readers in the design and implementation of the collaborative active learning lesson, the author provides general guidelines that discuss the design of learning activities, student assessment and feedback, the online and offline facilitation as well as the student cognitive and social interactions. They serve the purpose of realising personally meaningful and educationally worthwhile teaching and learning endeavours.

References

Alvarez, I., Espasa, A., & Guasch, T. (2011). The value of feedback in improving collaborative writing assignments in an online learning environment. *Studies in Higher Education, 37*(4), 387–400. https://doi.org/10.1080/03075079.2010.510182

Arvaja, M., Salovaara, H., Häkkinen, P., & Järvelä, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning and Instruction, 17*(4), 448–459. https://doi.org/10.1016/j.learninstruc.2007.04.003

Avidov-Ungar, C., Leshem, B., Margaliot, A., & Grobgeld, E. (2018). Faculty use of the active learning classroom: Barrier and facilities. *Journal of Information Technology Education: Research, 17*, 495–504. https://doi.org/10.28945/4142

Beebe, S. A., & Masterson, J. T. (2003). *Communicating in small groups*. Pearson Education Inc.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Lawrence Erlbaum Associates.

Boud, D. (1986). *Implementing student self-assessment*. Higher Education Research and Development Society of Australia (HERDSA) Green Guide No. 5.

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education, 38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Buchs, C., Butera, F., Mugny, G., & Darnon, C. (2004). Conflict elaboration and cognitive outcomes. *Theory into Practice, 43*(1), 23–30. https://doi.org/10.1207/s15430421tip4301_4

Capdeferro, N., & Romero, M. (2012). Are online learners frustrated with collaborative learning experiences? *The International Review of Research in Open and Distributed Learning, 13*(2), 26–44. https://doi.org/10.19173/irrodl.v13i2.1127

Carless, D., Salter, D., Yang, M., & Lam, J. (2011). Developing sustainable feedback practices. *Studies in Higher Education, 36*(5), 395–407. https://doi.org/10.1080/03075071003642449

Carvalho, A., Teixeira, S. J., Olim, L., de Campanella, S., & Costa, T. (2021). Pedagogical innovation in higher education and active learning methodologies—A case study. *Education + Training, 63*(2), 195–213. https://doi.org/10.1108/ET-05-2020-0141

Chang-Tik, C., & Dhaliwal, J. (2022). Collaborative learning approach to teach computer coding in informal spaces. *Learning: Research and Practice*, *8*(1), 5–24. https://doi.org/10.1080/23735082.2021.1953571

Chang-Tik, C., & Goh, J. N. (2020). Social and cognitive dimensions of collaboration in informal learning spaces (CLIS): Malaysian social science students' perspectives. *Interactive Learning Environments*. Advance online publication. https://doi.org/10.1080/10494820.2020.1799029

ChanLin, L. J. (2012). Learning strategies in web-supported collaborative project. *Innovations in Education & Teaching International, 49*(3), 319–331. https://doi.org/10.1080/14703297.2012.703016

Chi, M. T. H. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science, 1*(2009), 73–105. https://doi.org/10.1111/j.1756-8765.2008.01005.x

Cho, K., & MacArthur, C. (2010). Student revision with peer and expert reviewing. *Learning and Instruction*, *20*(4), 328–338. https://doi.org/10.1016/j.learninstruc.2009.08.006

Cress, U., & Kimmerle, J. (2008). A systemic and cognitive view on collaborative knowledge building with wikis. *Computer-Supported Collaborative Learning, 3*(2), 105–122. https://doi.org/10.1007/s11412-007-9035-z

Crooks, T. (2011). Assessment for learning in the accountability era: New Zealand. *Studies in Educational Evaluation, 37*(1), 71–77. https://doi.org/10.1016/j.stueduc.2011.03.002

Curseu, P. L., Schruijer, S. G. L., & Fodor, O. C. (2017). Minority dissent and social acceptance in collaborative learning groups. *Frontiers in Psychology, 8*(458), 1–9. https://doi.org/10.3389/fpsyg.2017.00458

Dawson, P., & Henderson, M. (2017). How does technology enable scaling up assessment for learning? In D. Carless, S. M. Bridges, C. K. Y. Chan, & R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 193–207). Springer Nature.

Deeley, S. J. (2014). Summative co-assessment: A deep learning approach to enhancing employability skills and attributes. *Active Learning in Higher Education, 15*(1), 39–51. https://doi.org/10.1177/1469787413514649

Deeley, S. J., & Brown, R. A. (2014). Learning through partnership in assessment. *Teaching and Learning Together in Higher Education, 1*(13). https://repository.brynmawr.edu/cgi/viewcontent.cgi?article=1107&context=tlthe

DeMonbrun, R. M., Borrego, M., Finelli, C. J., Prince, M., Henderson, C., & Waters, C. (2017, April). Creating an instrument to measure student response to instructional practices. *Journal of Engineering Education, 106*(2), 273–298. https://doi.org/10.1002/jee.20162

Dillenbourg, P., & Jermann, P. (2006). Designing integrative scripts. In F. Fischer, H. Mandl, J. Haake, & I. Kollar (Eds.), *Scripting computer supported collaborative learning: Cognitive, computational and educational perspectives* (pp. 275–301). Springer.

Evans, C., & Waring, M. (2009). The place of cognitive style in pedagogy: Realising potential in practice. In L. F. Zhang & R. J. Sternberg (Eds.), *Perspectives on intellectual styles* (pp. 169–208). Springer.

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(2011), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Frykedal, K. F., & Hammar Chiriac, E. (2018). Student collaboration in group work: Inclusion as participation. *International Journal of Disability, Development and Education*, *65*(2), 183–198. https://doi.org/10.1080/1034912X.2017.1363381

Fu, F.-L., Wu, Y.-L., & Ho, H.-C. (2009). An investigation of coopetitive pedagogic design for knowledge creation in web-based learning. *Computers & Education, 53*(3), 550–562. https://doi.org/10.1016/j.compedu.2009.01.004

Garcia-Prieto, P., Bellard, E., & Schneider, S. C. (2003). Experiencing diversity, conflict, and emotions in teams. *Applied Psychology: An International Review, 52*(3), 413–440. https://doi.org/10.1111/1464-0597.00142

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*, 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gikandi, J. W., & Morrow, D. (2016). Designing and implementing peer formative feedback within online learning environments. *Technology, Pedagogy and Education, 25*(2), 153–170. https://doi.org/10.1080/1475939X.2015.1058853

Haak, D. C., HilleRisLambers, J., Pitre, E., & Freeman, S. (2011). Increased structure and active learning reduces the achievement gap in introductory biology. *Science, 332*(6034), 1213–1216. https://doi.org/10.1126/science.1204820

Hadwin, A. F., Oshige, M., Gress, C. L. Z., & Winne, P. H. (2010). Innovative ways for using *gStudy* to orchestrate and research social aspects of self-regulated learning. *Computer in Human Behavior, 26*(5), 794–805. https://doi.org/10.1016/j.chb.2007.06.007

Hailikari, T., Virtanen, V., Vesalainen, M., & Postareff, L. (2021). Student perspectives on how different elements of constructive alignment support active learning. *Active Learning in Higher Education* (online). https://doi.org/10.1177/1469787421989160

Hakkinen, P., Arvaja, M., & Makitalo, K. (2004). Prerequisites for CSCL: Research approaches, methodological challenges and pedagogical development. In K. Littleton, D. Faulkner, & D. Miell (Eds.), *Learning to collaborate and collaborating to learn* (pp. 161–175). Nova Science Publishers.

Hamalainen, R., & Hakkinen, P. (2010). Teacher's instructional planning for computer-supported collaborative learning: Macro-scripts as a pedagogical method to facilitate collaborative learning. *Teaching and Teacher Education, 26*(4), 871–877. https://doi.org/10.1016/j.tate.2009.10.025

Hammar Chiriac, E. (2014). Group work as an incentive for learning – Students' experiences of group work. *Frontiers in Psychology*, *5*, 558. https://doi.org/10.3389/fpsyg.2014.00558

Hamouda, A. M. S., & Tarlochan, F. (2015). Engaging engineering students in active learning and critical thinking through class debates. *Procedia—Social and Behavioral Sciences, 191*, 990–995. https://doi.org/10.1016/j.sbspro.2015.04.379

Harrop, D., & Turpin, B. (2013). A study exploring learners' informal learning space behaviors, attitudes and preferences. *New Review of Academic Librarianship, 19*(1), 58–77. https://doi.org/10.1080/13614533.2013.740961

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., Gerrits, R., Lawford, H., Ott, B., Ross, K., Paige, O., Stowe, S., Jensen, M., & Hull, K. (2021). "I like and prefer to work alone": Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), ar12. https://doi.org/10.1187/cbe.19-12-0271

Huisman, B., Saab, N., Van den Broek, P., & Van Driel, J. (2019). The impact of formative peer feedback on higher education students' academic writing: A meta-analysis. *Assessment & Evaluation in Higher Education, 44*(6), 863–880. https://doi.org/10.1080/02602938.2018.1545896

Hunt, L., Huijser, H., & Sankey, M. (2012). Learning spaces for the digital age: Blending space with pedagogy. In M. Keppell, K. Souter, & M. Riddle (Eds.), *Physical and virtual learning spaces in higher education: Concepts for the modern learning environment* (pp. 182–197). IGI Global.

Jarvenoja, H., & Jarvela, S. (2009). Emotion control in collaborative learning situations: Do students regulate emotions evoked by social challenges? *British Journal of Educational Psychology, 79*(3), 463–481. https://doi.org/10.1348/000709909X402811

Johnson, S. D., & Aragon, S. R. (2003, Winter). An instructional strategy framework for online learning environments. *New Directions for Adult and Continuing Education, 2003*(100), 31–43. https://doi.org/10.1002/ace.117

Johnson, D. W., & Johnson, R. T. (2002). Learning together and alone: Overview and meta-analysis. *Asia Pacific Journal of Education, 22*(1), 995–1005. https://doi.org/10.1080/0218879020220110

Johnson, D. W., & Johnson, F. P. (2013). *Joining together: Group theory and group skills* (11th ed.). Allyn and Bacon.

Jonsson, A., & Panadero, E. (2017). The use and design of rubrics to support assessment for learning. In D. Carless, S. M. Bridges, C. K. Y. Chan, & R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 99–111). Springer Nature.

Joy, S., & Kolb, D. A. (2009). Are there cultural differences in learning style? *International Journal of Intercultural Relations, 33*(1), 69–85. https://doi.org/10.1016/j.ijintrel.2008.11.002

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75–86. https://doi.org/10.1207/s15326985ep4102_1

Klenowski, V. (2009). Editorial: Assessment for learning revisited: An Asia-Pacific perspective. *Assessment in Education: Principles, Policy, and Practice, 16*(3), 263–268. https://doi.org/10.1080/09695940903319646

Kober, N. (2015). *Reaching students: What research says about effective instruction in undergraduate science and engineering*. National Academies Press.
Kolb, A. Y., & Kolb, D. A. (2017). *The experiential educator: Principles and practices of experiential learning*. Experience Based Learning Systems.
Lee, S. J., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011). Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *Internet and Higher Education, 14*(3), 158–163. https://doi.org/10.1016/j.iheduc.2011.04.001
Lipponen, L. (2001). *Computer-supported collaborative learning: from promises to reality*. Unpublished doctoral dissertation, University of Turku.
Lun, V.M.-C., Fischer, R., & Ward, C. (2010). Exploring cultural differences in critical thinking: Is it about my thinking style or the language I speak? *Learning and Individual Difference, 20*(6), 604–616. https://doi.org/10.1016/j.lindif.2010.07.001
MacGregor, J. (1991). *Collaborative learning: Reframing the classroom. Essays on teaching excellence.* A publication of The Professional and Organizational Development Network in Higher Education (Pod Network). https://podnetwork.org/content/uploads/V2-N3-MacGregor.pdf
McConlogue, T. (2015). Making judgements: Investigating the process of composing and re ceiving peer feedback. *Studies in Higher Education, 40*(9), 1495–1506. https://doi.org/10.1080/03075079.2013.868878
McLoughlin, C., & Lee, M. J. W. (2008). Future learning landscapes: Transforming pedagogy through social software. *Journal of Online Education, 4*(5). https://nsuworks.nova.edu/innovate/vol4/iss5/1
Mercer, N. (1996). The quality of talk in children's collaborative activity in classroom. *Learning and Instruction, 6*(4), 359–377. https://doi.org/10.1016/S0959-4752(96)00021-7
Merrill, H. S. (2003). Best practices for online facilitation. *Adult Learning, 14*(2), 13–16. https://doi.org/10.1177/104515950401400204
Millar, P. R., Serbun, S. J., Vadalia, A., & Gutchess, A. H. (2013). Cross-cultural differences in memory specificity. *Culture and Brain, 1*(2–4), 138–157. https://doi.org/10.1007/s40167-013-0011-3
Miller, C. J., & Metz, M. J. (2014). A comparison of professional-level faculty and student perception of active learning: Its current issues, effectiveness, and barriers. *Advances in Psychology Education, 383*(3), 246–252. https://doi.org/10.1152/advan.00014.2014
Molinillo, S., Aguilar-Illescas, R., & Anaya-Sanchez, R. (2018). Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Computers & Education, 123*(2018), 41–52. https://doi.org/10.1016/j.compedu.2018.04.012

Muehlenkamp, J. J., Weiss, N., & Hansen, M. (2015). Problem-based learning for introductory psychology: Preliminary supporting evidence. *Scholarship of Teaching and Learning in Psychology, 1*(2), 125–136. https://doi.org/10.1037/stl0000027

Murphy, K., & Barry, S. (2016). Feed-forward: Students gaining more from assessment via deeper engagement in video-recorded presentations. *Assessment & Evaluation in Higher Education, 41*(2), 213–227. https://doi.org/10.1080/02602938.2014.996206

Nam, C. W. (2014). The effects of trust and constructive controversy on student achievement and attitude in online cooperative learning environments. *Computers in Human Behavior, 37*, 237–248. https://doi.org/10.1016/j.chb.2014.05.007

Naykki, P., Jarvela, S., Kirschner, P. A., & Jarvenoja, H. (2014). Socio-emotional conflict in collaborative learning—A process-oriented case study in a higher education context. *International Journal of Educational Research, 68*(2014), 1–14. https://doi.org/10.1016/j.ijer.2014.07.001

Nemeth, C., Brown, K., & Rogers, J. (2001). Devil's advocate versus authentic dissent: Stimulating quantity and quality. *European Journal of Social Psychology, 31*(6), 707–720. https://doi.org/10.1002/ejsp.58

Nicol, A. A. M., Owens, S. M., Le Coze, S. S. C. L., MacIntyre, A., & Eastwood, C. (2018). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education, 19*(3), 253–265. https://doi.org/10.1177/1469787417731176

Niemi, H., & Nevgi, A. (2014). Research studies and active learning promoting professional competences in Finnish teacher education. *Teaching and Teacher Education, 43*(October), 131–142. https://doi.org/10.1016/j.tate.2014.07.006

Panadero, E., & Alonso-Tapia, J. (2013). Self-assessment: Theoretical and practical connotations. When it happens, how is it acquired and what to do to develop it in our students. *Electronic Journal of Research in Educational Psychology, 11*(2), 551–576. https://doi.org/10.14204/ejrep.30.12200

Powell, K. C., & Kalina, C. J. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241–250. https://link.gale.com/apps/doc/A216181184/ITOF?u=monash&sid=bookmark-ITOF&xid=e2780743

Roberts, S., & Weaver, M. (2006). Spaces for learners and learning: Evaluating the impact of technology-rich learning spaces. *New Review of Academic Librarianship, 12*(2), 95–107. https://doi.org/10.1080/13614530701330380

Ryan, T., Henderson, M., & Phillips, M. (2019). Feedback modes matter: Comparing student perceptions of digital and non-digital feedback modes

in higher education. *British Journal of Educational Technology, 50*(3), 1507–1523. https://doi.org/10.1111/bjet.12749
Sadler, D. R. (2010). Beyond feedback: Developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education, 35*(5), 535–550. https://doi.org/10.1080/02602930903541015
Schneider, M., & Preckel, F. (2017). Variables associated with achievement in higher education: A systematic review of meta-analysis. *Psychological Bulletin, 143*, 565–600. https://doi.org/10.1037/bul0000098
Sinclair, H. K., & Cleland, J. A. (2007). Undergraduate medical students: Who seeks formative feedback? *Medical Education, 41*(6), 580–582. https://doi.org/10.1111/j.1365-2923.2007.02768.x
Stahl, G. (2006). Scripting group cognition: The problem of guiding situated collaboration. In F. Fischer, H. Mandl, J. Haake, & I. Kollar (Eds.), *Scripting computer-supported collaborative learning: Cognitive, computational and educational perspectives*. Kluwer-Springer Verlag.
Stains, M., & Vickrey, T. (2017). Fidelity of implementation: An overlooked yet critical construct to establish effectiveness of evidence-based instructional practices. *CBE Life Sciences Education, 16*, 1–11. https://doi.org/10.1187/cbe.16-03-0113
Swaffield, S. (2011). Getting to the heart of authentic assessment for learning. *Assessment in Education: Principles, Policy & Practice, 18*(4), 433–449. https://doi.org/10.1080/0969594X.2011.582838
Sweet, M., & Michaelsen, L. K. (2012). Critical thinking and engagement: Creating cognitive apprenticeships with team-based learning. In M. Sweet & L. K. Michaelsen (Eds.), *Team-based learning in the social sciences and humanities: Group work that works to generate critical thinking and engagement* (pp. 5–32). Stylus Publishing.
Szabo, Z. (2015). Better together: Teams and discourse in asynchronous online discussion forums. *Journal of Psychological and Educational Research, 23*(1), 73–88.
Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education*, *5*(7), 1–16. https://doi.org/10.1186/s40594-018-0102-y
Thomas, J., & Philpot, T. (2012). An inverted teaching model for a mechanics and materials course. Proceedings of the *Annual Conference of the American Society of Engineering Education.*
Turpen, C., & Finkelstein, N. D. (2009). Not all interactive engagement is the same: Variations in physics professors' implementation of peer instruction. *Physical Education Research, 5*(2), 020101. https://doi.org/10.1103/PhysRevSTPER.5.020101

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Weaver, M. R. (2006). Do students value feedback? Student perceptions of tutors' written responses. *Assessment & Evaluation in Higher Education, 31*(3), 379–394. https://doi.org/10.1080/02602930500353061

Weimer, M. G. (2002). *Learner-centred teaching: Five key changes to practice*. Jossey-Bass.

Wiggins, S., Chiriac, E. H., Abbad, G. L., Pauli, R., & Worrell, M. (2016). Ask not only 'what can problem-based learning do for psychology?' but 'what can psychology do for problem-based learning?': A review of the relevance of problem-based learning for psychology teaching and research. *Psychology Learning & Teaching, 15*(2), 136–154. https://doi.org/10.1177/1475725716643270

William, D. (2011). What is assessment for learning? *Studies in Educational Evaluation, 37*(1), 3–14. https://doi.org/10.1016/j.stueduc.2011.03.001

Wiltbank, L., Williams, K., Salter, R., Marciniak, L., Sederstrom, E., McConnell, M., Offerdahl, E., Boyer, J., & Momsen, J. (2019). Student perceptions and use of feedback during active learning: A new model from repeated stimulated recall interviews. *Assessment & Evaluation in Higher Education, 44*(3), 431–448. https://doi.org/10.1080/02602938.2018.1516731

Wright, M. C., Bergom, I., & Bartholomew, T. (2019). Decreased class size, increased active learning? Intended and enacted teaching strategies in smaller classes. *Active Learning in Higher Education, 20*(1), 51–62. https://doi.org/10.1177/1469787417735607

Yildiz Durak, H. (2022). Flipped classroom model applications in computing courses: Peer- assisted groups, collaborative group and individual learning. *Computer Applications in Engineering Education*. Advance online publication. https://doi.org/10.1002/cae.22487

Zimmerman, B. J. (2013). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologist, 48*(3), 135–147. https://doi.org/10.1080/00461520.2013.794676

CHAPTER 2

Active Learning: An Integrative Review

Gillian Kidman and Minh Nguyet Nguyen

Introduction

For over a century, the notion of active learning and effective student-centred instruction has been advocated for in educational research, educational reports policy, and educational values. We are familiar with theorists like Freire, Dewey, Montessori, Piaget and Vygotsky, who have built careers on this very notion. However, there is a plethora of evidence that educational systems globally fail to embrace active learning to its fullest potential. Instead, we continue to see the teacher-centred passive transmission of knowledge. It is not the purpose of this chapter to debate the active–passive divide. Instead, our goal is to explore the research

G. Kidman (✉) · M. N. Nguyen
School of Curriculum, Teaching and Inclusive Education, Monash University, Melbourne, Australia
e-mail: gillian.kidman@monash.edu

M. N. Nguyen
e-mail: minh.nguyen7@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_2

concerning active learning in higher education over the past two decades. Admittedly, passive learning will need to be mentioned. Still, the focus is on determining the elements of active learning that appear in the research literature that promote the learning gains in higher education institutions.

Higher education institutions largely remain places of learning structured around separate disciplines and feature lectures as the key form of knowledge dissemination. These are accompanied by workshops, tutorials, labs and so on. Within these formal classes, the Lecturer/teacher engages the students in the learning process. When this engagement has the student actively involved in the learning process (Bonwell & Eison, 1991) through technology-based learning, activity-based learning, group work, or project work, we classify this as active learning. Bonwell & Eison indicate that some students and their lecturers/teachers find it challenging to learn and teach actively.

Over time, researchers have explored the teaching and learning of active learning, with the consensus that active learning results in improved learning outcomes compared to passive learning. Much of the research shows impressive learning gains in the sciences: for example, STEM failure rates fall from 32 to 21% (Freeman et al., 2014), and physics students achieved an average gain of 48% compared to 23% for traditional lecture classes (Hake, 1998). This chapter presents an integrative review of two decades of research into active learning across various disciplines. We seek to determine the essence of active learning and how this is being determined.

The Rationale for the Review

There have been several literature review projects on active learning. However, all of them are narrative reviews, and this type of review does typically not aim to examine the internal validity of the studies in focus (Toronto, 2020). We argue that research quality appraisal should form an essential part of a literature review as this helps to mitigate bias in research. To fill this gap, we conducted an integrative review to assess the methodological quality of the studies reporting active learning in higher education from 2011 to 2021. Assessing the quality or internal validity of the research reported in the integrative review is crucial (Denney & Tewksbury, 2013). The strength of our review's findings depends on the quality of the studies reviewed (Coughlan & Cronin, 2017). We have based our study on Russell's (2005) recommendation of exploring:

1. the current state of evidence of active learning
2. the quality of the evidence on active learning
3. gaps in the literature
4. future steps for active learning research and practice.

The Search

Our literature search stage utilised a comprehensive and replicable search strategy to identify our unique article set (Cooper, 1984). The process we used is presented in Fig. 2.1.

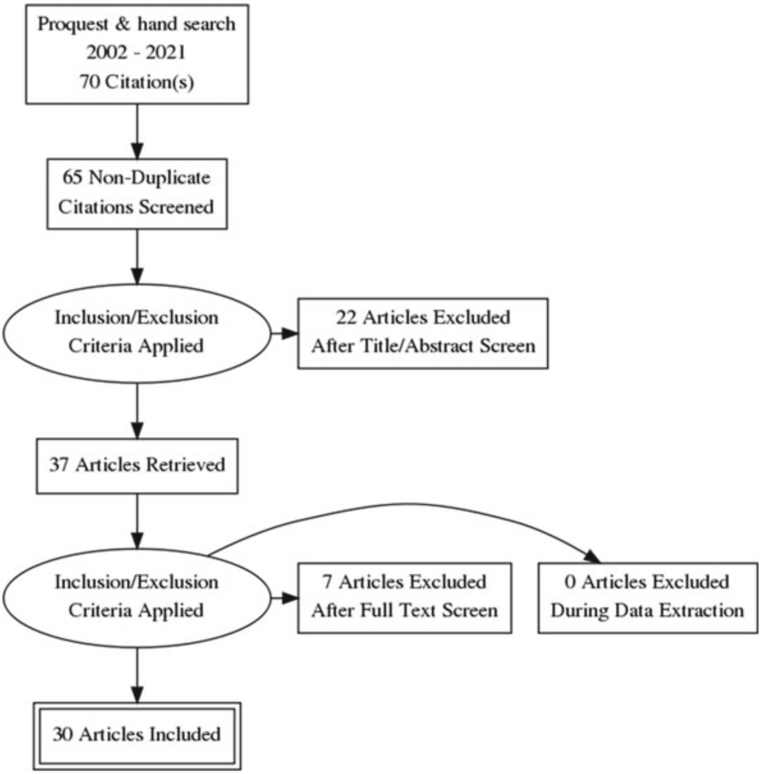


Fig. 2.1 Identification of studies via databases and hand search

We followed the systematic steps recommended by Toronto (2020, p. 2):

1. *Identifying the electronic database/s and sources*
    a. Our systematic search of the literature used predetermined criteria and allowed for replication.
2. *Developing an explicit search strategy*
    a. The inclusion criteria are
        i. Type of studies/study design: empirical
        ii. Active learning in the context of higher education
        iii. Published between 2011 and 2021
        iv. Peer reviewed
        v. Published in English
    b. The exclusion criteria are
        i. those that do not meet the inclusion criteria
        ii. review papers on active learning
        iii. articles where active learning is not presented as a term but as an adjective plus a noun phrase
3. *Screening titles, abstracts, and articles based on inclusion and exclusion criteria*
    a. Initial screening of the titles and abstracts removed 22 articles
    b. A data matrix on the author(s), year of publication, research design/methodology, the definition of active learning, and key findings was prepared, and a second screening was conducted
    c. Seven additional articles were removed from the list
    d. Reasons for exclusion were:
        i. Focus on topics other than active learning, e.g., flipped learning; student reciprocal peer teaching (e.g. Creation and Assessment of an Active e-Learning)
        ii. Did not treat active learning as a term but simply as a phrase (adjective + noun) (e.g. Creation and Assessment of an Active e-Learning Introductory ….)
        iii. Include active learning in high school education (e.g. A critical approach to active learning: A case study of two Bangladeshi colleges)
        iv. Was not empirical research (e.g. Rethinking active learning in the context of Japanese higher education)

4. *Abstracting data from selected literature in a standardised format*
   a. 30 empirical articles were analysed inductively using qualitative content analysis.

We sought theoretical frameworks about active learning to guide our analysis of the 30 articles. We wanted our analysis to reflect active learning research theories and the literature. The initial framework we located was that of The National Survey of Student Engagement (NSSE) survey, first used in 2000 and then updated in 2013. NSSE assesses students' engagement in educational practices associated with high levels of learning and development. The survey collects information across five categories. However, we found relevance in only the first two categories—participation in dozens of educationally purposeful activities, institutional requirements and the challenging nature of the coursework (NSSE, 2020). Of particular interest are the NSSE themes (academic challenge, learning with peers, and experiences with faculty) and the NSSE engagement indicators (reflective and integrative learning, learning strategies, quantitative reasoning, collaborative learning, discussions with diverse others). Engagement indicators were created by combining a theoretical and empirical analysis tested both quantitatively and qualitatively over a development process lasting several years (NSSE, 2020).

We created the *Active Learning Framework* (see Table 2.1) based on the NSSE conceptual framework of student engagement. The Active Learning Framework, derived from NSSE (2020), provided a lens to analyse the 30 articles. Table 2.1 became our conceptual framework for comprehending the various facets of student engagement as reported in the 30 articles.

The Coding and Analysis

Each of the 30 articles was analysed with a focus on the methodology and discussion sections to assess the quality of the evidence on active learning. The analysis was shaped by how active learning was defined and how the definition aligned with the Active Learning Framework.

The qualitative content analysis adapted the analytical steps of Braun and Clarke (2013):

Table 2.1 Aspects of the *active learning framework*

Content areas	*Engagement indicators*	*Explanation*
Academic challenge	*Reflective & Integrative Learning*	1. Combined ideas from different courses when completing assignments 2. Connected your learning to societal problems or issues 3. Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments 4. Examined the strengths and weaknesses of your views on a topic or issue 5. Learned something that changed the way you understand an issue or a concept 6. Connected ideas from your courses to your prior experiences and knowledge
	Learning Strategies	7. Identified key information from reading assignments 8. Reviewed course content (yournotes, lecture and tutorial ppt) after class 9. Summarized what you learned in class or from course materials
	Quantitative Reasoning	10. Reached conclusions based on your analysis of numerical information (numbers, graphs, statistics, etc.) using IT tools 11. Used numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.) using IT tools 12. Evaluated what others have concluded from numerical information

Content areas	*Engagement indicators*	*Explanation*
Learning with peers	*Collaborative Learning*	13. Asked another student to help you understand course material, both online and offline 14. Explained course material to one or more students, both online and offline 15. Prepared for assessments by discussing or working through course material with other students, both online and offline 16. Discuss with people from a racial/economic/religious or political background/belief other than your own, both online and offline
Experiences with faculty	*Discussion of course content* *Discussion of academic performance*	17. Discuss course topics, ideas, or concepts with a faculty member outside of class, both online and offline 18. Discuss your academic performance with a faculty member, both online and offline

1. The reading and familiarisation of each article—each article is read several times to gain an understanding of the active learning approach
2. Coding—identify phrases that captured the essence of active learning
3. Searching for themes—the frequency of codes exposed themes
4. Reviewing themes—themes and codes were scrutinised to identify subthemes
5. Defining and naming themes—terms derived from the language used by the article authors/author
6. Finalizing the analysis—themes and subthemes were considered in light of the literature cited
7. Presentation of the thematic analysis as new knowledge – new theoretical relationships were revealed.

Results

Our thematic analysis found different methodological approaches to studying and defining active learning. As indicated in Table 2.2, six articles report the study of students' behaviour and how they engage in their studies. Twenty-one articles examine the activities/tasks/strategies developed/used to generate/nurture/promote active learning. Six articles consider the theoretical approach to active learning, and two articles inform us of the impact of the environment, e.g., classroom layout and facilities.

Six articles were found to address multiple active learning approaches—Brewe et al. (2018), Gahl et al. (2021), Grossman and Simon (2020), Holec and Marynowski (2020), Hyun et al. (2017), and Mangram et al. (2015). Except for Brewe, the articles reporting on multiple active learning approaches all explored students' behaviour/skills and instructional strategies. Brewe considered both a theoretical approach and an active learning environment.

Further analysis of the 30 articles revealed three of the four engagement indicators (reflective and integrative learning, learning strategies, and collaborative learning) emphasised in the NSSE survey are commonly researched, with the fourth engagement indicator (quantitative reasoning) being the least explored indicator (see Table 2.3). Five of the articles considered just two engagement indicators, and interestingly, these five all combined reflective and integrative learning and collaborative

Table 2.2 Active learning approaches reported in reviewed articles

Active learning approaches (The study of.)	*Articles*
Students' behaviour/skills (6 articles)	Does it matter where you teach (Holec & Marynowski, 2020) Active learning for creating innovators (Ito & Kawazoe, 2015) Active Learning Strategies for Complementing the Lecture teaching method (Mangram et al., 2015) Perspectives on facilitating dynamic ecology courses online (Gahl et al., 2021) Students' satisfaction with their learning process in active learning (Hyun et al., 2017) Student perceptions of open educational resources video active learning exercises focusing on research reading and interpreting (Grossman & Simon, 2020) Synthesizing technology adoption and learners' approaches towards active learning in higher education (Chan et al., 2015) An experiment in active learning (Ludwig, 2021) Does it matter where you teach (Holec & Marynowski, 2020) Active-learning processes (Stewart et al., 2011) The influence of active learning practices on student anxiety in large-enrolment college science classrooms (Cooper et al., 2018) Active Learning Strategies for Complementing the Lecture teaching method (Mangram et al., 2015)

(continued)

Table 2.2 (continued)

Active learning approaches (The study of.)	*Articles*
Instructional strategies = Set of activities/ tools/techniques/exercises/strategies/pedagogical activities [without theory base] (20 articles)	Perspectives on facilitating dynamic ecology courses online (Gahl et al., 2021) From tootsie rolls to broken bones (Linsey et al., 2009) Applying the Plan-Do-Study-Act cycle: PDSA session (Rose et al., 2021) TBAL Technology-Based Active Learning in Higher Education (Ghilay & Ghilay, 2015) Teacher competences for active learning in engineering education (Das Neves et al., 2021) Students' satisfaction on their learning process in active learning (Hyun et al., 2017) Management strategies for active learning (Damaskou & Petratos, 2018) Perceptions on the effectiveness of active learning strategies (Daouk et al., 2016) Making it stick: use of active learning strategies in continuing medical education (Bucklin et al., 2021) Introducing sustainability into business education contexts using active learning (MacVaugh & Norton, 2012) Active learning through discussion (Lim et al., 2019) Sharing classroom research and the scholarship of teaching strategies (Walters, 2014) An introvert's perspective: analyzing the impact of active learning (William et al., 2020) Student perceptions of open educational resources video active learning exercises focusing on research reading and interpreting (Grossman & Simon, 2020)

Active learning approaches (The study of.)	*Articles*
Theoretical approach (6 articles)	Diverse Student Perceptions of active learning in a large enrolment STEM course (Kressler & Kressler, 2020) Costs of success: Financial implications of implementation of active learning (Brewe et al., 2018) Active learning pedagogy transformation (Fields et al., 2021) Introducing Sustainability into Business Education Contexts Using Active Learning (MacVaugh & Norton, 2012) Incoming medical students and their perception on the transition towards an active learning (Torres et al., 2019) Active learning in history teaching in higher education (Tirado-Olivares et al., 2021)
Active learning environment (2 articles)	Students' satisfaction on their learning process in active learning (Hyun et al., 2017) Costs of success: Financial implications of implementation of active learning (Brewe et al., 2018)

Table 2.3 Frequency of engagement indicators

		Engagement Indicators		
	Reflective & Integrative Learning	*Learning Strategies*	*Quantitative Reasoning*	*Collaborative Learning*
Number of articles	22	25	10	23
NB: Active learning is implied via activities/strategies in 2 articles				

learning. Ten articles considered three engagement indicators, and all ten included quantitative reasoning. Ten articles included all four engagement indicators.

Discussion and Conclusion

A collection of 30 unique articles published between 2002 and 2021 that fall within the topic area of active learning and satisfied the inclusion and exclusion criteria was identified and then analysed against the Active Learning Framework (Table 2.1) derived from NSSE (2020). Alignment was found to be about four of the NSSE engagement indicators: **reflective and integrative learning**, learning strategies, quantitative reasoning, and collaborative learning.

Reflective and Integrative Learning

Twenty-two articles aligned with the NSSE (2020) engagement indicator of reflective and integrative thinking. Higher education teaching and learning that emphasises reflection that relates to the learning as it occurs is known to connect the classroom with the local environment and extends to the world around them. The outcome is an examination of beliefs and values that pertain to the individual doing the reflecting and the perspectives of other people. Reflective and integrative learning was found to vary depending upon the base discipline. Reflective and integrative learning are common engagement indicators in Education and Communications, Media and Public Relations. However, the Physical Sciences, Mathematics, Computer Science; Engineering, biology, Agriculture, and Natural Resources only adopt reflective and integrative learning.

Within-disciplinary differences exist as Social Service Professions faculty consistently value reflective and integrative learning. Yet, Business have a greater diversity in the levels of importance placed on reflective and integrative learning. See Brewe et al. (2018), Bucklin et al. (2021), Chan et al. (2015), Cooper et al. (2018), Damaskou and Petratos (2018), Daouk et al. (2016), Das Neves et al. (2021), Fields et al. (2021), Gahl et al. (2021), Ghilay and Ghilay (2015), Grossman and Simon (2020), Hyun et al. (2017), Ito and Kawazoe (2015), Kressler and Kressler (2020), Lim et al. (2019), MacVaugh and Norton (2012), Mangram et al. (2015), Stewart et al. (2011), Torres et al. (2019), Tirado-Olivares et al. (2021), Walters (2014) and William et al. (2020).

Learning Strategies

Twenty-five articles aligned with the NSSE (2020) engagement indicator of learning strategies. Student learning is deepened by their active engagement with and analysing course material, rather than a surface approach to learning as absorption (NSEE, 2020). Effective learning strategies described in the 25 articles include taking notes in class and then reviewing the notes after class, summarising course material into new information, and creation of an environment conducive to learning. Active learning emphasises learning strategies as a fluid metacognitive skill resulting in students going beyond declarative and procedural knowledge to apply concepts and themes across multiple areas. See Beckerson et al. (2020), Brewe et al. (2018), Bucklin et al. (2021), Cooper et al. (2018), Damaskou and Petratos (2018), Daouk et al. (2016), Das Neves et al. (2021), Fields et al. (2021), Gahl et al. (2021), Ghilay and Ghilay (2015), Grossman and Simon (2020), Hartikainen et al. (2019), Hyun et al., (2017), Ito and Kawazoe (2015), Kressler and Kressler (2020), Lim et al. (2019), MacVaugh and Norton (2012), Mangram et al. (2015), Pundak et al. (2010), Rose et al. (2021), Stewart et al. (2011), Tirado-Olivares et al. (2021), Van Amburgh et al. (2007), Walters (2014), and William et al. (2020).

Quantitative Reasoning

Ten articles aligned with the NSSE (2020) engagement indicator of quantitative reasoning. Quantitative reasoning represents students' perceptions of how often they have engaged in activities that are thought to develop such skills. The articles revealed quantitative reasoning to be an increasingly important outcome of higher education. Regardless of the disciplinary focus, all students should be better and more informed users of quantitative information. They should also have ample opportunities to develop their ability to reason quantitatively—to evaluate, support, and critique arguments using numerical and statistical information. See Bucklin et al. (2021), Daouk et al. (2016); Fields et al. (2021); Gahl et al. (2021); Grossman and Simon (2020), Ito and Kawazoe (2015), Linsey et al. (2009), Mangram et al. (2015), Stewart et al. (2011), and Walters (2014).

Collaborative Learning

Twenty-three articles aligned with the NSSE (2020) engagement indicator of collaborative learning. Collaborative learning is collaborating with peers, both inside and outside the classroom. The articles revealed that problem solving and the mastery of challenging content deepens student understanding and prepares students to deal with real-world unscripted problems commonly found in the workforce. Collaborative learning activities included working on group projects, seeking help with challenging content, or the flip side of explaining it to others, and the shared preparation for examinations, all indicate collaborative learning is occurring. See Brewe et al. (2018), Bucklin et al. (2021), Chan et al. (2015), Cooper et al. (2018), Damaskou and Petratos (2018), Daouk et al. (2016), Das Neves et al. (2021), Fields et al. (2021), Gahl et al. (2021), Ghilay and Ghilay (2015), Grossman and Simon (2020), Holec and Marynowski (2020), Hyun et al. (2017), Ito and Kawazoe (2015), Kressler and Kressler (2020), Lim et al. (2019), MacVaugh and Norton (2012), Mangram et al. (2015), Rose et al. (2021), Stewart et al. (2011), Tirado-Olivares et al. (2021), Walters (2014), and William et al. (2020).

Studies from the past two decades in the topic area of active learning can be generalised as critical analyses of four engagement indicators reflective and integrative learning, student learning strategies, quantitative reasoning, and collaborative learning. The approaches to studying and defining active learning can be generalised to be studies of students' behaviour and how they engage in their studies, activities/tasks/strategies developed/used to generate/nurture/promote active learning, the theoretical approach to active learning the impact of the physical learning environment.

Having determined the four methodological approaches currently utilised in researching active research from the initial thematic analysis, then followed by an analysis of 30 articles through a lens of engagement indicators (NSSE, 2020), we now want to explore how the generalisations created can fit together. We used adjacency analysis and a functional diagram (Landscape Design Validation, 2009) (see Fig. 2.2) to achieve this. The functional diagram is a matrix of intersecting pairs of elements. A symbol within the box indicates the influence between a pair of elements. The advantage of this analysis and diagram is that it provides an opportunity to question the qualities of each generalised element: What function does it perform? How does it impact other elements, enhance them or interfere with them? We based our analysis on influence—*How do each of the elements influence another?*

The analysis is conducted by reviewing each article within each generalised pair of elements and assessing them in terms of their relationship to another generalised element set of articles. A symbol placed in that pair's box indicates the assessment of that pair. A blank square indicates

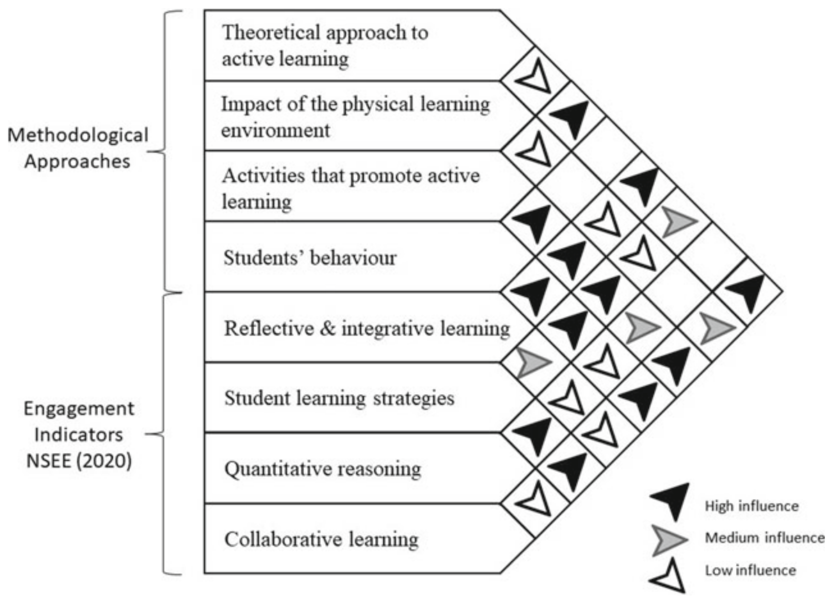


Fig. 2.2 Adjacency analysis for active learning element influence

no relationship has been determined. In Fig. 2.2, we have used a shaded-arrowhead coding system to indicate the degree of influence. An upwardly pointing black arrowhead suggests there is a high degree of influence between the pair. A sideways pointing grey arrowhead suggests there is a medium degree of influence between the pair. A downwards pointing white arrowhead indicates a low degree of influence between the pair.

The patterns that evolve provide us with a visualisation of high, medium and low influence. The four blank boxes are interesting. In the 30 articles analysed, we were unable to determine any influences between the following four pairs:

- theoretical approach to active learning and students' behaviour
- theoretical approach to active learning and quantitative reasoning
- the impact of the physical learning environment and students' behaviour
- the impact of the physical learning environment and quantitative reasoning.

The articles that included a theoretical approach did not consider students' behaviour or quantitative reasoning. Similarly, articles that had the impact of the physical learning environment did not consider students' behaviour or quantitative reasoning. Such research may exist, but it was not evident in our 30 articles over the 20 years.

Figure 2.2 indicates a high influence between pairs for 12 of the 28 element combinations. This suggests that for the eight elements that emerged from our integrative review, we have shown that 40% of the elements were reported to have a high influence on each other in terms of the student experience in active learning. A further 14% were deemed to have a moderate influence on another element. This suggests that the development of the field of active learning is maturing with a convergence of best practice and influence.

Keathley-Herring et al. (2016) inform us that a maturity characteristic rarely investigated is the relationship between academic research and typical methodological practice. We conducted a thematic analysis of the methods applied in our set of 30 articles identifying four methodological approaches (students' behaviour and how they engage in their studies, activities/tasks/strategies developed/used to generate/nurture/promote active learning, the theoretical approach to active learning the impact of the physical learning environment). We then investigated these methodological approaches with the integrative review of the same 30 articles. This study offers a comprehensive set of elements of active learning in higher education settings. This can further guide researchers in conducting further analyses of active learning—especially about the lecturer/teaching staff, as this perspective is entirely missing in our review. The results of this integrated review suggest that the field is indeed maturing, showing a strong degree of cohesion; we seem only to have the learning perspective relating to the student. We are missing the perspective of the lecturer/teaching staff, who are learners in their own right. Devoid of research attention is the lecturer/tutor and their identity as a facilitator of active learning.

References

* Denotes that the paper is included in the integrative review

* Beckerson, W. C., Anderson, J. O., Perpich, J. D., & Yoder-Himes, D. (2020). An introvert's perspective: Analyzing the impact of active learning on multiple levels of class social personalities in an upper level biology course. *Journal of College Science Teaching, 49*(3), 47–57.

* Brewe, E., Dou, R., & Shand, R. (2018). Costs of success: Financial implications of implementation of active learning in introductory physics courses for students and administrators. *Physical Review. Physics Education Research, 14*(1), 010109. https://doi.org/10.1103/PhysRevPhysEducRes.14.010109

* Bucklin, B. A., Asdigian, N. L., Hawkins, J. L., & Klein, U. (2021). Making it stick: Use of active learning strategies in continuing medical education. *BMC Medical Education, 21*(1), 44–44. https://doi.org/10.1186/s12909-020-02447-0

* Chan, K., Cheung, G., Wan, K., Brown, I., & Luk, G. (2015). Synthesizing technology adoption and learners' approaches towards active learning in higher education. *Electronic Journal of e-Learning, 13*(6), 431–440.

* Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *Int J STEM Educ, 5*(1), 1–18. https://doi.org/10.1186/s40594-018-0123-6

* Damaskou, E., & Petratos, P. (2018). Management strategies for active learning in AACSB accredited STEM discipline of CIS: Evidence from traditional and novel didactic methods in higher edu. *International Journal for Business Education, 158*, 41–56.

* Daouk, Z., Bahous, R., & Bacha, N. N. (2016). Perceptions on the effectiveness of active learning strategies. *Journal of Applied Research in*

Higher Education, 8(3), 360–375. https://doi.org/10.1108/JARHE-05-2015-0037
* Das Neves, R. M., Lima, R. M., & Mesquita, D. (2021). Teacher competences for active learning in engineering education. *Sustainability (Basel, Switzerland), 13*(16), 9231. https://doi.org/10.3390/su13169231
* Fields, L., Trostian, B., Moroney, T., & Dean, B. A. (2021). Active learning pedagogy transformation: A whole-of-school approach to person-centred teaching and nursing graduates. *Nurse Education in Practice, 53*, 103051–103051. https://doi.org/10.1016/j.nepr.2021.103051
* Gahl, M. K., Gale, A., Kaestner, A., Yoshina, A., Paglione, E., & Bergman, G. (2021). Perspectives on facilitating dynamic ecology courses online using active learning. *Ecology and Evolution, 11*(8), 3473–3480. https://doi.org/10.1002/ece3.6953
* Ghilay, Y., & Ghilay, R. (2015). TBAL: Technology-based active learning in higher education. *Journal of education and learning, 4*(4). https://doi.org/10.5539/jel.v4n4p10
* Grossman, G. D., & Simon, T. N. (2020). Student perceptions of open educational resources video-based active learning in university-level biology classes: A multi-class evaluation. *Journal of College Science Teaching, 49*(6), 36–44.
* Hartikainen, S., Rintala, H., Pylväs, L., & Nokelainen, P. (2019). The concept of active learning and the measurement of learning outcomes: A review of research in engineering higher education. *Education Sciences, 9*(4), 276. https://doi.org/10.3390/educsci9040276
* Holec, V., & Marynowski, R. (2020). Does it matter where you teach? Insights from a quasi-experimental study of student engagement in an active learning classroom. *Teaching and learning inquiry, 8*(2), 140–163. LEARNINQU.8.2.10. https://doi.org/10.20343/TEACH
* Hyun, J., Ediger, R., & Lee, D. (2017). Students' satisfaction on their Learning process in active learning and traditional classrooms. *International Journal of Teaching and Learning in Higher Education, 29*(1), 108–118.
* Ito, H., & Kawazoe, N. (2015). Active learning for creating innovators: Employability skills beyond industrial needs. *International Journal of Higher Education, 4*(2). https://doi.org/10.5430/ijhe.v4n2p81
* Kressler, B., & Kressler, J. (2020). Diverse student perceptions of active learning in a large enrollment STEM course. *The Journal of Scholarship of Teaching and Learning, 20*(1). https://doi.org/10.14434/josotl.v20i1.24688
* Lim, J., Ko, H., Yang, J. W., Kim, S., Lee, S., Chun, M.-S., Ihm, J., & Park, J. (2019). Active learning through discussion: ICAP framework for education in health professions. *BMC Medical Education, 19*(1), 477–477. https://doi.org/10.1186/s12909-019-1901-7

* Linsey, J., Talley, A., White, C., Jensen, D., & Wood, K. (2009). From tootsie rolls to broken bones: An innovative approach for active learning in mechanics of materials. *Advances in Engineering Education, 1*(3), 1–22.
* Ludwig, J. (2021). An experiment in active learning: The effects of teams. *International Journal of Educational Methodology, 7*(2), 353–360. https://doi.org/10.12973/ijem.7.2.353
* MacVaugh, J., & Norton, M. (2012). Introducing sustainability into business education contexts using active learning. *International Journal of Sustainability in Higher Education, 13*(1), 72–87. https://doi.org/10.1108/14676371211190326
* Mangram, J. A., Haddix, M., Ochanji, M. K., & Masingila, J. (2015). Active learning strategies for complementing the lecture teaching methods in large classes in higher education. *Journal of Instructional Research, 4*, 57–68.
* Pundak, D., Herscovitz, O., & Shacham, M. (2010). Attitudes of face-to-face and e-learning instructors toward "Active Learning". *The European Journal of Open, Distance and E-Learning, 13*.
* Rose, S., Hamill, R., Caruso, A., & Appelbaum, N. P. (2021). Applying the plan-do-study-act cycle in medical education to refine an antibiotics therapy active learning session. *BMC Medical Education, 21*(1), 1–459. https://doi.org/10.1186/s12909-021-02886-3
* Stewart, D. W., Brown, S. D., Clavier, C. W., & Wyatt, J. (2011). Active-learning processes used in us pharmacy education. *American Journal of Pharmaceutical Education, 75*(4), 68–68. https://doi.org/10.5688/ajpe75468
* Tirado-Olivares, S., Cózar-Gutiérrez, R., García-Olivares, R., & González-Calero, J. A. (2021). Active learning in history teaching in higher education: The effect of inquiry-based learning and a student response system-based formative assessment in teacher training. *Australasian Journal of Educational Technology, 37*(5), 61–76. https://doi.org/10.14742/ajet.7087
* Torres, V., Sampaio, C. A., & Caldeira, A. P. (2019). Incoming medical students and their perception on the transition towards an active learning. *Interface (Botucatu, Brazil), 23*. https://doi.org/10.1590/Interface.170471
* Van Amburgh, J. A., Devlin, J. W., Kirwin, J. L., & Qualters, D. M. (2007). A tool for measuring active learning in the classroom. *American Journal of Pharmaceutical Education, 71*(5), 85. https://doi.org/10.5688/aj710585
* Walters, K. (2014). Sharing classroom research and the scholarship of teaching: Student resistance to active learning may not be as pervasive as is commonly believed. *Nursing Education Perspectives, 35*(5), 342–343. https://doi.org/10.5480/11-691.1
* William, C. B., Jennifer, O. A., John, D. P., & Debbie, Y.-H. (2020). An introvert's perspective: Analyzing the impact of active learning on multiple

levels of class social personalities in an upper level biology course. *Journal of College Science Teaching, 49*(3), 47–57.

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. SAGE.

Bonwell, C., & Eison, J. (1991). *Active learning: Creating excitement in the classroom AEHE-ERIC higher education* (*Report No. 1*). Jossey-Bass.

Cooper, H. M. (1984). *The integrative research review: A systematic approach.* SAGE Publications.

Coughlan, M., & Cronin, P. (2017). *Doing a literature review in nursing, health and social care* (2nd ed.) (p. 11), Beverly Hills. SAGE Publications.

Denney, A. S., & Tewksbury, R. (2013). How to write a literature review. *Journal of Criminal Justice Education, 24*(2), 218–234. https://doi.org/10.1080/10511253.2012.730617

Freeman, S., Eddy, S., McDonough, M., Smith, K., Okoroafor, N., Jordt, H., & Wenderoth, M. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America., 111*(23), 8410–8415.

Hake, R. R. (1998). Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66,* 64. https://doi.org/10.1119/1.18809

Keathley-Herring, H., Van Aken, E., Gonzalez-Aleu, F., et al. (2016). Assessing the maturity of a research area: Bibliometric review and proposed framework. *Scientometrics, 109*, 927–951. https://doi.org/10.1007/s11192-016-2096-x

Landscape design validation. (2009). *Before drawing look at adjacency*. July 26 post. https://ldvalidate.wordpress.com/2009/07/26/before-drawing-look-at-adjacency/

National Survey of Student Engagement (NSSE). (2020). *Engagement indicators & high-impact practices*. https://nsse.indiana.edu/nsse/survey-instruments/engagement-indicators.html

Russell, C. L. (2005). An overview of the integrative research review. *Progress in Transplantation, 15*(1), 8–13. https://doi.org/10.7182/prtr.15.1.0n13660r26g725kj

Toronto, C. E. (2020). Overview of the integrative review. In C. E. Toronto & R. Remington (Eds.), *A step-by-step guide to conducting an integrative review* (1st ed.). Springer.

CHAPTER 3

Student Collaboration Through Assessment, Feedback and Peer Instruction

Chan Chang-Tik

> *Conflicts need to be seen as windows of opportunity instead of threats to progress.*
>
> Van den Bossche, Segers, & Kirschner, 2006

Introduction

In terms of increasing the effectiveness of group-based learning in the collaborative active learning (CAL) environments, the framework of participation developed by Black-Hawkins (2013) can serve this purpose quite well. If so, two principles mentioned in the framework, that is, participation concerns all members of a group and participation requires learning to be active and collaborative, can influence the efforts invested in enhancing student readiness for CAL. This is because collaborative

C. Chang-Tik (✉)
Monash University Malaysia, Subang Jaya, Malaysia
e-mail: chan.chang.tik@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_3

active learning entails some sort of change in the way learning is conceptualised. Consequently, it is reasonable to provide training to students to equip them with skills required to collaborate effectively in group-based learning. Still though, students need reasons as to why they have to collaborate when all the while in a teacher-centred approach they compete rather than collaborate. To this end, the Social Interdependence Theory developed by Johnson and Johnson (2013) proposes five elements to maximise the collaborative potential of groups.

Further, feedback plays an essential role in supporting student learning since it encourages self-evaluation which is one of the skills that typifies self-regulation; feedback also enhances group discussion as in peer formative feedback. However, according to Carless and Boud (2018), feedback literacy is crucial for students to make use of the information provided to improve their learning and it lays a bridge between teaching and learning. In this regard, lecturers should use feedback to narrow the learning gaps of students by feedforward to them on what to do based on the learning evidence gathered. Lastly, feedback is not about correcting mistakes or providing correct answers; it plays an important role in supporting learning from mistakes, learning by constructing meanings from peers and learning by collaborating and building on one another's ideas.

In a similar vein, assessment can be used for learning. To illustrate, instead of teaching certain learning outcomes and then assess students' understanding through assignments and tests as it is normally practised in teacher-centred approach, lecturers can turn the assignments and tests as group-based learning activities where students acquire the learning outcomes through collaborative interactions and at the same time be awarded marks and grades too. This simple practice of using assessment to support learning is known as assessment for learning (Heritage, 2016). In addition to blending assessment activities with learning, the use of authentic assessment in the CAL environments highlights the underlying principles of assessment for learning, that is, making learning explicit and promoting learning autonomy (James et al., 2007). It also helps students in their regulation of learning and that of their peers to meet the learning goals.

Indeed, regulation of learning—and self-regulation in particular—are beginning to be used in peer instruction together with peer formative feedback in CAL to facilitate students' control of their learning and self-regulation of discussion leading to reconstruction of understanding in their own terms (Green, 2019). In this context, peer instruction engages students in self-assessment to appraise their level of knowledge and skills (Arico & Lancaster, 2018), as a result they benefit in terms of learning from the reflective observation. However, looking at self-regulation and also social interaction through a different lens reveal that they are also the possible causes of student resistance to CAL. The resistance is particularly strong from the lower-performing students because of their weaknesses in self-regulation and social interaction. The social cohesion of this group of students is weak and their sense of community is not well developed (Chang-Tik & Dhaliwal, 2022). Nevertheless, in this chapter the author suggests some strategies to mitigate the resistance.

Getting Students to Collaborate Effectively in Group-Based Learning

As the studies covered in the review of collaborative active learning (CAL) indicated, the effects of group-based learning are considerably more positive when students receive well-structured group work experiences or when they are instructed in group work strategies (Hattie, 2009). In this respect, well-structured group work is already extensively discussed in Chapter 1 (Chang-Tik, this volume). As for the group work strategies the author shall present them in the current chapter together with the importance of social collaboration to promote group-based learning (Mercer, 2008). According to Kirschner et al. (2006), students' skills to collaborate effectively are not self-evident. If so, it is reasonable to refer to the framework of participation developed by Black-Hawkins (2013) to identify pedagogical practices that conceptualise participation. Among the five principles mentioned in the framework, two of them are of particular interest in this section. They are participation concerns all members of a group and participation requires learning to be active and collaborative.

Participation Concerns All Members of a Group

From a learning and teaching perspective, in order to involve all members in a group- based activity it is pertinent to ensure that students are engaged in the pre-class activities before they meet to collaborate in a group. According to Chang-Tik and Goh (2020), the lower-performing students may need extra assistance for them to comprehend and respond effectively to these activities. Specifically, they need a source to refer to when they are "confused or clueless". In this context, lecturers can arrange for them to study together so that they can mutually corroborate one another's understanding. Additionally, it may be beneficial to have online live chat (e.g., using Google Hangouts) on certain days and times. The aim is to provide guidance, to clarify doubts and importantly, for the students to respond to the activities. At this pre-class stage, it is crucial to emphasize strongly to the students the focus is on their responses and not correct answers.

It is evident that learning can be fun if students feel safe to make mistakes, and to openly interact with their peers contributing and commenting on one another's ideas (Molinillo et al., 2018). To this end, it helps to create a climate of mutual trust that encourages students to speak freely. Specifically, mutual trust implies the shared perception that every member of a group protects the interests and rights of one another and performs tasks deemed significant to the group interest (Fransen et al., 2011). In relation to that, lecturers should make themselves approachable for students to interact with them regarding their learning problems and other matters indirectly related to learning. One effective method is to assume an encouraging demeanour in order to establish an approachable rapport with students and to set a tone that helps them be more comfortable with asking questions and the possibility of being wrong (Tharayil et al., 2018). In doing so it gives them the impression you are here for them. Additionally, during the small group discussion workshop, lecturers can listen to the students' views and probe them to think of alternatives. This approach is in line with Van Zee and Minstrell (1997) "reflective toss" where the lecturers ask questions and throw the responsibility of thinking back to the students. Initially, the sharing of thoughts is between lecturers and students, but over time a comfort zone is developed for students to openly discuss any ideas with their peers. To further strengthen peer interaction, always refer students to their groups for support, therefore, granting them the authority to collaborate and to take greater responsibility for the group collective work, in line with Frykedal and Hammar Chiriac (2018) argument. To this end, peer interaction helps to develop the feeling of connectedness, of being accepted by their peers and these feelings may help to improve students' engagement (Sidelinger & Booth-Butterfield, 2010). Eventually, they will develop mutual trust and thus, are more open to communication and less wary of being laughed at.

Participation Requires Learning to be Active and Collaborative

Theoretically speaking, socio-constructivism that provides the framework for active learning opens up group-based learning of which collaboration is the nexus. According to Baker (2002), collaboration is defined as knowledge construction where participants build on others' ideas and thoughts and not just accumulate them. The main activities of collaboration are negotiation of shared meanings, elaboration, mutual explaining, and reasoning. In this regard, it is reasonable for lecturers to design learning tasks that require team effort to complete. To illustrate, each member of a team of five has to share his/her understanding of an assigned concept posted in Google Doc. Upon questioning from the peers, the student has to elaborate and explain his/her interpretations of the concept, which may be counter-challenged by the peers. In what follows, the students have to collectively and collaboratively select three of their best interpretations to argue orally in class a new phenomenon but somewhat related to the earlier assigned concept. In this exercise, students work as a group to pick the best outcomes and apply them in a new situation; notes and Internet links may be provided to assist them in their understanding.

It is believed that challenges and even conflicts are unavoidable in human interaction and thus, also in collaborative active learning (CAL). During collaboration as described above, students negotiate for shared meanings through arguments, challenges, reasoning, debate and elaboration. These activities may lead to socio-cognitive conflicts which are advocated as essential for the cognitive growth of individuals (Buchs et al., 2004). However, the lower-performing students tend to avoid socio-cognitive conflicts in order to attain a cordial learning environment (Chang-Tik & Goh, 2020). In what follows, they argue less and agree more, they ask questions for clarifications and not elaborations and they seldom challenge one another. Therefore, to create a learning environment that encourages collaboration, it is appropriate for lecturers to inform their students that socio-cognitive conflicts are essential for cognitive growth. In this regard, Van den Bossche et al. (2011) added constructive conflict is a significant behaviour to build shared mental models, where mutual understanding and mutual agreement are needed (Dillenbourg & Traum, 2006) to actively integrate students' contributions in the existing representation (Jeong & Chi, 2007). It is alright to argue and challenge peers' views, but it is not acceptable to overreact and get personal. However, in most circumstances, when students are challenged out of their comfort zones, socio-cognitive conflicts may give rise to socio-emotional conflicts (Naykki et al., 2014) and students have to learn how to regulate these conflicts. In relation to that, it is the responsibility of every group member to ensure that emotional conflicts do not disrupt the learning process. This is because in CAL, practising shared leadership is more beneficial than individual leadership (Kayes, 2004). In this respect, students in the group have to apply the interpersonal and small group skills, one of the five elements in the Social Interdependence Theory (Johnson & Johnson, 2002, 2013), to resolve conflicts. Nevertheless, the well-functioning group is more capable to regulate emotion and prevent it from turning into detrimental conflicts (Darnon et al., 2006; Sommet et al., 2014) which is negatively related to group cohesion, commitment and performance (De Dreu & Weingart, 2003).

Hrastinski (2008) asserted that social interaction is a key factor that influences CAL. When students interact in a group, they develop a sense of affective connections between themselves and the other members. This connection known as social presence affects the degree of development of a community (Smith & Flaherty, 2013) as well as the emotional (e.g., fun, interest, enjoyment) engagement (Finn & Zimmer, 2012). Specifically, when students feel at ease to communicate freely with their peers and lecturers, enjoy the atmosphere of openly expressing themselves without any fear of being laughed at, then it increases both their feeling of belonging to the group and the emotional engagement. Even though there are some positives here, social presence may invoke "groupthink" (Janis, 1972) leading to an uncritical acceptance of solutions. Still though, what matters most here is a conducive CAL climate which is essential for students to exchange and integrate ideas (socio-cognitive conflicts) and to regulate emotional conflicts when they arise.

Speaking of student effective collaboration in group-based learning, the two principles of the framework of participation provide the foundations to implement the main activities of collaboration from pre-class to the regulation of conflicts. In addition to the framework, it seems that students also need reasons to collaborate. Specifically, if they were taught in a teacher-centred approach where they competed with one another rather than collaborated. In this regard, the Social Interdependence Theory developed by Johnson and Johnson (2013) proposes five elements to maximise the collaborative potential of groups. Among the elements, positive interdependence gives students a strong reason to collaborate, that is, the perception of being linked to other group members enhances the probability of their achieving their joint goals and rewards. After all, according to Frykedal and Hammar Chiriac (2018), positive interdependence gives the group increased opportunities for developing collaborative processes by working together to complete the group tasks or assignments and be rewarded with good marks and grades. In addition to the positive interdependence, another two elements of the theory, individual accountability and promotive interaction, are also necessary.

First, in terms of individual accountability, there should not be free riders in the group, which incidentally, may destroy the spirit of collaboration. This is because free-riding behaviour is contagious (Kayes et al., 2005). On that note, it is the responsibility of every member to contribute his/her share of the work. In other words, students should not remain silent claiming their thoughts are similar to the one presented. By providing one student a chance to avoid sharing ideas may lead to more members of a group using this excuse. Eventually, the main activities of collaboration will collapse because there are very few students interacting.

Second, in relation to promotive interaction, students generally want to contribute to group discussions. However, at times language problems, personality traits, and missing or low prior knowledge may hinder students' participation. After all, according to Woolley et al. (2010), the group's success may depend on the students' attitude, motivation and personality traits. To this end, for group members to encourage each other's efforts through discussions and explanations, it is important that they know their learning partners' prior knowledge. The reason being this awareness ensures a target-oriented coordination of knowledge exchange (Dillenbourg & Betrancourt, 2006). In other words, it can trigger gap filling learning behaviours such as providing learning partners information about the missing knowledge and in general show a willingness to help other group members.

Further, in the context of the Social Interdependence Theory, the three elements discussed above (positive interdependence, individual accountability and promotive interactions) are necessary to maximise the collaborative potential of group-based learning. As such, to implement the three elements into group work requires active participation from students. This suggests that the use of the three elements together with the framework of participation could contribute to enriching collaborative group-based learning. In other words, to increase the effectiveness of group-based learning, the Social Interdependence Theory and the framework of participation can serve this purpose quite well. If so, the grouping of students can influence our efforts in enhancing group-based learning simply because the cognitive load theory entails that an incomplete knowledge base is important to create optimum conditions for collaborative learning (Retnowati et al., 2018). In the case of a homogeneous grouping, it is difficult for the members to fill the knowledge gap as they have a similar knowledge base (Zhang et al., 2016). However, in a heterogeneous grouping, obtaining information from other group members may be possible. Therefore, homogeneous grouping may cause collaboration to be redundant and thus, less effective than individual learning.

In what follows, a relevant question is how should lecturers group their students? Based on the findings presented, it is still possible to allow students to choose their group members due to the development of transaction memory. According to Hollingshead (2001), this memory provides group members knowledge of what each member knows and how to communicate this information. Therefore, there is an advantage to having group members who are more familiar with each other than otherwise. However, lecturers may have to intervene if there is any group where all the members are high distinction students or the other extreme. Of note, this situation is unlikely to frequently occur.

Lastly, in relation to the cognitive load theory again, there are two advantages of collaboration. First, when completing complex tasks, group members can reduce the intrinsic cognitive load of the tasks (stems from the to-be-learned materials) by offloading the cognitive effort across group members' working memories. Second, the extraneous cognitive load (generated by instructional designs) can also be reduced by learning relevant information communicated from other group members (Kirschner et al., 2009).

Development of Student Feedback Literacy and Peer Formative Feedback

One can approach the contributions of feedback to CAL from two perspectives. The first perspective suggests the student feedback literacy, thereby extending the scope of the students' involvement in CAL. For the second perspective, on the other hand, it involves the lecturers' contributions that may reflect a new dimension of feedback related to learning and teaching. It is important to gain insights into these perspectives, starting from a common complaint from university students on the lack of feedback they received or more specifically the quality of feedback. To this end, universities have put in a lot of effort to improve the feedback quality, but according to Wingate (2010), it still does not result in improved student learning. It is important to note here that feedback is just a comment unless students act on it. If so, students are less likely to act on feedback if they perceive the assessment tasks are not authentic and/or relevant to their studies (Evans & Waring, 2011). Therefore, to make assessment and learning authentic and relevant to students, Garrison and Cleveland-Innes (2005) suggest to structure effectively the interaction among lecturers, students and disciplinary content. Additionally, Carless and Boud (2018) define feedback as a process whereby students make use of the information from various sources to improve their learning. The question is can students act on the information provided from the interaction and several sources? In other words, are they equipped with feedback literacy in order to make sense of the information? In what follows, the author discusses the framework of feedback literacy which consists of appreciating feedback, making judgments, managing affect, and taking action (Carless & Boud, 2018).

First, appreciating feedback—lecturers have to provide students with feedback, but do so to support learning and not because of increasing discourses of students as consumers and therefore, lecturers have to tell students what to do to achieve high grades (Bunce et al., 2017). It is important to note here that accepting these discourses may inhibit students from taking responsibility for their learning and eventually lead to passive student reactions to feedback. In doing so, they may not appreciate the value of feedback and sometimes fail to recognise feedback can take different forms other than written comments on submitted work. To this end, it is essential that students are made aware that lecturers may provide audio and video feedback. Additionally, while interacting in CAL environments peer feedback is a powerful tool that may lead to the development of a supportive learning community that mutually provides peer learning support (Gikandi & Morrow, 2016).

Second, feedback judgments—lecturers have to provide opportunities for students to make decisions on the quality of work of oneself and others (Tai et al., 2018). To illustrate, lecturers can explain to students how to self-evaluate one's work using a rubric. Consequently, point out areas for improvements. Once students have acquired the self-evaluation skills then they are ready to carry out peer evaluation. It may be useful to note that self-evaluation is one of the skills that typifies self-regulation, which is at the nexus of CAL. Specifically, as students review their progress of a task, internal feedback is generated which students can refine in comparison with the external lecturer feedback. In doing so, feedback can beneficially be focused on supporting student learning than conventional feedback as telling (McConlogue, 2015).

Third, managing affect—generally students are defensive when they receive negative feedback such as critical comments or low grades. To this end, does it mean negative affective reactions may demotivate students in learning? According to Lipnevich et al. (2016), it depends on the tone of the feedback. Even though the feedback may be negative if it signifies that the lecturers care for the student learning, then student engagement with the feedback is enhanced (Sutton, 2012). Further, students' mixed activating affect, that is, positive activating emotions (e.g., enjoyment) and negative activating emotions (e.g., anxiety) are more likely to be triggered by socially-related factors rather than task-related factors (Tormanen et al., 2021). In CAL, lecturers facilitate student learning and not passively deliver information to students as it is normally practised in a teacher-centred environment. Consequently, through facilitation and social interaction an emotional engagement develops over time where lecturers show more interest and care in their student learning. In what follows, in this trusting atmosphere students are more likely to engage with the feedback provided.

Fourth, taking action – at the last stage of the feedback literacy students need to engage actively with the information in the feedback and use it to inform their later work, thereby closing the feedback loop (Boud & Molloy, 2013). It is pertinent that lecturers ensure the loop is closed, otherwise, the information given will remain as comments and not feedback designed to support learning. To serve this purpose, there are many possibilities. One, consider giving socio-constructivist feedback where students have to act on it in their group-based activities in order to proceed. Two, allow students to resubmit their work for better marks when they act on the feedback and explain how they use the information to improve their work. Three, incorporate peer feedback as a group-based learning activity requiring students to act on members' comments to arrive at the group consensus. Subsequently, when they exchange ideas and responses in intergroup discussions, they have to react reasonably to every feedback from their peers. Four, provide training to students on how to affectively, cognitively and behaviourally engage with peer feedback and to encourage students to explore how they act upon peer feedback (Yu et al., 2019).

Once students are equipped with feedback literacy, they are in a stronger position to review peers' work and offer formative feedback, which in turn helps them to develop self-assessment (Nicol & Macfarlane, 2006). For the feedback to achieve effectiveness in the formative processes, it has to be constructive (Gikandi et al., 2011) so that students have to play an active role in constructing their own meaning from the feedback they received (Nicol & Macfarlane, 2006). To this end, the peer formative feedback helps to foster self-regulated learning as it exposes students to alternative perspectives, which in turn triggers students' self-assessment to revise or reject their initial perspectives. As such, new knowledge is constructed collaboratively through negotiated meanings (Nicol & Macfarlane, 2006). Therefore, it is theoretically plausible to state that peer formative feedback is a form of collaborative active learning. Likewise, conceptualising peer formative feedback as self-regulatory learning, Green (2019) argues the need to enact feedback as a process that is both dialogic and empowering: students need to see their need to negotiate meaning through dialogue and to be empowered to "talkback" in order to reconstruct feedback in their own terms. In doing so, they are not suppressed into accepting feedback with no choice or say.

It is noteworthy that CAL can only succeed in a supportive learning community. One important ingredient to nurture this community is peer formative feedback where students mutually provide peer learning support and increasingly self-regulate their learning (Gikandi & Morrow, 2016). Interestingly, this learning community may stimulate students to narrate their prior knowledge and experiences that provide opportunities for collaboration and peer feedback. In doing so, it may help to connect their thinking to other broader contexts in ways that demonstrate authentic learning in the real-world environments (Gikandi & Morrow, 2016). In what follows, the second ingredient which complements the first in nurturing the learning community comes from the lecturers. They have to avoid providing feedback as a means of information transmission which is very similar to feedback as telling. Initially, lecturers may face strong resistance from students, especially those who still believe it is the lecturers' responsibility to convey correct information to them when they make mistakes. In other words, getting these students to construct meanings from feedback is certainly beyond their beliefs and values regarding feedback and their role in the process. Nevertheless, lecturers have to guide students on how to engage constructively and to facilitate group discussions by providing responses for the students to reflect and to enrich the discourse with expansive ideas and probes. Lastly, lecturers should explicitly inform students that in CAL, peer formative feedback is a key aspect within the learning processes. As such, it is an individual and shared responsibility of every group member to contribute constructively to these processes. Evans and Waring (2011) concur that tackling students' perceptions of peer feedback should begin from the outset.

Assessment for Learning as Support of Student Self-Regulation

Traditionally, lecturers use assessment to determine how well students have learned. As a result, students usually associate assessment with marks and grades and rarely with learning. In what follows, based on the collaborative active learning (CAL) strategies, feedback as discussed in the previous section, and now assessment have been bestowed functional roles in support of student learning by the lecturers. Specifically, students are given activities with clear learning outcomes and performance criteria. Next, lecturers, students and peers elicit, interpret and reflect on the learning evidence obtained from observation, dialogue and demonstration. Following this evidence, lecturers shall take pedagogical actions to promote students' active involvement in the assessment process. In other words, the activities are forms of assessment, not for marks, but for learning and this practice is known as assessment for learning (Heritage, 2016). Besides lecturers, students should take an active role in assessing their own learning with the intention of making adjustments to their goal attainment in relation to the learning evidence obtained (self-regulation of learning). Finally, the peers in the group provide regulatory support through scaffolding (co-regulation of learning). When members of a group receive this type of learning support, it helps them to appropriate the learning processes, regulate their own learning and generate their own judgments of performance (Hadwin et al., 2011).

Having a socio-constructivist theoretical basis, the CAL strategies primarily deal with activities which are group-based and require collaborative interactions among group members. If so, in the context of assessment for learning, lecturers have to blend learning activities with the assessment activities that mirror real-life uses of the discipline that helps students in their regulation of learning. Therefore, lecturers have to set clear learning outcomes and performance criteria (rubric) in the activities. Additionally, they have to explain the criteria in the rubric as well as the expectations of the learning outcomes. The reason being, the regulation of learning can only be carried out with respect to specific targets, in this case, they are learning outcomes and performance criteria. In what follows, activities that induce collaboration between students are tasks that compel them to work together. This is essential because assessment for learning is a process that requires constant inputs of information that students can use as feedback to regulate their own learning process and that of the peers to meet the learning goals (Black et al., 2004).

According to Swaffield (2011), lecturers can regulate opportunities for learning, but not learning per se which is solely the function of students. To this end, how can students self-regulate learning in the context of assessment for learning? It is important to note here that Boekaerts and Cascallar (2006) regard self-regulation entails setting goals, developing plans to attain goals, monitoring progress towards goals and finally adapting learning approaches to move closer to the desired goals. If so, the initial practice of assessment for learning is the setting of the learning outcomes of the activities and performance criteria by lecturers which can easily become the learning goals students have to set in self-regulation. Even though it is just a short-term goal in relation to the activities, students can learn from this experience and eventually set their own long term personal learning goals. Next, lecturers play a pertinent role to assist students in understanding the expectations of the learning outcomes and the performance criteria which will be used to draw evidence of learning under the assessment for learning practice (Heritage, 2018). In doing so, students learn to develop plans to achieve the expectations and criteria mentioned. Consequently, as the learning progresses more evidence emerges and in the CAL environments through co-regulation as in scaffolding, students monitor and adapt the learning approaches to attain the desired goals. In other words, co-regulation is a process of joint regulatory ownership between a student who is providing regulatory support and a student who is accepting regulatory knowledge and skills with the ultimate goal of students acquiring their own self-regulatory skills in learning (Heritage, 2018). Additionally, co-regulation encourages students to put more effort into goal setting, monitoring and group work (Lai, 2021) and it also increases students' attention to tasks and group awareness, which according to Panadero and Järvelä (2015) is a vital factor in students' collaborative learning. Lecturers can also play a moderator role by providing pedagogical support to move student learning forward. Given all the insights above, it is reasonable to state that the practice of assessment for learning helps students to self-regulate their learning.

After reporting the practices of assessment for learning, it may be judicious to consider the effect of authentic assessment in these practices. According to Wiggins (1993), authentic assessment refers to real-world tasks that require students to demonstrate their knowledge and skills effectively and creatively. The nature of the tasks tends to reflect the kinds of problems usually faced by professionals in the field. Therefore, it provides opportunities for students to learn whilst undertaking the assessment (Swaffield, 2011). To this end, the opportunities themselves challenge the students to think like professionals in coming up with plans and strategies to complete the tasks. Unsurprisingly, students have to work in a group actively collaborating with one another to offer regulatory support through scaffolding. Of course, lecturers will facilitate the learning processes by giving the students autonomy in learning. Therefore, the use of authentic assessment in the CAL environments does serve the two underlying principles of assessment for learning, that is, making learning explicit and promoting learning autonomy (James et al., 2007).

Implementing Collaborative Active Learning Using Student Peer Instruction

The present section provides insights into a pragmatic transition from a traditional lecture style of delivery to an engaging constructive approach using peer instruction which is an effective active learning pedagogy (Mazur, 1997). In the context of collaborative active learning (CAL), every group member should be cognisant that peer instruction is a joint effort and not a sole responsibility of one or two members. In other words, peer-to-peer teaching resulted in a collaborative engaged learning. According to Arico and Lancaster (2018), during peer instruction, students are entirely in control of their learning, and self-regulate the discussion. They can refer to notes, discuss in small groups and even extend it across different groups. Based on the description of peer instruction enriched by self-regulation and discussion, it is pertinent that students must negotiate meaning through dialogue and be empowered to "talkback" in order to reconstruct understanding in their own terms (Green, 2019). In other words, they are not suppressed into accepting their peer teaching with no choice or say. Therefore, peer instruction or, by and large, peer formative feedback in CAL appears to share a common element of self-regulation which is the ability of students to monitor and manage their learning. What matters most here is any nuanced distinctions that exist between peer instruction and peer formative feedback are just conceptual definitions with no significant impact on student learning.

What are the natures of learning activities that are suitable for peer instruction in the CAL environments? In this regard, the activities must be complex enough to mirror the real-life uses of the disciplines and yet challenging to compel students to peer teach and learn from one another. To illustrate, let's consider online and offline quizzes. Normally, quizzes are used to test students' understanding of the lessons taught. From a CAL perspective, quizzes can be turned into lessons for students to peer teach one another supported by notes and other learning materials. To this end, questions are set to stimulate thinking and discussion based on new concepts but somehow related to those already taught. Initially, students are invited to answer the questions autonomously and without consulting with one another. After that, they come together to peer teach, to reconstruct understanding and to negotiate meaning of the new concepts. In doing so, they collectively agree to the most appropriate answers to the questions and present them to their peers in the other groups as well as the lecturers. Following this presentation, students have to explain and defend their answers when they are challenged. Given all the insights above, it is clear that peer instruction assists students to collaboratively engage and construct understanding in the spirit of active learning.

The format of the activities can vary, that is, besides quizzes the other options are online forum discussion, small group debate in Zoom Breakout Rooms, and assessment for learning activities. All these different formats purport to bridge the significance of self-assessment to self-regulation so that the pragmatic insights of the transition to CAL using peer instruction can become stronger and more comprehensive. The ability to self-assess is an important metacognitive skill. According to Arico and Lancaster (2018), through self-assessment students are able to appraise their level of knowledge and skills prior to engaging in peer instruction. In a similar vein, they also benefit from reflective observation as described in Kolb's experiential learning model (Kolb, 2015). In this regard, peer instruction serves to strengthen the perception that students learn more when they teach others. This is because during peer instruction students observe any inconsistencies between their existing understanding and the experience. Consequently, they reflect on the observation leading to improved learning. In addition, technology-enhanced peer learning has a positive impact on mentors' metacognitive awareness and on the development of communicative and collaborative competencies (Carvalho & Santos, 2022).

Strategies to Mitigate Student Resistance

A glance at the literature reveals that students respond positively to active learning (O'Brocta & Swigart, 2013), however, there are counterbalancing studies which show mixed student responses (Wilke, 2003) and even negative student responses (Lake, 2001). It is noteworthy that in active learning students have to construct meaningful mental models of new knowledge based on their prior knowledge by being cognitively involved and engaged in the learning process (Clark & Mayer, 2008). By allowing students to express themselves easily and to engage in the learning process, why do they react differently from positive consequences to negative effects? It may be useful to explore the possible causes of student resistance or negative reaction to active learning before engaging in strategies to mitigate the resistance. In what follows, under the collaborative active learning (CAL) environment for students to engage in the learning process, first it involves student self-regulation of the learning followed by group members' social interaction to arrive at a consensus. To this end, the possible causes of student resistance may lie in self-regulation and social interaction.

To illustrate, according to Zimmerman and Tsikalas (2005), being aware of missing or low prior knowledge may facilitate students' self-regulation to select appropriate strategies to fill the knowledge gaps. The problem is the lower-performing students may need assistance in regulating their cognitive processes (Vrugt & Oort, 2008) of self-regulation such as planning activities, awareness of comprehension and task performance and evaluation of strategies (Lai, 2011). Consequently, it is reasonable to state that the self-regulatory skills needed in CAL may trigger student disdain for active learning as they feel handicap in the learning process. In this regard, to mitigate the situation lecturers can set up an active community for the lower-performing students to support one another and for the more capable peers to assist them. If so, through the process known as co-regulation the peers provide regulatory support in the form of scaffolding. When members of the active community receive this type of learning support, it helps them regulate their own learning and generate their own judgments of performance (Hadwin et al., 2011). Eventually, this group of students will learn self-regulatory skills. Also, in the community, students may receive personalised feedback from their peers which according to Zheng et al. (2022) may enable them to better co-regulate their behavioural patterns and to significantly improve their collaborative knowledge-building.

In terms of arriving at a shared co-constructed meaning through social interaction, ideally all members of a group should contribute to the discussion. However, occasionally there are individuals who put in less effort than is fair while adding little or no value to the group work; they are known as free riders. The majority of the free riders want to take advantage of the group, but there are a few cases where the students' academic ability and language problem may be an impediment to their contributions. Therefore, it may be judicious to resolve any misunderstanding by checking the students' commitments in the social interaction. This is crucial because social interaction is paramount in CAL and according to Abernethy and Lett (2005), free riders may cause students to feel anxiety and frustration about grades received for group work. If the problem is not mitigated it may drive other students to be free riders later on (El Massah, 2018). When it happens, social interaction will fail and according to the theories of social loafing and the sucker effect, free-riding behaviour has a cumulatively negative impact on student learning (Chapman et al., 2006).

Therefore, to address free riders in a collaborative group work there are three options: peer assessment, lecturer pressure and incentives and penalties. Studies suggest that peer assessment may improve student engagement when individual members assess their peers' contributions (Johns-Boast, 2010) and also reward students who make greater efforts (Hall & Buzwell, 2012). Furthermore, lecturer pressure may be effective in determining individual performance and somehow control free-riding (Jones, 1984). The author highlights that lecturer can randomly call upon any member of a group to query his/her understanding of the group work submitted as well as during the CAL interaction. In this manner, it may not add extra workload on the lecturer and at the same time, the students are reminded of their participation. Finally, employing a grading scheme that penalises unproductive group members may eliminate free riders (Roberts & McInnerney, 2007).

In terms of increasing the effectiveness of social interaction, besides addressing the issue of free riders, the social interdependence theory (Johnson & Johnson, 2009) is particularly helpful and essential to student collaborative work. Specifically, the element of positive interdependence among students that spells out every group member's contribution, commitments and responsibilities to the group learning process and product. Given the high expectations of the student participation, it is plausible to expect substantial role shifts for students and also student resistance to group work (Perumal, 2008). After all, according to MacGregor (1991), the transition from passive learning into CAL settings may cause students to struggle with several role shifts. Still though, what matters most here is what strategies lecturers used to mitigate the problems or resistance arising from the role shifts.

The author highlights a few pertinent issues as follows:

- Students have to play an active role as problem solvers rather than passive listeners. They are expected to contribute to group discussion, argue and defend their position and arrive at a group consensus. Lecturers can support students by valuing their contributions and engagements in group work (Stover & Holland, 2018). It is also important to take a look at students' personal preference for learning mode that may cause some resistance to CAL (Reynolds & Trehan, 2001) and the patterns of power dynamics related to race and gender within the collaborative group formation (Perumal, 2008).
- Students are expected to come prepared for group discussions as compared to a low expectation of preparation for a lecture class. They are required to respond to the pre-class learning activities in the forms of reading, watching a short video, attempting an online quiz, and virtual discussions. Lecturers can add values to the pre-class activities by linking them to the in-class activities and eventually to graded assignments. Furthermore, according to Chang-Tik and Goh (2020), the lower-performing students may need some scaffolding for them to comprehend and respond effectively to these activities. It may take the form of worked examples and process worksheets (Van Merrienboer, 1997) to provide descriptions of the activity students should go through, complete with some hints.
- Students are required to collaborate with peers rather than compete with them. Generally, since secondary school time students were used to competing with one another and not collaborating as a team.

Lecturers can encourage students to collaborate by explaining to them group work helps to build transferable skills such as leadership, management and communication skills (Curseu et al., 2012). In addition, it promotes deep, active, and experiential learning and the skills developed in a team will increase their chances for future employment (Davies, 2009). As students' skills to collaborate are not self-evident (Kirschner et al., 2006), lecturers have to teach them these skills as well as to provide feedback and encouragement for them to self-reflect.

- Students need to accept another source of authority and knowledge rather than from the lecturers alone. They find it difficult to be in a position where they are unsure of an answer and do not have an authoritative figure to distinguish the important content from others (Owens et al., 2020). Lecturers need to communicate clear intentions, and develop protocols and structures for active learning so that students are aware that peer feedback (Carless & Boud, 2018) and peer instruction (Arico & Lancaster, 2018) are valuable sources of knowledge. Additionally, to promote greater joint responsibility for group work and peer learning, lecturers should encourage students to refer to their peers for support (Frykedal & Hammar Chiriac, 2018) rather than focusing on only one source, that is, the lecturers themselves.

Conclusion

In a collaborative active learning (CAL) environment, students are expected to come prepared for group interaction, actively participate in the argument, elaboration and reasoning, and also to collectively regulate emotional conflicts. The majority of students are inexperienced in these activities, especially the lower-performing ones. Therefore, it is pertinent that lecturers have the pedagogical strengths to promote productive knowledge construction through the CAL approach. To this end, lecturers can rely on the framework of participation (Black-Hawkins, 2013) to increase the effectiveness of interaction and also the Social Interdependence Theory (Johnson & Johnson, 2013) to maximise the collaborative potential of groups. Otherwise, it may lead to student resistance and disdain for active learning.

To be included as pedagogical strengths, lecturers have to develop student feedback literacy so that students can actively act on feedback in their learning process and to provide formative feedback leading to peer learning. On this note, lecturers have to explicitly inform students that in CAL, peer formative feedback is a key aspect within the learning processes. As such, it is an individual and shared responsibility of every group member to contribute constructively to these processes. Additionally, lecturers have to utilise assessment for learning as a foundation for students to acquire self-regulatory skills as well as co-regulation with the group members through the use of authentic assessment. Lastly, lecturers have to design complex and challenging activities to induce students to peer instruction in hospitable learning environments. It is pertinent that in peer instruction students must negotiate meaning through dialogue and be empowered to "talkback" in order to reconstruct understanding in their own terms (Green, 2019).

Practically speaking, placing students in groups is just the first initial step in the CAL approach. There are many essential moves needed to get them ready to reap the benefits of collaborative active learning. This suggests both lecturers and students have to mutually complement each other to achieve success in CAL.

References

Abernethy, A., & Lett, W. (2005). You are fired! A method to control and sanction free riding in group assignments. *Marketing Education Review, 15*(1), 47–54. https://doi.org/10.1080/10528008.2005.11488891

Arico, F. R., & Lancaster, S. J. (2018). Facilitating active learning and enhancing student self-assessment skills. *International Review of Economics Education, 29*(2018), 6–13. https://doi.org/10.1016/j.iree.2018.06.002

Baker, M. J. (2002). Forms of cooperation in dyadic problem-solving. *Revue D'intelligence Artificielle, 16*(4–5), 587–620. https://doi.org/10.3166/ria.16.587-620

Black-Hawkins, K. (2013). Researching inclusive classroom practices: The framework for participation. In L. Florian (Ed.), *The sage handbook of special education* (pp. 389–403). Sage Education.

Black, P., Harrison, C., Lee, C., Marshall, B., & William, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 86*(1), 8–21. https://doi.org/10.1177/003172170408600105

Boekaerts, M., & Cascallar, E. (2006). How far have we moved toward the integration of theory and practice in self-regulation? *Educational Psychology Review, 18*(3), 199–210. https://doi.org/10.1007/s10648-006-9013-4

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education, 38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Buchs, C., Butera, F., Mugny, G., & Darnon, C. (2004). Conflict elaboration and cognitive outcomes. *Theory into Practice, 43*(1), 23–30. https://doi.org/10.1207/s15430421tip4301_4

Bunce, L., Baird, A., & Jones, S. (2017). The student-as-consumer approach in higher education and its effects on academic performance. *Studies in Higher Education, 42*(11), 1958–1978. https://doi.org/10.1080/03075079.2015.1127908

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & Evaluation in Higher Education, 43*(8), 1315–1325. https://doi.org/10.1080/02602938.2018.1463354

Carvalho, A. R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*, Article 100070. https://doi.org/10.1016/j.caeo.2021.100070

Chang-Tik, C., & Dhaliwal, J. (2022). Collaborative learning approach to teach computer coding in informal spaces. *Learning: Research and Practice, 8*(1), 5–24. https://doi.org/10.1080/23735082.2021.1953571

Chang-Tik, C., & Goh, J. N. (2020). Social and cognitive dimensions of collaboration in informal learning spaces (CLIS): Malaysian social science students' perspectives. *Interactive Learning Environments*. Advance online publication. https://doi.org/10.1080/10494820.2020.1799029

Chapman, K., Meuter, M., Toy, D., & Wright, L. (2006). Can't we pick our own groups? The influence of group selection method on group dynamics and outcomes. *Journal of Management Education, 30*(4), 557–569. https://doi.org/10.1177/1052562905284872

Clark, R. C., & Mayer, R. E. (2008). Learning by viewing versus learning by doing: Evidence-based guidelines for principled learning environments. *Performance Improvement, 47*(9), 5–13. https://doi.org/10.1002/pfi.20028

Curseu, P. L., Janssen, S. E., & Raab, J. (2012). Connecting the dots: Social network structure, conflict, and group cognitive complexity. *High Education, 63*(5), 621–629. https://doi.org/10.1007/s10734-011-9462-7

Darnon, C., Muller, D., Schrager, S., Pannuzzo, M., & Butera, N. F. (2006). Mastery and performance goals predict epistemic, and relational conflict regulation. *Journal of Educational Psychology, 98*(4), 766–776. https://doi.org/10.1037/0022-0663.98.4.766

Davies, W. M. (2009). Groupwork as a form of assessment: Common problems and recommended solutions. *Higher Education, 58*(4), 563–584. https://doi.org/10.1007/s10734-009-9216-y

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology, 88*(4), 741–749. https://doi.org/10.1037/0021-9010.88.4.741

Dillenbourg, P., & Betrancourt, M. (2006). Collaboration load. In J. Elen & R. E. Clark (Eds.), *Scripting computer-supported collaborative learning* (pp. 275–301). Springer.

Dillenbourg, P., & Traum, D. (2006). Sharing solutions: Persistence and grounding in multimodal collaborative problem solving. *Journal of the Learning Science, 15*(1), 121–215. https://doi.org/10.1207/s15327809jls1501_9

El Massah, S. S. (2018). Addressing free riders in collaborative group work: The use of mobile application in higher education. *International Journal of Educational Management, 32*(7), 1223–1244. https://doi.org/10.1108/IJEM-01-2017-0012

Evans, C., & Waring, M. (2011). Exploring students' perceptions of feedback in relation to cognitive styles and culture. *Research Papers in Education, 26*(2), 171–190. https://doi.org/10.1080/02671522.2011.561976

Finn, J. D., & Zimmer, K. S. (2012). Student engagement: What is it? Why does it matter. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.). *Handbook of research on student engagement* (pp. 97–132). Springer Science & Business Media.

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(3), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Frykedal, K. F., & Hammar Chiriac, E. (2018). Student collaboration in group work: Inclusion as participation. *International Journal of Disability, Development and Education, 65*(2), 183–198. https://doi.org/10.1080/1034912X.2017.1363381

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133–148. https://doi.org/10.1207/s15389286ajde1903_2

Gikandi, J. W., & Morrow, D. (2016). Designing and implementing peer formative feedback within online learning environments. *Technology, Pedagogy and Education, 25*(2), 153–170. https://doi.org/10.1080/1475939X.2015.1058853

Gikandi, J. W., Morrow, D., & Davis, N. E. (2011). Online formative assessment in higher education: A review of the literature. *Computers & Education, 57*(4), 2333–2351. https://doi.org/10.1016/j.compedu.2011.06.004

Green, S. (2019). What students don't make of feedback in higher education: An illustrative study. *Journal of English for Academic Purposes, 38*(2019), 83–94. https://doi.org/10.1016/j.jeap.2019.01.010

Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially shared regulation of learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *The handbook of self-regulation of learning and performance* (pp. 65–84). Routledge.

Hall, D., & Buzwell, S. (2012). The problem of free-riding in group projects: Looking beyond social loafing as reason for non-contribution. *Learning in Higher Education, 14*(1), 37–49. https://doi.org/10.1177/1469787412467123

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Heritage, M. (2016). Assessment for Learning: Co-regulation in and as student-teacher interactions. In D. Laveault & V. L. Allal (Eds.), *Assessment for learning: Meeting the challenge of implementation* (pp. 327–343). Springer.

Heritage, M. (2018). Assessment for learning as support for student self-regulation. *The Australian Educational Research, 45*(1), 51–63. https://doi.org/10.1007/s13384-018-0261-3

Hollingshead, A. B. (2001). Cognitive interdependence and convergent expectations in transactive memory. *Journal of Personality and Social Psychology, 81*(6), 1080–1089. https://doi.org/10.1037//0022-3514.81.6.1080

Hrastinski, S. (2008). What is online learner participation? A literature reviews. *Computers & Education, 51*(4), 1755–1765. https://doi.org/10.1016/j.compedu.2008.05.005

James, M., Black, P., Carmichael, P., Drummond, M. J., Fox, A., MacBeath, J., & McCormick, R. (2007). *Improving learning how to learn: Classrooms, schools and networks*. Routledge.

Janis, I. L. (1972). *Victims of groupthink*. Houghton Mifflin.

Jeong, H., & Chi, M. T. H. (2007). Knowledge convergence and collaborative learning. *Instructional Science, 35*(4), 287–315. https://doi.org/10.1007/s11251-006-9008-z

Johnson, D. W., & Johnson, F. P. (2013). *Joining together: Group theory and group skills* (11th ed.). Allyn and Bacon.

Johnson, D. W., & Johnson, R. T. (2002). Learning together and alone: Overview and meta-analysis. *Asia Pacific Journal of Education, 22*(1), 995–1005. https://doi.org/10.1080/0218879020220110

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher, 38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Johns-Boast, L. (2010). Group work and individual assessment. Proceedings of the *21st Annual Conference for the Australasian Association for Engineering Education* (pp. 46–51). Engineers Australia, Sydney.

Jones, G. R. (1984). Task visibility, free riding, and shirking: Explaining the effect of structure and technology on employee behaviour. *The Academy of Management Review, 9*(4), 684–695. https://doi.org/10.5465/amr.1984.4277404

Kayes, D. (2004). The 1996 Mount Everest climbing disaster: The breakdown of learning in teams. *Human Relations, 57*(10), 1263–1284. https://doi.org/10.1177/0018726704048355

Kayes, A., Kayes, C., & Kolb, D. (2005). Experiential learning in teams. *Simulation and Gaming, 36*(3), 330–354. https://doi.org/10.1177/1046878105279012

Kirschner, F., Paas, F., & Kirschner, P. A. (2009). A cognitive load approach to collaborative learning: United brains for complex tasks. *Educational Psychology Review, 21*(1), 31–42. https://doi.org/10.1007/s10648-008-9095-2

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75–86. https://doi.org/10.1207/s15326985ep4102_1

Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Pearson Education.

Lai, C.-L. (2021). Effects of the group-regulation promotion approach on students' individual and collaborative learning performance, perceptions of regulation and regulation behaviours in project-based tasks. *British Journal of Educational Technology, 52*(6), 2278–2298. https://doi.org/10.1111/bjet.13138

Lai, E. R. (2011). *Metacognition: A literature review*. Upper Saddle River: Pearson.

Lake, D. (2001). Student performance and perceptions of a lecture-based course compared with the same course utilizing group discussion. *Physical Therapy, 81*(3), 896–902. https://doi.org/10.1093/ptj/81.3.896

Lipnevich, A. A., Berg, D., & Smith, J. K. (2016). Toward a model of student response to feedback. In G. T. L. Brown & L. Harris (Eds.), *Human factors and social conditions in assessment* (pp. 169–185). Routledge.

MacGregor, J. (1991). Collaborative learning: Reframing the classroom. *Professional and Organizational Development Network in Higher Education, 2*(3). Retrieved from https://podnetwork.org/content/uploads/V2-N3-MacGregor.pdf

Mazur, E. (1997). *Peer instruction: A user's manual*. Prentice Hall.

McConlogue, T. (2015). Making judgements: Investigating the process of composing and receiving peer feedback. *Studies in Higher Education, 40*(9), 495–1506. https://doi.org/10.1080/03075079.2013.868878

Mercer, N. (2008). Talk and development of reasoning and understanding. *Human Development, 51*(1), 90–100. https://doi.org/10.1159/000113158

Molinillo, S., Aguilar-Illescas, R., Anaya-Sanchez, R., & Vallespin-Aran, M. (2018). Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Computers & Education, 123*(August), 41–52. https://doi.org/10.1016/j.compedu.2018.04.012

Naykki, P., Jarvela, S., Kirschner, P. A., & Jarvenoja, H. (2014). Socio-emotional conflict in collaborative learning – A process-oriented case study in a higher education context. *International Journal of Educational Research, 68*(2014), 1–14. https://doi.org/10.1016/j.ijer.2014.07.001

Nicol, D., & Macfarlane, D. (2006). Formative assessment and self-regulated learning; A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218. https://doi.org/10.1080/03075070600572090

O'Brocta, R., & Swigart, S. (2013). Student perceptions of a top 200 mediation course utilizing active learning techniques. *Currents in Pharmacy Teaching and Learning, 5*(1), 49–53. https://doi.org/10.1016/j.cptl.2012.09.001

Owens, D. C., Sadler, T. D., & Barlow, A. T. (2020). Student motivation from and resistance to active learning rooted in essential science practices. *Research in Science Education, 50*, 253–277. https://doi.org/10.1007/s11165-017-9688-1

Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist, 20*(3), 190–203. https://doi.org/10.1027/1016-9040/a000226

Perumal, J. (2008). Student resistance and teacher authority: The demands and dynamics of collaborative learning. *Journal of Curriculum Studies, 40*(3), 381–398. https://doi.org/10.1080/00220270701724570

Retnowati, E., Ayres, P., & Sweller, J. (2018). Collaborative learning effects when students have complete or incomplete knowledge. *Applied Cognitive Psychology, 32*(6), 681–692. https://doi.org/10.1002/acp.3444

Reynolds, M., & Trehan, K. (2001). Classroom as real world: Propositions for a pedagogy of difference. *Gender and Education, 13*(4), 357–372. https://doi.org/10.1080/09540250120081724

Roberts, T., & McInnerney, J. (2007). Seven problems of online group learning (and their solutions). *Educational Technology and Society, 10*(4), 257–268.

Sidelinger, R. J., & Booth-Butterfield, M. (2010). Co-constructing student involvement: An examination of teacher confirmation and student-to-student connectedness in the college classroom. *Communication Education, 59*(2), 165–184. https://doi.org/10.1080/03634520903390867

Smith, R., & Flaherty, J. (2013). The importance of social presence in an online MBA program – a preliminary investigation. *Teaching and Learning Innovation, 16*(2013).

Sommet, N., Darnon, C., Mugny, G., Quamzade, A., Pulfrey, C., Dompnier, B., & Butera, F. (2014). Performance goals in conflictual social interactions: Towards the distinction between two modes of relational conflict regulation. *British Journal of Social Psychology, 53*(1), 134–153. https://doi.org/10.1111/bjso.12015

Stover, S., & Holland, C. (2018). Student resistance to collaborative learning. *International Journal for the Scholarship of Teaching and Learning, 12*(2), 1–9. https://doi.org/10.20429/ijsotl.2018.120208

Sutton, P. (2012). Conceptualizing feedback literacy: Knowing, being, and acting. *Innovations in Education and Teaching International, 49*(1), 31–40. https://doi.org/10.1080/14703297.2012.647781

Swaffield, S. (2011). Getting to the heart of authentic assessment for learning. *Assessment in Education: Principles, Policy & Practice, 18*(4), 433–449. https://doi.org/10.1080/0969594X.2011.582838

Tai, J., Ajjawi, R., Boud, D., Dawson, P., & Panadero, E. (2018). Developing evaluative judgement: Enabling students to Make decisions about the quality of work. *Higher Education, 76*, 467–481. https://doi.org/10.1007/s10734-017-0220-3

Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education*, *5*(7), 1–16. https://doi.org/10.1186/s40594-018-0102-y

Tormanen, T., Jarvenoja, H., & Manty, K. (2021). Exploring groups' affective states during collaborative learning: What triggers activating affect on a group level? *Educational Technology Research and Development*, *69*, 2523–2545. https://doi.org/10.1007/s11423-021-10037-0

Van den Bossche, P., Gijselaers, W., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science, 39*(3), 283–301. https://doi.org/10.1007/s11251-010-9128-3

Van Merrienboer, J. J. G. (1997). *Training complex cognitive skills*. Educational Technology Publications.

Van Zee, E., & Minstrell, J. (1997). Using questioning to guide student thinking. *Journal of the Learning Sciences, 6*(2), 227–269. https://doi.org/10.1207/s15327809jls0602_3

Vrugt, A., & Oort, F. J. (2008). Metacognition, achievement goals, study strategies and academic achievement: Pathways to achievement. *Metacognition and Learning, 3*(2), 123–146. https://doi.org/10.1007/s11409-008-9022-4

Wiggins, G. P. (1993). *Assessing student performance*. Jossey-Bass.

Wilke, R. R. (2003). The effect of active learning on student characteristics in human physiology course for non-majors. *Advances in Physiology Education, 27*(4), 207–220. https://doi.org/10.1152/advan.00003.2002

Wingate, U. (2010). The impact of formative feedback on the development of academic writing. *Assessment & Evaluation in Higher Education, 35*(5), 519–533. https://doi.org/10.1080/02602930903512909

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science, 330*(6004), 686–688. https://doi.org/10.1126/science.1193147

Yu, S., Zhang, Y., Zheng, Y., Yuan, K., & Zhang, L. (2019). Understanding student engagement with peer feedback on master's theses: A Macau study. *Assessment & Evaluation in Higher Education, 44*(1), 50–65. https://doi.org/10.1080/02602938.2018.1467879

Zhang, L., Kalyuga, S., Lee, C., & Lei, C. (2016). Effectiveness of collaborative learning of computer programming under different learning group formations according to students' prior knowledge: A cognitive load perspective. *Journal of Interactive Learning Research, 27*(2), 171–192.

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education, 47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

Zimmerman, B. J., & Tsikalas, K. E. (2005). Can computer-based learning environments (CBLEs) be used as self-regulatory tools to enhance learning? *Educational Psychologist, 40*(4), 267–271. https://doi.org/10.1207/s15326985ep4004_8

PART II

Practical Activity-Based Approaches in Different Disciplines

CHAPTER 4

Learning to Teach with Technology with Real-World Problem-Based Learning

Meng Yew Tee

Introduction

Teachers who teach effectively with technology activate and draw from the synergies between three essential knowledge foundations—their content knowledge, their pedagogical knowledge and their technological knowledge (Koehler & Mishra, 2005; Tee & Lee, 2011). Mishra and Koehler (2006) conceptualized these synergistic interactions using three intersecting circles with each circle representing technological knowledge, pedagogical knowledge and content knowledge. They called this framework TPACK i.e. technological, pedagogical and content knowledge.

Helping teachers to develop synergistic understandings between these three essential knowledge foundations post practical as well as conceptual challenges. Teachers have often lamented that technology taught to them are not always useful in helping them improve the quality of learning in the classroom. Researchers have found this to be true in many cases

M. Y. Tee (✉)
Universiti Malaya, Kuala Lumpur, Malaysia
e-mail: mytee@um.edu.my; mytee22@yahoo.com

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_4

(Mishra & Koehler, 2006; So & Kim, 2009). The specific technologies may not always be available or reliable in the real-world settings. It may not be suitable for the subjects or the levels they teach at. The classroom setting or their students may not have the necessary infrastructure for the teachers to implement new technology-inspired ideas. In addition, according to Nicol et al. (2018), some students are not mentally prepared to engage with the materials in a technology-based environment. In other words, the users' perception of technologies is related to their relevant experience (Jeong & Hmelo-Silver, 2016). Therefore, for any approaches to be effective in a technology-enhanced learning environment, they should encompass cognitive, emotional and behavioural regulation (Lai, 2021). Therefore, in this chapter, TPACK is developed using an improvised PBL design based on the IDEAL model (Bransford & Steins, 2002) and SECI (socialisation, externalisation, combination and internalisation) processes.

The conceptual challenges can be equally daunting. Teachers in a postgraduate education and professional development setting have different types and levels of content knowledge, pedagogical knowledge and technological knowledge. They have different goals, and teach in very different settings. Their students too can be very different, in terms of their academic, linguistic, cognitive and affective foundations, as well as their socio-economic background and access to different kinds of technologies. Is there a more effective way to help teachers become more aware of their existing knowledge foundations, and take next steps forward in learning to teach with technology more effectively? (Chang-Tik, Chapter 14 this volume) Are there ways to help teachers learn to choose, apply, evaluate and further develop the use of different tools and technologies available in their context, while taking into account their existing instructional know-how, their learners, the contexts they are in, and the nature of the subject they teach?

This chapter will attempt to address these questions, through describing a synthesis of case studies carried out in postgraduate education and professional development settings. The learners or participants in this context are in-service educators who have been teaching for a number of years. The instructional design used to address these challenges is grounded in problem-based learning, with a particular emphasis on problems situated in real-life settings and collaborative support in addressing this real-life problem. The subsequent sections will discuss in further detail the context, the instructional design and implementation, followed by a discussion.

Learning Goals and Context

The in-service educators enrol in this 14-week (3 hours per session, per week) module on technology in teaching and learning as a core subject in the masters in instructional technology program, or as an elective for several other Masters programs in the School of Education at a public university in Malaysia. Most of the participants in this module are teachers, while a few are trainers and aspiring instructional designers. The participants who have participated in this module are in their mid-20s to 50s, with commensurating experience in education. The goal of this instructional technology module was to help the participants, most of whom are in-service teachers, to develop a more synergistic understanding between their three essential knowledge bases—technological, pedagogical and content knowledge.

Briefly, content knowledge (CK) refers to the teacher's knowledge of the subject matter. Pedagogical knowledge (PK) has to do with the teacher's knowledge of the principles, processes and practices of teaching and learning. Technological knowledge (TK), broadly, involves knowing what and how technologies work. The successful synergistic interactions between these knowledge bases inform the teachers' decisions in ways that take advantage of what they know (and what needs to be known) to create more effective learning environments. For instance, pedagogical content knowledge (PCK)—initially conceived by Shulman (1986, 1987)—involves effective synergies between knowledge of pedagogy and the knowledge of a given content area. A history teacher who is drawing from his PCK, for example, may decide to use a case discussion approach to direct the students' attention to the nuances in the interpretation of a historical event, and then conclude with a brief lecture to highlight the most salient points in characterizing that historical event.

However, PCK is not merely utilising certain strategies for a certain content. It also has to be capable of answering how well that particular strategy is useful to facilitate students' understanding. Good teaching with technology for any given content area is complex and multidimensional (Koehler et al., 2007). It requires a nuanced understanding of how different configurations and applications of certain technologies and pedagogical techniques can make learning more or less effective. In this regard, Means et al. (2010) state that in order to improve student learning with technologies, instructional designs, learning outcomes and assessment need to be tailored to suit the new media. This is because technology available within a classroom can have a positive or negative effect on student learning and evaluations of teaching (Lei, 2010).

To develop TPACK, a number of studies have found problem-based learning (PBL) and different forms of inquiry learning to be promising (So & Kim, 2009; Tan & Tee, 2021; Tee & Lee, 2011). In the instructional design of this course, through a collaborative PBL process, the in-service educators will not only learn about technology, they will also learn "how to learn" and "how to think" about technology for the situation they are in, with the goal of helping them engage their students towards the intended learning experiences and outcomes.

Instructional Design: Improvised PBL with Real-World Problems

PBL is an instructional approach in which the instructor creates learning conditions that engages and facilitates student learning through problem-solving, collaboration, self-directed learning and reflection (Hmelo-Silver, 2004). Specifically, according to Hadwin et al. (2017), collaborative learning involves self-regulation of learning, co-regulation of learning and socially shared regulation of learning. In this regard, Er et al. (2021) suggest that dialogic peer feedback plays a significant role in the regulations of learning at different levels. In other words, students have to socially regulate their learning, support one another in the regulation of learning and help to prepare for the transition towards self-regulation. In PBL, students have to discover for themselves the problems and possible resolutions and it is through their attempts to solve the case, they learn the subject (Kaplan, 2018) through collaboration and regulation using the knowledge they already have or the search for new information. In this module, each student team works towards, diagnosing, solving and designing a solution for a complex or ill-structured problem situated in a live, real-world context. In terms of Jonassen and Hung's (2015) typology of problem types, the problems participants worked on in this module has the characteristic of a diagnosis-solutions problem as well as a design problem (see Table 4.1).

The problem introduced in this module is not pre-designed by the instructor or derived from an existing case study. It comes from the participants themselves, and the real-life educational context they are situated in (see Table 4.1). The problem had to be directly related to teaching and learning (in contrast to say, policy or management issues or purely

Table 4.1 Characterization of this module's problem type, redrafted based on Jonassen and Hung's (2015) typology of problem

Problem type	*Diagnosis-solution problems*	*Design problems*
Learning activity	Troubleshoot teaching and learning issues and faults; select and evaluate intervention or solution options and monitor	Acting on goal to produce artifact (or instructional design solution for implementation); problem structuring and articulation
Inputs	Complex teaching and learning systems with faults and numerous possible solutions	Vague goal statement with few constraints; requires structuring
Success criteria	Strategy used; effectiveness and efficiency of intervention; justification of intervention selected	Multiple, undefined criteria; no right or wrong but there's better or worse
Context	Real-world, technical, mostly closed system	Complex, real-world; degrees of freedom; limited input and feedback
Structuredness	Finite faults and outcomes	Ill-structured; assessments and judgments about the nature of the teaching and learning problem are needed
Abstractness	Problem situated	Problem (and context) situated

technical problems). The problem had to be complex (and potentially, ill-structured, See Table 4.1), as opposed to being too simplistic or procedural (for example, 'the technology in my classroom is not reliable' or 'my students don't have access to that technology'). The problem preferably had to be common or similar to what is being faced by at least two other participants in the class. The students worked in teams based on the specific problems they choose to own and respond to. At the initial stages, the instructor's role in this context is to facilitate the problem identification and definition process as well as the formation of collaborative teams. In the latter stages where each team's role is to design and implement a solution for the problem they have identified, the instructor's role is to help them to realize the synergies between their three essential knowledge bases—CK, PK and TK.

This PBL instructional design was based on the essential elements described in Bransford and Steins' (2002) IDEAL model. IDEAL problem-solving process consists of five primary components: Identify problems and opportunities; define goals; explore possible strategies; anticipate outcomes and act; and look back and learn.

Improvisations were made to scaffold the PBL process (Hmelo-Silver et al., 2007), especially for students who have never or rarely engaged in such learning activities. The first aspect of improvisation involved a more deliberate use of guided instruction, in the form of selected readings, mini lectures, and recommended approaches for dealing with the problems (e.g., fishbone diagram). Readings were selected to provide students the framework, language and awareness to discuss their progress in light of TPACK. Mini lectures and reflections by the instructor were given on an as needed basis—most lasting just for a few minutes, but a few may go a bit longer. These brief lectures were given when a majority of students were experiencing a common issue or for establishing essential normative understandings (Tee et al., 2022).

The second aspect of improvisation involved constantly engaging students in the socialisation, externalisation, combination and internalisation (SECI) processes (Nonaka & Takeuchi, 1995; Tee & Karney, 2010; Tee & Lee, 2011). To encourage socialisation, the instructor cultivated informal classroom ethos that encouraged sharing of feelings, emotions, experiences, and mental models. Even though social interaction and collaboration is needed in group-based learning environments, there is a need to pay attention to socially oriented anxiety that may refrain students from answering questions or sharing ideas due to social evaluations concerns (Cooper et al., 2018; Eddy et al., 2015). According to Hood et al. (2021), instructors can help to reduce social anxiety by increasing the transparency in the rationale behind the instructional practices, by supporting greater instructor availability and approachability and decreasing the overly competitive classroom climate. Similarly, Van den Bossche et al. (2006) claimed that psychological safety is a crucial aspect in the engagement of team members to coordinate and build their understanding and to disagree with each other. In this regard, team members have to deal constructively with different opinions (constructive conflicts), to thoroughly consider each other's ideas and comments and to speak freely in order to develop a shared mental model and to promote team learning (Van den Bossche et al., 2011). Of note, to achieve a shared mental model the role of conflict is highly relevant (De Dreu & Weingart, 2003) to reach mutual understanding and mutual agreement (Dillenbourg & Traum, 2006). To encourage individual and group "externalising" activities, participants were asked to externalise their thinking and their progress in more concrete forms through writing exercises, model or prototype development and presentation, and reflections. This is because reflection is a distinctive feature of active learning; it helps students to integrate new knowledge with what they already have (Kim et al., 2019), and make meaning and understanding of their experiences. "Combination" activities involved students organizing and re-organizing their varied knowledge bases to prepare for application in a real-world setting. "Internalisation" activities involve acting and reflecting on their proposed solutions, as learners take ownership of the learnings from these collective learning experiences.

Throughout the semester, approximately two thirds of each 3-hour class session were allocated for sharing findings, and suggesting and justifying ways forward. The remaining time was mostly allocated for mini lectures or for collaborative meetings. The latter proved important as students found it difficult to find common times to meet outside class due to professional and personal obligations. Each team was required to write a chapter in an electronic book (e-book) project using a wiki-based web site to chronicle their on-going experience during the course. In addition, they were also asked to write reflections every four weeks on what they have learnt during the process.

In summary, the PBL design was based on the IDEAL model, with two key aspects of improvisation that involved guided instruction and SECI processes. This model provided the basis for the instructional sequences and learning activities that guided the participants to become aware, draw on and develop the synergies between their three essential knowledge bases—their content knowledge, their pedagogical knowledge and their technological knowledge.

Instructional Sequence and Implementation

The following subsections will describe and discuss the sequence and implementation of the instructional design explained above. The instructional sequence of the module can be divided into four chronological phases, over a span of a 14-week semester (one 3-hour session per week).

Phase 1: Identify Problems and Opportunities

Phase 1 involves the first four to five weeks of the semester. During the first week of this phase, the participants are introduced to the features of the module, and are briefed about their responsibilities. The subsequent weeks during this first phase were focused on the "I" of the IDEAL model. The sessions were facilitated to guide participants to focus on identifying and discussing the teaching and learning problems and challenges they were facing in their own contexts, as discussed in the above section. This is because the current focus on the learning outcomes is on what students can do and not just about what they know, therefore, they have to learn how to tackle authentic problems in their fields (Long & Ehrmann, 2005).

To ascertain if it was suitable as a teaching and learning problem for this PBL-based module, extended and detailed discussions were needed to assess, judge and justify as to the fundamental nature of the problem (see Table 4.1). Some participants said that they were surprised and many expressed relief that many of their fellow teachers were struggling with similar issues in their own classroom. In a sense, it felt like a support group. One of the participants, Raylin, wrote in her reflections: "I was on the verge of giving up on my own students. But after 4 weeks of attending this module, it opened my mind (to different ways of teaching that are more sensitive to my students' learning needs)" (translated). Another student also wrote about Raylin's situation: "I still remember the face of Raylin when she started talking about her case, she looked so hopeless that I felt we have to think hard and give her good and refreshing ideas."

As the problems became better defined, consensus was reached as to what problems would be most suitable for this module and its intended learning experiences and outcomes. The participants also self-selected themselves into teams of three to six people based on their interest in a given problem. For instance, as the definition of the problem became clear, the mathematics teachers began to gather as a team to address the issues of high failure rate and poor conceptual understanding. Another group consisted of language teachers who struggled with engaging their seemingly uninterested or unmotivated students. And yet another, attempted to help their colleagues adopt more technology in the classroom.

In the final parts of Phase 1, each team collected data from the context their problem was situated in, to provide further definition to the problem as well as to identify the root(s) of the problem. To do these, teams carried out cause and effect analysis using such models as the fishbone diagram and 5 whys technique. One of the participants reported:

> *In the search for the root cause(s), I was always thinking: why is it so difficult for pupils to understand the concepts I was teaching? Is it due to the pupils themselves or can the teacher help change the learning pattern?*

Guided by such questions and follow-up analyses, understanding of their problems grew as participants collected data about their own students' circumstances through brief surveys, interviews and quizzes to test their students' level of understanding.

Another team of Chinese language teachers, through this analysis process, found that 90 percent of the errors in their students' essays can be attributed to vocabulary errors and only 10 percent can be attributed to grammatical errors. Vocabulary errors included miswritten Chinese characters and misuse of certain Chinese characters. They also found from a brief anonymous survey that a large majority of their students did not like writing Chinese essays, and found it difficult to stay engaged in the learning process. It was these kinds of analyses that prepared them for the next phase—to clarify their goals, and explore possible strategies and solutions.

Phase 2: Define Goals and Explore Possible Strategies

Phase 2 focussed on the "D" and "E" of the IDEAL model. This took place mostly between the fifth to eighth week of the semester, as each team defined their goals and explored possible strategies and solutions, given the problems that they had identified at Phase 1. The team of Mathematic teachers, for example, set goals to help Faizah's Year 5 students pass Mathematics, especially in fractions. Many of her students were failing in her class and many did not show any motivation to improve. As the goals became more explicit, discussions began to revolve around potential pedagogical approaches and technology that can be used to address students' motivation as well as poor conceptual understanding of fractions. Faizah wrote in her reflections:

> *While teaching, I do not have many opportunities to find other pedagogical techniques in teaching Mathematics. I came to realise that my pedagogical practices should be geared (more) towards providing my students with a variety (or a rich) learning environment… (and) I should utilise technology in order to increase students' understanding.*

As the teams wrestled to design a solution for the learning problems that they have identified, they began to question each other's approaches—fuelled by intense socialisation and externalisation processes that occurred during this phase. One began to question if teachers were too quick to "overuse or abuse the use of technology in teaching" without really understanding what the actual learning needs. Further, social interaction motivates students to learn and to exchange ideas with others. But guidance is needed to improve the quality of students' collaborative learning processes (Weinberger et al., 2007), such as structuring students' interactions in certain ways. In this regard, there is a need to strengthen the social cohesion among the students, particularly the lower performing students, so that they will take social responsibility on group learning seriously and to agree that interdependence relates to accepting peers' views and defending their own contributions (Chang-Tik & Dhaliwal, 2022). They began to ask questions about what their students really needed and how to address those specific needs given the existing knowledge they had (individually and as a team) and new skills they could develop. For many of the participants, they began to realize more acutely their strengths and weaknesses as teachers. One of the teachers, for example wrote:

> *When my team started looking into my case (and my students), I found that I had many weaknesses (in my teaching and learning approaches). This impacted my students' interest in learning.* (translated)

The back-and-forth discussion created the cognitive and affective space for the participants to explore their pedagogical and technological knowledge. Further, research has shown that positive affect has been linked positively to group interactions, collaboration and conceptual understanding, while negative affect may be responsible for disengagement and social loafing (Linnenbrink-Garcia et al., 2011; Pietarinen et al., 2018). Likewise, a strong positive affective state is favourable for collaborative learning which in turn strengthens the positive socio-emotional interactions among students (Bakhtiar et al., 2018; Isohätälä et al., 2018). In the final week of this second phase, each team would go on to concretize their final instructional design and technology solution for implementation in the following phase.

The team of Chinese language teachers, for example, explored the idea of making "all-the-time" learning more engaging. The idea was to ask each student to take pictures (with their smartphone) or screenshots of vocabulary errors that they see on signboards, print materials or digital and social media materials. This, the teachers argued, would encourage their students to become more sensitive as to how Chinese characters are written and used. And once these pictures are collected, it can be utilized in class to discuss how poorly written signboards or print materials can be corrected. One of the teachers in this team reported that having to explain and justify their design to their classmates made them much more disciplined in understanding the nature of the problem and how best to address the problem in the design of their lesson plans. Other teachers also became much more sensitive about the importance of aligning the pedagogical approaches and technological applications to the learning needs and goals.

Phase 3: Anticipate Outcomes and Act

In Phase 3, the focus would move to "A" of the IDEAL model—anticipate outcomes and act. About four weeks are allocated to this phase. The preparation to implement and enact their solutions was particularly important. It seemed to energize the teams to pay close attention to essential details needed for the implementation. In a sense, it is preparing for when the rubber meets the road—where design is readied for implementation, and when theory and idea is put to the test to see if the proposed solution will actually work. One of the participants wrote that the intense discussions before and during implementation help her ask "the right questions while designing the lesson plan and while conducting the class itself." She began to constantly ask herself, her team members, and her classmates: Is this method of using this technology aligned with the (intended) learning outcomes? How will the students respond to this?

Another participant wrote that the design and planning phase can be very "idealistic" but the implementation makes it real, with many "unexpected" things occurring. For example, the e-portfolio assignment that they planned for their students did work well for students who did have their own computers at home.

The team of mathematics teachers had more success when they anticipated that some of their students did not have reliable computers and internet access at home. They designed a series of game-based activities that culminated in an online fractions tournament that only needed one laptop in the classroom. Faizah explained the rules of the tournament to her students. She also told her students that every class will be used to prepare for the tournament. She ran a simulation to make sure the students understood the expectations. She created four stations in class. The first station was for each team of students to coach each other to prepare for the online tournament. The second station was a waiting station—a station designed for students to reflect on their own practice while watching a classmate play the online fractions game. The third station (where the sole laptop was situated) was for each student from each team to play the online game. The fourth station was where the teacher would coach the individual student immediately after the game, when errors and correct responses were still fresh. This eventually climaxed a few weeks later on the day of the final online fractions game tournament. The students were thoroughly engaged and had great fun throughout the process.

When another quiz was administered after the tournament, virtually all the students had passed the test. This was a marked improvement as the failure rates were high prior to this implementation. Perhaps more importantly, a large majority of the students reported a renewed interest in Mathematics and felt that they could master Mathematics. The teacher also discovered that some of her students had used much of their leisure gaming time to practice their fractions in different online Math gaming sites. One of the Mathematics teachers in the team wrote that "when technologies come (together) with pedagogy and content, it makes teaching and learning more meaningful and interesting."

Some teams were as successful as the mathematics teachers, but others were not as successful. But what is critical is that the implementation phase provided a naturally-occurring, and powerful, natural feedback loop. Specifically, it suggests that students have to actively engage in making sense of the information received and use it to inform their later work, thereby closing the feedback loop (Boud & Molloy, 2013) in line with one of the features of feedback literacy. Through ongoing socialisation and externalisation, together with more intensive combination activities through Phases 2 and 3 made their learning—both successes and failures—more visible and subject to greater scrutiny and feedback. And as they implemented their solutions, they acted on their plans in a real-world setting, and "received" feedback from the real-world setting. Their discussions with their team- mates and fellow classmates as well as the instructor made it a fertile ground for individual and collective evaluation and reflection. According to Wise and Vytasek (2017), after the collective evaluation, they should make strategic changes in their engagements if they fail to meet the targets set earlier. That acting and reflecting on their proposed solutions provided a foundation for internalization of how technological, pedagogical and content knowledge can come together to create a promising instructional design.

Phase 4: Look Back and Learn

The focus of this phase is on the "L" of the IDEAL model. It is a phase of evaluation and reflection. This fourth and final phase happens during the final two weeks of the semesters. During this phase, each team will present their final solution, the results of their implementation, what was successful and what they would improve. Whole-class discussions focussed on the key elements that created more fruiting learning as well as how and what could have been improved.

The team of Chinese language teachers, for example, reported that vocabulary errors in later essays were reduced by more than 40 percent. The use of more appropriate words and descriptive adjectives also improved significantly. Additionally, the team was also excited by their students' renewed interest in learning Chinese. However, they also found that planning needed to be done more carefully, and instruction for the assignments needed to be clearer. As importantly, they began to work out how technology can be used for different pedagogical purposes:

> *We (can) use technology to bring out the content we want to teach. (When) we teach idioms, we use online games… (and) students learn through games (that seems to help them) remember easily. When we want to improve their vocabulary, we assign them a task to take photos (of) typos on signboards. When we want them to write an essay, we posted (a) video clip (online) for them to access and discuss the topic online.*

Cumulative Outcome and Discussion

In one of the semesters with 24 students, twenty different technologies were learned throughout the course, including Wiki, Blog, video and picture editing tools, and online games. Several tools such as PowerPoint (as students' storytelling tool) and cameras on smartphones were repurposed to instigate learning activities. Similar trends were observed in other implementations of this module.

A self-report survey was utilised to obtain measures of the participants' own beliefs about their CK, PK, TK, PCK, TPK, TCK and TPACK, at the beginning and at the end of the semester. The instrument had a reported Cronbach's alpha of between 0.75 and 0.85 for each knowledge domain measured (Schmidt et al., 2009; Shin et al., 2009). The responses—on a Likert scale of 1 to 5—were analysed using repeated measures *t*-test.

The results of the repeated measures *t*-tests (see Table 4.2; redrafted from Tee & Lee, 2011, p. 95) indicate that the participants who completed this module reported to have improved their abilities to draw on, apply and develop the synergies between their three essential knowledge bases—their content knowledge, their pedagogical knowledge and their technological knowledge. The effect sizes, as measured by Cohen's *d*, were all relatively large—more than 0.8. In other words, the interacting knowledge domains of T, P, and C showed strong progress from before to after the course. At 1.75, the effect size for the TPACK dimension was the highest compared to the other subdomains. The effect sizes for the other dimensions that required synergistic interactions between two knowledge domains—PCK, TCK and TPK—were also large at 1.09, 1.32 and 1.18 respectively. This seems to reinforce the notion that the improvised PBL learning activities were effective in activating synergies between the participants' different knowledge bases.

It is also worth noting that the effect size for changes in TK was low (0.74) compared to the other dimensions. The effect size is almost as low as content knowledge (CK) which measured in at 0.73. While the difference is still quite positive, the similarities in developments in TK and CK can potentially be interpreted in two ways. First, the module was designed to focus on how their existing technological knowledge and pedagogical knowledge can be used more effectively in relation to the learning goals in the context that the participants were teaching in. In this regard, some teachers learned to repurpose technologies that they already knew how to operate. Other teachers learned to use technologies that

Table 4.2 TPACK and subdomain scores before and after the improvised PBL module (redrafted from Tee & Lee, 2011, p. 95)

	Mean score at the beginning of semester	*Mean score at the end of semester*	*Mean difference*	*Cohen's* d
TK	3.43	3.70	0.27[a]	0.74
PK	3.38	4.00	0.62[a]	1.34
CK	3.51	3.82	0.31[a]	0.73
PCK	3.23	3.86	0.63[a]	1.09
TCK	3.00	4.00	1.00[a]	1.32
TPK	3.16	4.55	1.39[a]	1.18
TPACK	2.98	4.07	1.09[a]	1.75

[a]significantly different, $p < 0.003$, $N = 24$

their teammates and classmates talked about or from their own research in designing the solutions to their problem. While they were not taught directly how to use a specific technology, they had learned through other avenues.

Secondly, in analysing the problem and designing the solution for it, the teachers had to rethink how their subject was being taught. In doing so, they had to rethink how the content could be learned and presented to their students. This can partly explain why CK had also improved. This is quite similar to what teachers involved in lesson studies might experience (Vermunt et al., 2019).

Given how the TK and CK scores compared to the other dimensions, future designs of this module should consider two proposals to provide a more focussed learning experience. One: Consider introducing a selected combination of technologies through direct instruction during the module e.g., video editing software and a collaboration software. Two: Consider implementing the module with subject-specific groups of teachers, much like in lesson studies (Vermunt et al., 2019) e.g., a module just for Mathematics teachers or a module just for English teachers. By doing so, teachers participating in the module can potentially learn specific technologies most pertinent to their content area, while solving real-world challenges from their classroom. For example, a group of mathematics teachers can be introduced to graphing or visualization software while going through a similar improvised PBL experience. Or a group of language teachers can learn to use oral and textual collaboration software to create more inter-class, intra-class and beyond-class speaking/listening and writing/reading opportunities. Of note, it is important to have a pedagogy-driven approach to integrating technology in the classroom rather than just a technology-driven approach (Ertmer & Ottenbreit-Leftwich, 2013).

Conclusion

The improvised PBL provided the necessary framework and guidance for the participants to reconsider and redesign their pedagogical-technological practices for implementation in the context they were teaching in. The complex and ill-structured problems were identified by the participants from the very context that they were situated in. This provided a significant opportunity as an instructional design challenge in a PBL setting (Jonassen & Hung, 2015).

Taking the quantitative data together with the qualitative data reported above, the findings suggest that learning activities with this improvised PBL design was successful in getting teachers in the module to recognize and use the synergies between their three essential knowledge bases—CK, PK and TK. The IDEAL model (Bransford & Stein, 2002) provided the necessary step-by-step framework in planning the sequence of PBL over a 14-week period. Guided and direct instructions were carried out as needed. This allowed the instructor to teach specific content and concepts that were essential to the module, as well as to provide guidance to the participants whenever the need arose.

The SECI model, on the other hand, provided the necessary framework to ensure that essential learning processes were occurring throughout the 14 weeks (Nonaka & Takeuchi, 1995; Tee & Karney, 2010; Tee & Lee, 2011). In addition, task cohesion and interdependence seem to promote learning processes, particularly task commitment coupled with shared responsibility may drive students to collective learning processes (Van den Bossche et al., 2006). The collaboratively based socialisation and externalisation processes can be seen taking place during weekly presentations and discussions, as the participants wrestled with the problems they were facing. Creating a conducive environment where students can share feelings and ideas (socialisation), and to present as well as to discuss emerging new understandings (externalisation) are particularly important as the participants attempt to engage in new practices. To this end, the conducive environment is significant because learning activities that merely provide opportunities for collaboration do not always lead to effective group work (Panadero et al., 2015). Therefore, a regulatory mechanism is needed to increase students' attention to tasks and group awareness (Lai, 2021). Without these opportunities and guidance, the students can easily get overwhelmed or distracted (Tan & Tee, 2021). Combination (usually following externalisation activities) can be seen in the e-book project and higher-stakes presentation at the end of the course—critical activities that require them to consolidate and concretize their understandings into a meaningful whole. Opportunities for internalisation came from the implementation followed by oral and written reflections. Action and reflection create opportunities for individuals to make sense of their personal learning (Tee & Karney, 2010).

In summary, the learning activities in this improvised PBL design created guided opportunities for participants to re-evaluate their teaching practices and technology usage, and to rethink the nature of the subject that they teach with the goal of creating learning experiences that could help their students learn better. In this process, the teachers began to re-evaluate their existing knowledge bases (CK, PK and TK), and this seemed to open doors to new synergies to be incorporated into their thinking and practice.

References

Bakhtiar, A., Webster, E. A., & Hadwin, A. F. (2018). Regulation and socio-emotional interactions in a positive and a negative group climate. *Metacognition and Learning, 3*(1), 57–90. https://doi.org/10.1007/s11409-017-9178-x

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education, 38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Bransford, J. D., & Stein, B. S. (2002). *Ideal problem solver* (2nd ed.). W.H Freeman and Company.

Chang-Tik, C., & Dhaliwal, J. (2022). Collaborative learning approach to teach computer coding in informal spaces. *Learning: Research and Practice, 8*(1), 5–24. https://doi.org/10.1080/23735082.2021.1953571

Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *International Journal of STEM Education, 5*(1), 23. https://doi.org/10.1186/s40594-018-0123-6

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology, 88*(4), 741–749. https://doi.org/10.1037/0021-9010.88.4.741

Dillenbourg, P., & Traum, D. (2006). Sharing solutions: Persistence and grounding in multimodal collaborative problem solving. *Journal of the Learning Science, 15*(1), 121–151. https://doi.org/10.1207/s15327809jls1501_9

Eddy, S. L., Brownell, S. E., Thummaphan, P., Lan, M.-C., & Wenderoth, M. P. (2015). Caution, student experience may vary: Social identities impact a student's experience in peer discussions. *CBE—Life Sciences Education, 14*(4), 45. https://doi.org/10.1187/cbe.15-05-0108

Er, E., Dimitriadis, Y., & Gašević, D. (2021). A collaborative learning approach to dialogic peer feedback: A theoretical framework. *Assessment & Evaluation in Higher Education, 46*(4), 586–600. https://doi.org/10.1080/02602938.2020.1786497

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64*(1), 175–182. https://doi.org/10.1016/j.compedu.2012.10.008

Hadwin, A. F., Jarvela, S., & Miller, M. (2017). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In D. H. Schunk & J. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 87–101). Routledge.

Hmelo-Silver, C. (2004). Problem-based learning: What and how do students learn. *Educational Psychology Review, 16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Hmelo-Silver, C., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller and Clark (2006). *Educational Psychologist, 42*(2), 99–107. https://doi.org/10.1080/00461520701263368

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., … Hull, K. (2021). "I like and prefer to work alone": Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), 12. https://doi.org/10.1187/cbe.19-12-0271

Isohätälä, J., Näykki, P., Järvelä, S., & Baker, M. J. (2018). Striking a balance: Socio-emotional processes during argumentation in collaborative learning interaction. *Learning, Culture and Social Interaction, 16*, 1–19. https://doi.org/10.1016/j.lcsi.2017.09.003

Jeong, H., & Hmelo-Silver, C. E. (2016). Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help? *Educational Psychologist, 51*(2), 247–265. https://doi.org/10.1080/00461520.2016.1158654

Jonassen, D. H., & Hung, W. (2015). All problems are not equal: Implication for problem-based learning. In A. Walker, H. Leary, C. E. Hmelo-Silver, & P. A. Ertmer (Eds.), *Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows* (pp. 17–42). Purdue University Press. https://doi.org/10.2307/j.ctt6wq6fh.7

Kaplan, A. (2018). European management and European business schools: Insights from the history of business schools. In S. Siebert (Ed.), *Management research, European perspective* (pp. 211–226). Routledge.

Kim, A. M., Speed, C. J., & Macaulay, J. O. (2019). Barriers and strategies: Implementing active learning in biomedical science lectures. *Biochemistry and Molecular Biology Education, 47*(1), 29–40. https://doi.org/10.1002/bmb.21190

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94–102. https://doi.org/10.1080/10402454.2005.10784518

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education, 49*, 740–762. https://doi.org/10.1016/j.compedu.2005.11.012

Lai, C.-L. (2021). Effects of the group-regulation promotion approach on students' individual and collaborative learning performance, perceptions of regulation and regulation behaviours in project-based tasks. *British Journal of Educational Technology, 52*(6), 2278–2298. https://doi.org/10.1111/bjet.13138

Lei, S. A. (2010). Classroom physical design influencing student learning and evaluations of college instructors: A review of the literature. *Education, 131*(1), 128–134.

Linnenbrink-Garcia, L., Rogat, T. K., & Koskey, K. L. K. (2011). Affect and engagement during small group instruction. *Contemporary Educational Psychology, 36*(1), 13–24. https://doi.org/10.1016/j.cedpsych.2010.09.001

Long, P. D., & Ehrmann, S. C. (2005). The future of the learning space: breaking out of the box. *EDUCAUSE Review, 40*(4), 42–58. https://er.educause.edu/articles/2005/1/future-of-the-learning-space-breaking-out-of-the-box

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2010). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. Report of U.S. Department of Education. https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Nicol, A. A. M., Owens, S. M., Le Coze, S. S. C. L., MacIntyre, A., & Eastwood, C. (2018). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education, 19*(3), 253–265. https://doi.org/10.1177/1469787417731176

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press.

Panadero, E., Kirschner, P. A., Järvelä, S., Malmberg, J., & Järvenoja, H. (2015). How individual self-regulation affects group regulation and performance: A shared regulation intervention. *Small Group Research, 46*(4), 431–454. https://doi.org/10.1177/1046496415591219

Pietarinen, T., Vauras, M., Laakkonen, E., Kinnunen, R., & Volet, S. (2018). High school students perceptions of affect and collaboration during virtual science inquiry learning. *Journal of Computer Assisted Learning, 35*(3), 334–348. https://doi.org/10.1111/jcal.12334

Schmidt, D., Baran, E., Thompson, A., Koehler, M. J., Mishra, P., & Shin, T. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544

Shin, T., Koehler, M. J., Mishra, P., Schmidt, D., Baran, E. & Thompson, A. (2009). Changing technological pedagogical content knowledge (TPACK) through course experiences. Paper presented at the 2009 International Conference of the Society for the Information and Technology & Teacher Education, 2–6 March, Charleston, South Carolina. http://punya.educ.msu.edu/publications/Shin_et_al_SITE2009.pdf

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1–22. https://doi.org/10.17763/haer.57.1.j463w79r56455411

So, H.-J., & Kim, B. (2009). Learning about problem-based learning: Student teachers integrating technology, pedagogy and content knowledge. *Australasian Journal of Educational Technology, 25*(1), 101–116. https://doi.org/10.14742/ajet.1183

Tan, S. C., & Tee, M. Y. (2021). In-service Educators Co-constructing Knowledge in a PBL Setting: Phases of Interaction. *Interdisciplinary Journal of Problem-Based Learning, 15*(2). https://doi.org/10.14434/ijpbl.v15i2.28769

Tee, M. Y., & Karney, D. (2010). Sharing and cultivating tacit knowledge in an online learning environment. *International Journal of Computer-Supported Collaborative Learning, 5*(4), 385–413. https://doi.org/10.1007/s11412-010-9095-3

Tee, M. Y., & Lee, S. S. (2011). From socialisation to internalisation: Cultivating technological pedagogical content knowledge through problem-based learning. *Australasian Journal of Educational Technology, 27*(1), 89–104. https://doi.org/10.14742/ajet.984

Tee, M. Y., Samuel, M., Tan, S. Y., & Sathasivam, R. (2022). Multi-voice, mono-perspective classroom discourses: Re-thinking monologicality. *The Asia-Pacific Education Researcher*. https://doi.org/10.1007/s40299-022-00651-8

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Van den Bossche, P., Gijselaers, W., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science, 39*(3), 283–301. https://doi.org/10.1007/s11251-010-9128-3

Vermunt, J. D., Vrikki, M., van Halem, N., Warwick, P., & Mercer, N. (2019). The impact of Lesson Study professional development on the quality of teacher learning. *Teaching and Teacher Education, 81*, 61–73. https://doi.org/10.1016/j.tate.2019.02.009

Weinberger, A., Stegmann, K., & Fischer, F. (2007). Knowledge convergence in collaborative learning: Concepts and assessment. *Learning and Instruction, 17*(4), 416–426. https://doi.org/10.1016/j.learninstruc.2007.03.007

Wise, A. F., & Vytasek, J. (2017). Learning analytics implementation design. In C. Lang, G. Siemens, A. Wise, & D. Gasevic (Eds.), *Handbook of learning analytics* (pp. 151–160). Society for Learning Analytics Research.

CHAPTER 5

Collaborative Learning in Informal Spaces: Formulating a Pedagogical Project of Student-Centred Active Learning in Gender Studies

Joseph N. Goh

'Because I'm a feminist!'
'I want to fight for women's rights'
'I'm a straight ally who wants to know more about the LGBT community and help them'
'Being bisexual, I need to learn more about my sexuality'

These quotes are somewhat representative of my undergraduate students' responses over the years to my question on why they chose to enrol in units (subjects) in Gender Studies. Their feedback registered a common theme that reflected the premise of Gender Studies at Monash University

J. N. Goh (✉)
School of Arts and Social Sciences, Monash University Malaysia, Subang Jaya, Selangor, Malaysia
e-mail: joseph.goh@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_5

Malaysia: This area of study harbours a practical, real-world dimension that can potentially equip students with the necessary tools to engage in projects of community change and social transformation, particularly in issues of gender and sexuality.

At Monash University Malaysia, Gender Studies began life in the early 2000s in the School of Arts and Social Sciences as a few elective units before being elevated to the status of a Minor and eventually a Major in 2016 (Bong & Goh, 2018). The units which are parked under this area of study have been designed with the belief that Gender Studies should not serve merely as theoretical ventures, no matter how fascinatingly so, but more importantly as practical storehouses for action research. Many of the activities and assessments in each unit contain elements that prompt students to consider the irrefutable relationship between the classroom and the world. A diverse range of topics on gender, sexuality and sex are offered at the University, including complex intersections of heteronormative and non-heteronormative gender and sexuality issues with diverse facets of social and personal life, and sexual and reproductive health and rights in Asia and beyond.

As such, the pedagogical trajectory of Gender Studies is one that pursues and echoes an Active Learning Approach (ALA), itself 'a very broad concept that covers or is associated with a wide variety of learning strategies' (Carr et al., 2015, p. 173). While many interpretations of ALA abound, scholars generally agree that ALA refers to student-centred pedagogies or 'any teaching method that facilitates student reflection upon ideas and how they are using those ideas' (Jacob et al., 2016, p. 42), and lies at the opposite spectrum of passive absorption of information, rote learning and uncritical regurgitation of facts (Machemer & Crawford, 2007; Petress, 2008). ALA encourages learners to think deeply and critically, process what they learn, and meaningfully apply what they learn to the world outside the classroom (Chau & Cheung, 2017; Powner & Allendoerfer, 2008; Stolk & Harari, 2014).

In Gender Studies, I train students to think critically, take ownership of their own academic journey, study interdependently, and develop culturally sensitive and effective leadership skills. To this end, I deployed an experimental pedagogical project called Collaborative Learning in Informal Spaces (CLIS) that was fused with a Gender Studies elective Unit (subject) entitled *Critical Methodologies for Action Research* (hereafter *Critical Methodologies*). I taught this Unit, coded as AMU2908

(Monash University, 2021), over a 12-week semester from 4th March to 31 May 2019. This chapter details the ALA processes involved in the creation and implementation of CLIS-infused learning activities, and the eventual outcomes.

Collaborative Learning in Informal Spaces

CLIS was a project that was developed by a former colleague who was then in the Education Excellence Unit of Monash University Malaysia, Chan Chang-Tik—coincidentally a lead-editor of this volume—and further developed with the participation of a lecturer each from the School of Science, School of Information Technology, and School of Arts and Social Sciences.[1] Chan acted as my non-lecturing collaborator on *Critical Methodologies* for the duration of the semester. It was an opportune moment to experiment with CLIS as the University had freshly constructed several informing learning spaces. Representing the School of Arts and Social Sciences, I volunteered AMU2908 for the project only for 2019 but with certain modifications, chiefly that CLIS-specific sessions would be explicitly implemented for only four weeks during the semester.

CLIS is a form of ALA that looks to the Community of Inquiry framework (CoI), which 'focuses on learning processes from a collaborative, constructivist point of view [and] assumes that learning in online environments occurs through the interaction of three core elements: social presence, cognitive presence, and teaching presence' (Tirado Morueta et al., 2016, p. 123). In other words, the CoI framework comprises the organised construction of a safe space for interaction and expression, meaning-making through critical thinking and effective communication, and pedagogical facilitation for effective learning engagements (Garrison et al., 2000; Lee et al., 2021). My interpretation of CLIS for AMU2908 focused largely on in-person, rather than online learner interactions. Drawing on the CoI framework, CLIS emphasised the element of social presence, which 'can help students feel safe to share ideas and collaborate with others on course content' (Wicks et al., 2015, p. 54) by fostering a safe and comfortable space for student-centred learning in

[1] Monash University Malaysia comprises the School of Arts and Social Sciences, the School of Business, the School of Engineering, the School of Information Technology, the Jeffrey Cheah School of Medicine and Health Sciences, the Department of Psychology, the School of Science, and the School of Pharmacy.

informal spaces. According to Akyol and Garrison (2011) the framework was based on the socio-constructivist orientation where the focus was on the students' interactions in a socio-cultural context. I developed a climate for collaborative learning and made it comfortable for students to share their thoughts, and to avoid dominance and intimidation in order to build relationships and mutual trust. I intervened when students were overly polite and not willing to challenge misconceptions. Likewise, students were encouraged to resolve their own emotional conflicts, and only when needed my input and correction were provided with sensitivity and respect as shown in Table 5.1. Of note, when students are aware of the emotional status of the group members, they can initiate positive communication to overcome problems due to negative emotions (Zheng et al., 2022). Additionally, as Lavoué et al. (2020) reveal, emotional awareness may provoke positive emotions.

Although I believe that CLIS would augment the pedagogical strategies of many academic disciplines, I find that it particularly enhances ALA in Gender Studies because it promotes the values of mutual respect and appreciation in the process of learning highly controversial issues of gender, sexuality and sex, thus encouraging a free circulation of rational and mature ideas without the threat of belittlement or disparagement hanging over the heads of learners. Hence CLIS helps 'students construct the process of understanding together through the sharing of individual perspectives in a process called collaborative elaboration' (Chan & Goh, 2020, p. 2) by maintaining an atmosphere of respect and trust among learners in order to encourage open communication even if participants do not share identical views with each other but wish to air their personal convictions or debate the issue at hand. Therefore, peer-to-peer constructive feedback is crucial in all CLIS activities as it assists in the internalisation of deeper and more self-reflexive learning through peer interaction. There is thus an element of group efficacy in the process, or the belief that individual success is linked to group success in achieving the desired outcomes of the activity.

Introducing the Unit

In brief, *Critical Methodologies* focuses on the learning and deployment of feminist and queer theories in the formulation of team research proposals for the benefit of marginalised and vulnerable communities. These proposals form cumulative assessment tasks that are not meant to

Table 5.1 CoI framework for the implementation of CLIS

	Teaching presence		
	Design	*Facilitation*	*Direct Instruction*
Cognitive presence	• The pre-CLIS and CLIS sessions activities were designed to encourage students to move from a trigger event to resolution • Students were provided learning resources as pre-CLIS activities to assist them to find solutions to problems • Students discussed in small groups, shared ideas and reflected on their experiences during the CLIS sessions • Formative assessment was employed to set a constructive climate for collaborative thinking during the CLIS sessions and presentations	• Challenged students to defend their position, highlighted different students' opinions, and prompted them to consider alternative viewpoints during the CLIS presentations • Challenged their ideas, identified areas of agreement and disagreement, and focused the discussion during the CLIS presentations	• Scaffolded student knowledge and provided useful and timely feedback during CLIS presentations • Guided the learning process towards resolution by shifting direction and focus according to the academic needs during CLIS presentations • Intervened to address misconceptions and suggested alternative ideas when needed during CLIS presentations

(continued)

Table 5.1 (continued)

	Teaching presence		
	Design	*Facilitation*	*Direct Instruction*
Social presence	• Students introduced themselves to group members and shared concerns about the course expectations, and identified their personal concerns before CLIS • Created "chat" room for informal interactions of the CLIS activities • Established participation protocol and online discussion etiquette for the CLIS activities	• Set a welcoming tone for openness by having clear norms and guidelines on how to engage socially and emotionally before the CLIS activities • Sustained group cohesion through the learning activities for pre-CLIS and CLIS sessions which were designed for purposeful discourse and collaborative engagement • Development of interpersonal relationship in a natural manner during CLIS activities • Creating trust at an initial stage of CLIS may be more important than challenging ideas of individual	• Developed climate for CAL • Avoided dominance and intimidation during the CLIS sessions and presentations • Intervened when students were overly polite and not willing to challenge misconceptions during the CLIS presentations • Students were encouraged to resolve their own emotional conflicts during the CLIS sessions

be implemented as actual research projects by students. Instead, they are academic exercises that provide opportunities for students to engage with the dynamics of qualitative research at an undergraduate level in Gender Studies that could prove useful should they venture towards researched-based Honours, Master's or doctoral programmes thereafter, and/or engagements at the workplace or with various civil society organisations.[2]

Feminist and queer theories are two critical theories which play a crucial role in Gender Studies as they prioritise elements of research which are often overlooked, dismissed, silenced or taken for granted in mainstream research projects that uncritically adopt more patriarchal, androcentric and heteronormative forms (Levy & Johnson, 2012). Both theories acknowledge that research projects are driven by bias from the outset. Such bias is politically potent as it aims at social change for the betterment of human lives (Browne & Nash, 2010; Harding, 1993). Feminist and queer theories privilege the recounting of lived experiences of subjects who are experts of their own lives through various forms of storytelling. They emphasise the need for consistent self-reflexivity, and the awareness of personal privilege and positionality as simultaneously insiders and outsiders in a research project (Bhopal, 2010; Kuga Thas, 2013). My conceptualisation of action research in this Unit is partially based on the notion of critical participatory action research which 'expresses a commitment to bring together broad social analysis, the self-reflective collective self-study of practice, and transformational action to improve things' (Kemmis et al., 2014, p. 12).

In incorporating CLIS into *Critical Methodologies*, I designed and implemented learning activities that would enable learners to ponder deeply on the vital aspects of doing research with vulnerable and ostracised groups, which ranged 'from identifying a research topic, mapping research design, generating and analysing data to writing-up and disseminating research findings' (Monash University, 2021). Therefore, in *Critical Methodologies*:

> a feminist and queer ethos also find [sic] full expression in taking action as a primary outcome of the research process hence action research (e.g., change mindsets, review policy, formulate framework for activism, etc.). The transformative ends of such research potentially realise feminist and

[2] For more information on the Honours programme, see Monash University Malaysia (2020).

queer praxis and in doing so, apply learning towards effecting social justice. (Monash University, 2021)

Journeying with Students Through the Project

Providing an Overview of the Unit

To accommodate the incorporation of CLIS, I took some time prior to the start of the semester to rethink the teaching presence element of the CoI framework, namely 'the design of the educational experience [which], includes the selection, organisation, and primary presentation of course content, as well as the design and development of learning activities and assessment' (Garrison et al., 2000, p. 90). The teaching presence through the design, facilitation and direct instruction categories play an important role in establishing and sustaining the CoI (Shea et al., 2006). In this regard, Keles (2018) concurs and adds that students should play significant roles in the teaching presence. Specifically, in the context of the cognitive presence the activities were designed to encourage students to move from a trigger event to resolution. In other words, students were provided learning resources to assist them to find solutions to problems, to discuss in small groups, share ideas and to reflect on their experiences. In addition, formative assessment was employed to set a constructive climate for collaborative thinking. Over the semester, I offered *Critical Methodologies* as a blended Unit that comprised both in-person and online modes. The provision of resources for all learning activities as well as the submission and consequent feedback for assessment tasks were all carried out through the open-source online learning platform Moodle.

I conducted an on-campus, offline two-hour lecture and a one-hour tutorial for *Critical Methodologies* on a weekly basis. The incorporation of CLIS necessitated a re-designation of some of these sessions to a '2-hour session' and '1-hour session' as any of these time slots could be devoted to lectures, discussions, presentations and self-studying. 20 students from Hong Kong, India, Malaysia, Martinique, Pakistan, Singapore, the Maldives and the United Kingdom enrolled in the Unit. This cohort comprised individuals with a range of gender and sexual identities and expressions.

I designated the first two-hour, in-person session of Week 1 as 'Information Session 1'. Students were guided through the aims of the Unit and the various Topics that would be covered. I reminded them to strive towards the accomplishment of the learning outcomes through the various learning activities and assessment tasks. I emphasised the significance of the learning outcomes, chiefly to learn the key features of queer and feminist theories and methodologies in order to compare their efficacy for application to real-life situations of marginalised and vulnerable communities through engagements with action research. Consequently, students were expected to design Research Proposals that would be interlaced with key queer and/or feminist concepts as the pinnacle of the Unit. Students were also mandated to carry out these tasks effectively and ethically with due consideration for cross-cultural sensitivity.[3]

In the following one-hour session of Week 1, termed 'Information Session 2', I provided a detailed overview of how CLIS was incorporated into the Unit throughout the semester for the first time as a pedagogical experiment. As a good practice of professional courtesy, I also gave students the opportunity to dis-enrol from the Unit if they felt uncomfortable with the arrangement. I was gratified (and relieved!) that all of them unanimously agreed on participation.[4] I informed students that Weeks 6, 7, 9 and 10 were dedicated CLIS study weeks. In a general sense, they were tasked with independent team discussions on various online academic resources in the two-hour sessions in Week 6, and then present the fruits of their discussions in the two-hour sessions in Week 7. This arrangement was to be repeated in Weeks 9 and 10.

While students were excited about CLIS as a new venture in learning, it was obvious that their willingness to engage with pre-CLIS activities, CLIS sessions, and CLIS presentations and feedback were prompted by the fact that these learning activities in Weeks 6, 7, 9 and 10 were annexed to assessment tasks. Admittedly, the interlocking of learning activities with assessment tasks was a calculated strategy to encourage the students to be more vested in the learning tasks. At the same time, a grade-bearing appraisal of learning activities was an important tool to convey to students the significance of their labours, chiefly that they could potentially achieve success if they devoted themselves to the Unit as individuals and teams. This approach is in line with one of the main elements emphasised in the learning-oriented assessment framework to ensure that the focus is on the

[3] To view a listing of the Learning Outcomes, see Monash University (2021).

[4] Students also read, signed and returned Consent Forms which were created for this purpose.

quality of student learning outcomes—the element is assessment tasks are designed as learning tasks (Leong et al., 2018).

Weeks 1, 2, 3, 4, 5 and 8 did not feature dedicated CLIS sessions. Instead, the two-hour and one-hour sessions served as preparatory periods to help students engage in upcoming CLIS-focused weeks. Hence, these weeks were designated as lectures and tutorials on feminist and queer theories and methodologies for the purpose of grounding students in the relevant key concepts with which they would be engaging in the forthcoming weeks. Weeks 2 and 3 covered Topics 1 and 2 respectively on feminist theory and feminist methodology, Weeks 4 and 5 focused on queer theory and queer methodology respectively, and Week 8 laid emphasis on the notion of a researcher's sense of self-reflexivity from feminist and queer perspectives.

During Weeks 1, 2, 3, 4, 5 and 8, which saw a 'combination of traditional (teacher-centred approach and direct transmission of knowledge through lecturing) and active (student-centred approach and constructivism through learning by doing) learning methodologies' (Chau & Cheung, 2017, p. 133), students were expected to share their views on how they deployed theories to analyse and interpret real-world contexts. Through the ensuing interactions that occurred with me and each other, students were encouraged 'to construct meaning through sustained communication' (Garrison et al., 2000, p. 89)—a crucial feature of the CoI. I encouraged and guided them in refining, and to a lesser extent, rectifying their interpretations and applications of queer and feminist theories and methodologies. On many occasions, I lauded their efforts in comprehension and application.

It is important to note that these non-CLIS sessions were not 'traditional' or 'conventional' in a strict sense as they were infused with elements of ALA rather than patterned on a 'instructor-lecture student-receiver environment' (Nicol et al., 2018, p. 261). For instance, although these non-CLIS sessions saw more conventional styles of pedagogical delivery through the use of PowerPoint slides, lectures were also heavily peppered with the active elicitation of students' views on key concepts and interpretation of current events, through individual responses, think-pair-share activities and peer-to-peer constructive feedback on peer responses. Tutorials were dedicated to motivating students towards greater critical thinking, specifically in applying theoretical ideas to real-life situations. Peer feedback transforms the role of students and requires them to generate and interpret feedback while engaging with their peers (Ion et al., 2017).

Pre-CLIS Activities

In Week 6, students were mandated to carry out several pre-CLIS activities. First, they were required to watch a 47-minute online documentary featuring the narration of personal experiences by several transgender people in the United States entitled 'My Transgender Life' (TMW Media, 2016). This documentary was made available to all students via Kanopy, an on-demand streaming video platform provided by the University. Second, they were instructed to engage with two book chapters on the appreciation of storytelling and lived experiences that utilised feminist and queer frameworks respectively. These readings were accessible online through the University's library search guide. Students were repeatedly informed that it was vital for them to go through these resources individually before discussing and ascertaining the key points contained in these resources as teams during CLIS sessions. I scaffolded their learning efforts with extensive and detailed Guiding Questions, the responses to which actually formed the main component for their CLIS session discussions and presentations. While watching the documentary, students were asked to reflect on these questions:

1. What were the challenges, affirmations and inspirations that the interviewees experienced?
2. What were the factors that led them to their self-realisation?
3. What are the factors that assist them in constructing their current gender identities?
4. How do they live their lives as transgender people?
5. How do the insights and lived experiences of these individuals challenge social and cultural norms?
6. What are some narratives that can best be analysed and interpreted through the key aspects of feminist and queer modes of enquiry?

Students were also asked to reflect on the following questions while going through the two academic readings:

1. Read the introduction and conclusion. What do the authors set out to do, and what have they concluded at the end?

2. What are key feminist and queer modes of enquiry that these authors use themselves?
3. Why do the authors place such great importance on storytelling and lived experiences in their research?
4. What are some findings of their research, based on the narratives of their research participants? Based on these findings, what are some key theoretical concepts that they have devised as their own modes of enquiry?
5. What are some key theoretical concepts from each author that you intend to use as modes of enquiry for narratives of one person who appears in the documentary?

Students were informed that they needed to collate their discussions in Week 6 for both their team presentation in Week 7 and to produce the first team-based assessment task, the 'Change It!' Team Video Essay. In other words, they were tasked to translate the outcome of their deliberations to an in-class presentation, and a media-based project that would eventually be submitted at the end of Week 7. In the one-hour sessions of Week 6 and 7, students were charged with crafting the script, filming, editing and refining the Video Essay in any informal learning space on campus. No formal classes were held during these one-hour sessions as students were given free rein to meet and work on their Video Essays at on-campus informal learning spaces.

Week 9 followed a similar pedagogical pattern. Students were instructed to participate in pre-CLIS activities by reading two journal articles on issues of research ethics and researchers' insider/outsider positions from feminist and queer perspectives respectively. While students were asked to plan their discussion-based team presentations in Week 10, they were also invited to begin preliminary discussions on the second and final team-based assessment task, the Research Proposal. Akin to Weeks 6 and 7, no in-person classes were slated for the one-hour sessions in Weeks 9 and 10. Instead, these time slots were earmarked for students to extend their discussions on, and write up the Research Proposal in informal learning spaces. I discovered later those students found these one-hour sessions useful. Although students met in person for these sessions, I see potential in holding these exchanges completely online in the future and thus be freed from the physical limitations of having to meet on campus. I suspect that online meetings could encourage students to 'communicate online with others in a cooperative and sociable manner' (Lee et al., 2021,

p. 3) and thus further enhance the element of social presence in CLIS. Nevertheless, social presence is more difficult to develop in an online environment. I would start by getting students to introduce themselves to their peers, share concerns about the course expectations, and identify their personal concerns. I would create a 'chat' room for informal interactions, and establish participation protocol and online discussion etiquette.

During informal chats with students on the Pre-CLIS activities, I learned that the vast majority of students enjoyed viewing the documentary as they were previously unfamiliar with the struggles and achievements of transgender people. A few commented on how some of the experiences of these transgender people resonated on several levels with their own, particularly the daily sense-making of their own gender and sexual identities and expressions. The online journal articles and book chapters were not as well received. Most students expressed difficulty in grasping both the language and content of the academic readings. Although several expressed their gratitude for ensuing team-based discussions that helped bring greater clarity to their comprehension and interpretation of the reading material, some felt less confident in their understanding of the academic readings without my intervention.

CLIS Sessions

During the two-hour CLIS sessions in Weeks 6 and 9, I made my 'rounds' or brief visits to the on-campus informal learning spaces that were occupied by the student teams. The purpose of these visits was to ensure that the students had indeed gathered for the CLIS sessions, were engaged in productive discussions and did feel 'abandoned' by me. I made it a point to arrive approximately an hour after the sessions were slated to commence as I wanted them to take the lead in discussions without my presence. I was also keen to witness them in the thick of their exchanges.

One team decided to meet at the *Lepak* Café and sipped Slurpees while discussing the resources. The other teams met at the Idea Link, the Hive and the Library Collaborating Space, all of which were informal learning spaces that were equipped with tables, chairs and whiteboards.[5] As I was later informed by students, the vast majority of students came well-prepared for CLIS and had gone through the various resources and

[5] The composition of these teams, each with a student-elected team facilitator, was designated in Week 3.

were armed with notes. The discussions, as evident from my visits as well as video recordings made of each team during the CLIS sessions, were robust and boisterous.[6] The opportunity to discuss matters sans the lecturer's presence seemed to make for freer exchanges, although I learned later from students that those who were less prepared for the session or had a weaker grasp of the concepts felt less entitled to contribute to discussions. This did not, however, prevent them from engaging with other students in light banter and swapping jokes that seemed to heighten the social presence of the CLIS sessions, or 'the ability of participants to identify with a group, communicate purposefully in a trusting environment, and develop personal and affective relationships progressively by way of projecting their individual personalities' (Garrison, 2011, p. 23). At each informal learning space, I greeted students and asked friendly, general questions like 'How's it going?' and 'What did you discuss?' My projection of a casual, non-threatening and an informal demeanour was intentional as I did not want to diminish the spirit of student-centred learning that had been created in each team. My objective was to develop interpersonal relationships in a 'natural' manner because creating trust at an initial stage may be more important than challenging the ideas of peers. This is in turn follows from the imperative to respect all individuals, and need to develop a sense of belonging so that over time, personal relationships may develop and thus establish social presence (Garrison & Vaughan, 2008).

Prior to their coming together in Weeks 6 and 9, I had informed students that I would be available for live chats via Google Hangouts with the team facilitators during CLIS sessions should they encounter a learning impasse. I soon discovered that the team facilitators deemed it unnecessary to avail themselves of this avenue. Instead, the teams decided to field questions to me during my visits. What was particularly noteworthy was that most clarifications were not sought after for complex theoretical concepts, but on *collated discussions on interpretations* of complex theoretical concepts. Rather than 'What does this mean?', I was asked, 'This is what *we think* it means, are we on the right path?' The absence of an academic authority created a relaxed, non-hierarchical atmosphere that impelled and invigorated efforts on the part of students themselves to unpack complex theoretical notions.

[6] My collaborator Chan had organised for research assistants to video-record the sessions.

When there were diverse interpretations of the resources, teams would unanimously vote for a majority interpretation. Even then, as mentioned earlier, some students were not entirely convinced by the results of their discussions. Interestingly, none of the teams reported any conflicts during the CLIS sessions even though I had informed them that arguments and disagreements are common in such activities. I was also not informed of any conflictual peer-to-peer feedback during the sessions. Any sort of feedback between students seemed to take the form of polite exchanges of opinions that were readily rescinded when challenged. It is possible that students had consciously avoided any uncomfortable disputes for the sake of preserving friendships in their teams, or relinquished their right to debate on opinions due to either nonchalance or a lack of confidence, or just did not feel sufficiently invested in the Unit to go beyond acquiescence to adamant voices or the majority interpretation. According to Hung (2016), when students are anxious, they fear the possibility of conflicts with others and therefore avoid feedback discussions.

I wanted to reserve my personal feedback to guide and supplement peer-to-peer feedback for Weeks 7 and 10 when the entire student cohort was present as a sort of co-facilitation which I regarded as cohering with the CoI element of teaching presence that could 'support and enhance social and cognitive presence for the purpose of realising educational outcomes' (Garrison et al., 2000, p. 90). Accordingly, to facilitate the cognitive presence I challenged students to defend their position, highlighted different students' opinions, and prompted them to consider alternative viewpoints. To this end, I challenged their ideas, identified areas of agreement and disagreement, and focused the discussion. With regard to the facilitation of social presence, I set a welcoming tone for openness by having clear norms and guidelines on how to engage socially and emotionally. In order to sustain group cohesion, the learning activities were designed for purposeful discourse and collaborative engagement. In this respect, students gradually developed mutual trust when they interacted productively to achieve their mutual goals. Hence, I decided to provide more general responses to their questions during the visits. I either applauded them for being on the right path and then posed further questions to stimulate deeper reflection, or subtly informed them of blatantly erroneous interpretations, and provided additional guidance and direction on analysing the resources. Similar to the stance I took upon visiting the teams during CLIS sessions, I wanted to maintain a student-centred learning ethos that could easily fracture under the articulations of my own opinions.

In Week 7, all four teams took turns to present the outcomes of their discussions via PowerPoint slides at the two-hour session at formal learning spaces. For each team, ten minutes were allocated for the actual presentation and 20 minutes for feedback. Whenever I deemed it necessary to provide some feedback throughout the session, I did so sparsely and concentrated on peer-to-peer feedback for the most part, in which students were to appraise each other's interpretation and analysis of the resources. This practice was meant to help build their sense of confidence and social interaction in learning and public speaking, as well as reinforce the strategy of mutual and collaborative learning that fostered a greater sense of social interdependent learning.

As most students were unfamiliar or uncomfortable with providing comments to their peers and/or regarded this practice as personal criticism, it was necessary for me to preface the session with assurances that peer feedback was a form of mutual, interdependent learning meant to elicit deeper thinking rather than a catalyst for inciting warring factions between students. According to Altiok et al. (2019), giving and receiving feedback in collaborative and peer learning environments are assured through social interaction and it also offers metacognition benefits. Initially, some students elected to stare at their laptop screens while others turned bashfully to each other. The hush that fell over the class was a clear indication of awkwardness. I attempted to ease students into peer-to-peer feedback by posing basic questions such as 'What do you like and not like about the presentation?', 'What are the strengths and weaknesses of what they presented?', 'What do you agree or disagree with?', 'What was missing?' and 'What do you think could have been improved or emphasised?'

Soon after, one or two students voluntarily voiced their opinions. The few students who took to peer feedback with increasing zeal asked poignant questions and offered good suggestions for improvement. Still, most students needed prompting to comment on the work of their peers and did so in the most diplomatic manner. By Week 10, more students gained confidence and the 2-hour session saw more mutual exchanges between students on their discussions on the resources provided for Week 9, which I interpret as an increase in learning experience in the form of the CoI element of cognitive presence, or the ability 'to construct meaning through sustained communication' (Garrison et al., 2000, p. 89). It is likely that the affirming experiences of both peer-to-peer and lecturer feedback in Week 7 as well as a growing familiarity and sense of ease with each other contributed to more verbose exchanges. In other words, I scaffolded student knowledge and provided useful and timely feedback whereby I guided the learning process towards resolution by shifting its direction and focus according to the academic needs. As mentioned earlier, I occasionally intervened to address misconceptions and suggest alternative ideas when necessary. While I tried to avoid excessive direct instruction to prevent discouraging students from participating, I also realised that too little intervention can also be a problem in driving forward the cognitive presence. Therefore, personalised feedback is provided when necessary, as this form of feedback can help improve the collaborative knowledge-building capability as well as elicit positive emotions and reduce negative emotions (Zheng et al., 2022).

Nevertheless, despite the modest success of both presentations and peer-to-peer feedback in both weeks, I intuited some uncertainty in the facial expressions and body language of students. They seemed more settled when I corroborated their analyses, or commended them on sound interpretations and gently corrected them on imprecise findings. While I did not explicitly elicit their thoughts on the matter, I am fairly certain that students continued to look to authority figures for assurances of their learning experiences. This is unsurprising as most of these students had been schooled in traditional learning styles that centre on passive assimilation of knowledge from the educator rather than active learning 'skills which cannot be imparted effectively using the traditional passive lecture format' (Jacob et al., 2016, p. 42).

It is important to note that the assurances I offered were not moulded on the right-and-wrong paradigm. I steered clear of binary responses to the students' findings and helped them to see that it was possible to provide different but sound interpretations of the material that they had studied and presented. The nature of Gender Studies was such that students could experience in-depth learning by considering various arguments for and against a subject matter. Firmer and more conclusive responses were given to the very few completely erroneous interpretations of the resources. I also provided summaries of the in-class peer-to-peer and lecturer feedback on a Google Spreadsheet that was shared with students.

Deploying the Assessment Tasks

In 2019, *Critical Methodologies* was designed with four assessment tasks in mind. Through Moodle, students were provided with rubrics for all assessment tasks in this Unit. A rubric is 'a set of criteria for grading assignments' (Rezaei & Lovorn, 2010, p. 19). As 'a rubric typically focuses on specific *content*, follows a particular *development process*, and targets at a particular application context' (Yuan & Recker, 2015, p. 18; original emphasis), I ensured that the students were clear about the criteria in the rubrics as they worked on their assessment tasks.

Two of the assessment tasks—what I refer to as minor assessment tasks—the Personal Audio Reflection 1 and Personal Audio Reflection 2, were individual 5–6-minute audio reflections with smaller grade weightages due for submission at the end of Weeks 4 and 11 respectively. These were minor tasks designed to facilitate students' reflections on their personal aims for the Unit at the outset and close of the semester, as well as the personal and socio-cultural challenges that they felt would influence/had influenced them in attaining these aims. Through these two open-ended Reflections, students were to plan and reflect on practical strategies towards mitigating and overcoming possible and imminent personal and social challenges. In building up this Unit, I was acutely aware of the political, socio-cultural and religious sensitivities that permeated the issues of marginalised and vulnerable communities in Malaysia and beyond. It was thus crucial that students, many of whom hailed from conservative Asian countries—including Malaysia—engaged in purposeful self-reflexive exercises and learned to communicate their realities 'perceptively, effectively and with cultural sensitivity' (Monash University, 2021). I believed that remaining oblivious to such issues could prove to be detrimental to their performance in the Unit.

In both Reflections, students spoke about personal challenges in realising their personal goals for the Unit, which mainly revolved around difficulties in understanding theoretical concepts, language barriers, distractions, poor time management, lack of familiarity with academic writing, challenges in writing and speaking in English, ineptitude in peer interaction, and mental and physical health issues. Some spoke of personal problems with regard to their families, friends and religious beliefs, especially on matters of gender and sexuality. In Personal Audio Reflection 2, several students expressed a certain degree of success in acknowledging and owning their personal challenges. A few spoke of overcoming their problems while others shared on tentative resolutions.

The Personal Audio Reflection assessment tasks also included a section on students' expectations and experiences of CLIS. In Personal Audio Reflection 1, they were asked how CLIS would help them achieve the Learning Outcomes of the Unit. In Personal Audio Reflection 2, they were required to comment on their experiences of CLIS and if CLIS had helped them achieve their personal learning goals. The earlier submissions of the Personal Audio Reflection contained more generic and even idealistic responses. Conversely, at the end of the semester, I received a wide variety of reflections on CLIS. Some students found the requirements of CLIS convoluted and/or demanding. One of their main concerns—as mentioned earlier—was their lack of confidence in personally grasping the core contents of the resources and accepting the interpretations of their teammates. Other students expressed their deep satisfaction with the incorporation of CLIS into *Critical Methodologies*. In particular, they enjoyed the camaraderie that was fostered in their teams, the relaxed atmosphere in which they could analyse the resources at their own pace, and the peer-to-peer learning during CLIS sessions that helped affirm and clarify their understanding of the material. According to Carvalho and Santos (2022), peer learning helps to enhance collaborative skills and metacognitive awareness, particularly to the mentors, as it requires them to recall and use skills of learning to master competence.

The first of what I consider as two major assessment tasks in the Unit was the team-based 'Change It!' Team Video Essay, a project meant to train students to critically appreciate and appraise media texts, and to analyse and interpret these texts using relevant theoretical feminist and queer concepts. As the media both reflects and constructs reality through imagery (visual representation) and rhetoric (speech representation), they frequently create and promote stereotypes that exacerbate marginality and vulnerability (for instance, Gooch, 2010). Yet, while the media can act as 'sites of oppression' (Yee, 2009, p. 53), they are also avenues for resistance and counter-speech. As part of the assessment task, students were required to watch and reflect on the 'My Transgender Life' documentary.

Each team was then tasked to choose some 'thick' narratives of one out of seven transgender people who appeared in the documentary, and to analyse and interpret these narratives using key concepts from two book chapters that featured storytelling and lived experiences from feminist and queer perspectives. I did not receive any negative feedback from students for the Team Video Essay in terms of the content of the documentary, fulfilling the requirements of the assessment task or collaborating with each other. In fact, a few students casually remarked to me that they enjoyed the experience of learning about transgender lives. They also expressed their delight in being able to apply key aspects of feminist and queer modes of enquiry to the narratives they had collectively chosen without much difficulty.

The second major assessment task, the Research Proposal, served as the pinnacle of student evaluation for this Unit. After having studied numerous topics of feminist and queer theory and methodology throughout the semester, students were tasked to demonstrate their individual and collective grasp of these topics, and how they could be applied to actual action research. Students were instructed to come together mini-teams of two or three and select a current issue involving marginalised or vulnerable groups from a specific political and socio-cultural context that could make for a good Research Proposal. At every stage of their Research Proposal, they needed to consider and integrate these topics, namely storytelling, lived experiences, ethics, insider/outsider positions and self-reflexivity. Students were also required to strategise on how the eventual research findings could be effectively and practically communicated and disseminated.

Students eventually submitted a spectrum of Research Proposals with titles such as 'Social Challenges: Same-Sex Couples in a Heteronormative Society', 'Child Marriages and Their Implications on Human Rights of Girls in Malaysia', 'What Instigates Acid Attacks in Pakistan, and How Prevalent Are They?', 'Queering Identities of Muslim Hijras: Practising and Negotiating Religiosity in Masjids', 'Queering the Veil: Transgender Women's Navigation of the Hijab in the Indonesian Context', 'De/reconstructing "Asian Values" through Narratives of Muslim Trans Women and Act of Veiling', 'Experiences of Malaysian Women Within Same-Sex Relations: Significance of Sexual Health Knowledge', 'Mental Health Issues within LGB Individuals in Malaysia', 'Stigmatisation of Transgender Individuals in their Professional Careers or Workplace in the United States', and 'The Role of Religiosity in Female Labour Participation in the Maldives'. All the Research Proposals were replete with feminist and queer theories and methodologies.

For both the 'Change It!' Team Video Essay and Research Proposal, just as I was eager for them to gain mastery of feminist and queer theories and methodologies and their application to real-world affairs, I was also keen on helping students develop the skills of team work. As I had given permission for students to choose the composition of their own teams, it did not come as a surprise that none of them reported any collaborative conflicts. Students spoke briefly of the enjoyment and trust that came from working with peers who were existing friends or who became friends during CLIS sessions.

For CLIS Session 2, teams were asked to discuss two academic readings on the topic of research ethics and researchers' insider/outsider positions from feminist and queer perspectives in Week 9. This discussion was intended to prepare students to design Research Proposals on real-life issues involving marginalised and vulnerable communities, which in turn served to appraise their ability to grasp and integrate the numerous topics in feminist and queer theories and methodologies for action research. When I spoke to students at the end of the semester, I learned that CLIS Session 2 was unfortunately not as enriching an experience for them as CLIS Session 1. Reading up on and discussing two journal articles for a Research Proposal did not seem to speak to them as effectively as watching a documentary and analysing it via critical theories. While the lack of appeal in CLIS Session 2 may have been due to students' struggles in fulfilling a more academically challenging task in the form of designing a Research Proposal, it may have proven helpful to include a media-based element to accompany the scholarly readings, such as a footage documentary depicting the experiences of a researcher in fieldwork or a short video portraying the lived experiences of a marginalised or vulnerable group.

Towards the close of the semester, the two-hour session 'In-Class Brainstorming Session' and one-hour session 'Workplace' in Weeks 11 and 12 respectively provided an opportunity for students to amend and/or refine their Research Proposals through peer-to-peer and lecturer feedback. As such, a substantial degree of autonomy was accorded to students for independent learning without relinquishing my role as mentor and guide in my students' undergraduate journey.

Conclusion

Based on my experiences of deploying CLIS as a form of ALA, I wish to highlight some practical considerations for ALA learning projects. First, pedagogical designs and implementations of ALA learning projects must emphasise a socially conducive environment for learning. In the absence of a safe space for expressing, discussing and debating personal ideas that enables students to become cognisant of their roles as active instead of passive learners, students will find it challenging to hone the skills of critical thinking, personal confidence, mutual respect and mutual learning in and beyond the classroom. It is important to bear in mind that the creation of a safe space is an ongoing process that may oscillate between an increase and a decrease in the level of camaraderie and social ease during learning activities. However, what is vital is that students are aware of, and encouraged to play an active role themselves in pursuing this safe space.

Second, the linking of learning activities to assessment tasks is an effective strategy to promote a greater sense of commitment among students to the learning process in ALA. While it may seem like a disingenuous act of 'dangling a carrot' in front of students, experience shows that this strategy actually acts as a powerful incentive that can encourage students to develop a deeper appreciation of, and commitment to their learning efforts.

Third, although the goal of ALA is to instil a sense of independent and interdependent learning among students by training them in critical reflection, appraisal, investigation and communication (Fink, 2013), it does not abrogate the role of the lecturer in providing gentle—as opposed to heavy-handed—mentoring and guidance to students. Fourth, the incorporation of various forms of audio-visual media in ALA activities is indispensable as it acts as an additional tool to prompt students in the analysis and (co-)production of knowledge.

CLIS has shown itself to hold great potential in being developed as a viable strategy of 'student-centred learning [which] is characterised by active learning techniques that push students to be responsible participants in their own education' (Machemer & Crawford, 2007, p. 10). CLIS also creates an environment that supports the CoI framework in that it fosters the elements of cognitive presence, social presence and teaching presence for more holistic learning. Through the learning activities and assessment tasks that are infused with elements of CLIS, and aided and mentored by the lecturer, students are trained to take charge of their own undergraduate journey. More importantly, CLIS prepares students to embrace, participate in, and transform the world in which they live.

References

Akyol, Z., & Garrison, D. R. (2011). Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. *British Journal of Educational Technology, 42*(2), 233–250. https://doi.org/10.1111/j.1467-8535.2009.01029.x

Altiok, S., Baser, Z., & Yukselturk, E. (2019). Enhancing metacognitive awareness of undergraduates through using an e-educational video environment. *Computer & Education, 139*, 129–145. https://doi.org/10.1016/j.compedu.2019.05.010

Bhopal, K. (2010). Gender, identity and experience: Researching marginalised groups. *Women's Studies International Forum, 33*(3), 188–195. https://doi.org/10.1016/j.wsif.2009.12.005

Bong, S. A., & Goh, J. N. (2018). Gender Studies major: Monash University Malaysia. In C. Ng, I. Rusaslina, & W. T. Lai (Eds.), *Overview of women's and gender studies in Malaysia* (pp. 46–56). Institut Wanita Berdaya (IWB), University of Malaya and Universiti Sains Malaysia.

Browne, K., & Nash, C. J. (Eds.). (2010). *Queer methods and methodologies: Intersecting queer theories and social science research*. Ashgate Publishing Ltd.

Carr, R., Palmer, S., & Hagel, P. (2015). Active learning: The importance of developing a comprehensive measure. *Active Learning in Higher Education, 16*(3), 173–186. https://doi.org/10.1177/1469787415589529

Carvalho, A.R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*. Article 100070. https://doi.org/10.1016/j.caeo.2021.100070

Chan, C. T., & Goh, J. N. (2020). Social and cognitive dimensions of collaboration in informal learning spaces: Malaysian social science students' perspectives. *Interactive Learning Environments*, 1–15. https://doi.org/10.1080/10494820.2020.1799029

Chau, S., & Cheung, C. (2017). 'Bringing life to learning': A study of active learning in hospitality education. *The Asia - Pacific Education Researcher, 26*(3–4), 127–136. https://doi.org/10.1007/s40299-017-0333-6

Fink, L. D. (2013). *Creating significant learning experiences: An integrated approach to designing college courses*. John Wiley & Sons Inc.

Garrison, D. R. (2011). *E-Learning in the 21st century: A framework for research and practice* (2nd ed.). Routledge.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education—Framework, principles and guidelines*. Jossy-Bass.

Gooch, L. (2010, October 28). Film pushes Malaysian censorship boundaries, but not too far. *The New York Times*. https://www.nytimes.com/2010/10/29/world/asia/29iht-movie.html

Harding, S. (1993). Rethinking standpoint epistemology: What is 'strong objectivity'? In L. Alcoff & E. Potter (Eds.), *Feminist epistemologies* (pp. 49–82). Routledge.

Hung, S.-T.A. (2016). Enhancing feedback provision through multimodal video technology. *Computer & Education, 98*, 90–101. https://doi.org/10.1016/j.compedu.2016.03.009

Ion, G., Cano, E., & Fernandez, M. (2017). Enhancing self-regulated learning through using written feedback in higher education. *International Journal of Educational Research, 85*, 1–10. https://doi.org/10.1016/j.ijer.2017.06.002

Jacob, S. A., Khan, T. M., Pusparajah, P., Velu, S. S., Lee, L. H., & Davey, T. M. (2016). Students' perceived predictors of an effective active learning/problem-based learning session: A pilot study. *Journal of Pharmacy Practice and Research, 46*(1), 42–46. https://doi.org/10.1002/jppr.1150

Keles, E. (2018). Use of Facebook for the community services practices course: Community of inquiry as a theoretical framework. *Computers & Education, 116*(2018), 203–224. https://doi.org/10.1016/j.compedu.2017.09.003

Kemmis, S., McTaggart, R., & Nixon, R. (2014). *The action research planner: Doing critical participatory action research*. Springer.

Kuga Thas, A. M. (2013). No right to live? Malaysia's Islam and implications for its sexual minority storytellers. *Conflicted narratives: Underdogs, minorities and heroic myths*, 1–21. 4th Global Storytelling Conference. http://www.inter-disciplinary.net/probing-the-boundaries/persons/storytelling-global-reflections-on-narrative/project-archives/conference-programme-abstracts-and-papers/session-14b-conflicted-narratives-underdogs-minorities-and-heroic-myths/

Lavoué, E., Kazemitabar, M., Doleck, T., Lajoie, S. P., Carrillo, R., & Molinari, G. (2020). Towards emotion awareness tools to support emotion and appraisal regulation in academic contexts. *Educational Technology Research and Development, 68*(1), 269–292. https://doi.org/10.1007/s11423-019-09688-x

Lee, R., Looi, K. H., Faulkner, M., & Neale, L. (2021). The moderating influence of environment factors in an extended community of inquiry model of e-learning. *Asia Pacific Journal of Education, 41*(1), 1–15. https://doi.org/10.1080/02188791.2020.1758032

Leong, W. S., Ismail, H., Costa, J. S., & Tan, H. B. (2018). Assessment for learning research in East Asian countries. *Studies in Educational Evaluation, 59*, 270–277. https://doi.org/10.1016/j.stueduc.2018.09.005

Levy, D. L., & Johnson, C. W. (2012). What does the Q mean? Including queer voices in qualitative research. *Qualitative Social Work, 11*(2), 130–140. https://doi.org/10.1177/1473325011400485

Machemer, P. L., & Crawford, P. (2007). Student perceptions of active learning in a large cross-disciplinary classroom. *Active Learning in Higher Education, 8*(1), 9–30. https://doi.org/10.1177/1469787407074008

Monash University. (2021). *AMU2908—Critical Methodologies for Action Research*. Handbook. https://handbook.monash.edu/2021/units/AMU2908

Monash University Malaysia. (2020). *Honours: Bachelor of Arts (Honours)*. School of Arts and Social Sciences. https://www.monash.edu.my/sass/future/undergraduate/honours

Nicol, A. A., Owens, S. M., Le Coze, S. S., MacIntyre, A., & Eastwood, C. (2018). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education, 19*(3), 253–265. https://doi.org/10.1177/1469787417731176

Petress, K. (2008). What is meant by 'active learning?' *Education, 128*(4), 566–569.

Powner, L. C., & Allendoerfer, M. G. (2008). Evaluating hypotheses about active learning. *International Studies Perspectives, 9*(1), 75–89. https://doi.org/10.1111/j.1528-3585.2007.00317.x

Rezaei, A. R., & Lovorn, M. (2010). Reliability and validity of rubrics for assessment through writing. *Assessing Writing, 15*(1), 18–39. https://doi.org/10.1016/j.asw.2010.01.003

Shea, P., Li., C., Swan, K., & Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *The Internet and Higher Education*, *9*(3), 175–190. https://doi.org/10.1016/j.iheduc.2006.06.005

Stolk, J., & Harari, J. (2014). Student motivations as predictors of high-level cognitions in project-based classrooms. *Active Learning in Higher Education, 15*(3), 231–247. https://doi.org/10.1177/1469787414554873

Tirado Morueta, R., Maraver López, P., Hernando Gómez, Á., & Harris, V. W. (2016). Exploring social and cognitive presences in communities of inquiry to perform higher cognitive tasks. *The Internet and Higher Education*, *31*, 122–131. https://doi.org/10.1016/j.iheduc.2016.07.004

TMW Media. (2016). *My transgender life*. Kanopy. https://monash.kanopy.com/video/my-transgender-life

Wicks, D. A., Craft, B. B., Mason, G. N., Gritter, K., & Bolding, K. (2015). An investigation into the community of inquiry of blended classrooms by a Faculty Learning Community. *The Internet and Higher Education*, *25*, 53–62. https://doi.org/10.1016/j.iheduc.2014.12.001

Yee, J. (2009). Ways of knowing, feeling, being, and doing: Toward an Asian American and Pacific Islander feminist epistemology. *Amerasia Journal, 35*(2), 49–64. https://doi.org/10.17953/amer.35.2.u4671681k9351632

Yuan, M., & Recker, M. (2015). Not all rubrics are equal: A review of rubrics for evaluating the quality of open educational resources. *International Review of Research in Open and Distributed Learning*, *16*(5). https://doi.org/10.19173/irrodl.v16i5.2389

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education*, *47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

CHAPTER 6

Collaborative Active Learning (CAL) Approach in Finance: A Case of Business Strategy Pitch Presentation

Yessy Peranginangin

Introduction

Finance lecturers have been relying on traditional lectures as their core pedagogy due to the familiarity of the teaching method (McCullough & Munro, 2018; Smith & Gibbs, 2020), the need to cover complex materials (Akimov et al., 2018; Smith & Gibbs, 2020), the lack of access to modern teaching space (Huxham, 2005), and the large number of students enrolled in classes (Freeman & Mckenzie, 2001). The increasing number of students learning finance can be attributed to the requirement for a business graduate to master the financial aspects of business (Cagle et al., 2010; Marriott et al., 2015) as well as the growing interest in the subject (Smith & Gibbs, 2020). While traditional lectures may remain the primary pedagogy for many finance lecturers, some have started

Y. Peranginangin (✉)
Monash University Malaysia, Subang Jaya, Selangor, Malaysia
e-mail: yessy.arnold@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_6

to incorporate active learning into their teaching methods to enhance learning opportunities among students. The adoption of active learning in finance units is a response to the criticisms of traditional lectures (Abeysekera & Dawson, 2015; Cashin, 1985), the availability of technology that promotes active learning (Seiver, 2013; Stephen, 2015), and the value systems of today's learners (Black, 2000; Marriott et al., 2015). To this end, active learning engages students in their learning and helps to improve higher level learning (Zepke, 2013) as it requires them to reflect on their actions. It is a student-centred instruction that holds students accountable for their learning, encourages learning with peers, and supports student self-pacing of learning (Prosser & Trigwell, 2014; Taylor et al., 2012). However, the social activities in active learning may induce anxiety as the activities create opportunities for social judgment (Hood et al., 2021).

Traditional lectures typically focus on one-way information transmission, leading to passivity among students who are less involved in the learning process (Abeysekera & Dawson, 2015). Given the complexity of the material taught in university-level finance units, a passive learning attitude can adversely affect a student's level and pace of learning (Cashin, 1985). To survive in an increasingly competitive business environment, business school graduates must have an in-depth understanding of financial concepts and their application and this supports the need to include active learning components in finance units (Akimov et al., 2018; Smith & Gibbs, 2020). Active learning components expose students to the real-world application of theories or concepts (Cheung & Zhong, 2017; Chiang et al., 2021), provide students with a personalised experience that allows them to experiment with the materials (Black, 2000; Smith & Gibbs, 2020), and help students to perform better, as active learning components may match the various learning styles of different students (Ashraf et al., 2013; Black, 2000).

Active learning components can be incorporated into finance units by including them in short in-class activities during lecture time (Cavanagh, 2011; McCullough & Munro, 2018). Alternatively, they can be included in after-class activities in the form of team-based learning (Lam, 2007), peer mentoring (Fox & Stevenson, 2006), spreadsheet-based assignments (Cagle et al., 2010), and trading simulations (Cheung & Zhong, 2017; Smith & Gibbs, 2020). These types of active learning activities must be designed carefully to ensure that students go through the experiential learning cycle (Kolb, 1984). In implementing experiential learning in a finance unit, Black (2000) suggests that the learning cycle starts when students are exposed to new experiences that are combined with old ones. This process resembles the concrete experiences (CE) in the cycle. Next, students engage in reflective observation (RO) to compare and contrast the new experiences against the old ones. The CE stage can be considered passive learning. However, the RO stage is the initial step towards active learning and students are gradually exposed to more activities requiring them to consider alternative solutions to a problem. The activities help to develop students' analytical skills, and this stage is labelled as abstract conceptualisation (AC). Once students can reconcile their experiences and analytical abilities, they would be comfortable performing active experimentation (AE) to propose solutions to a given problem. The experiential learning cycle does not stop with the completion of AE and students may start another process when they are exposed to new experiences. The reflective practices associated with the application of knowledge in experiential learning encourage active learning (Lucas, 1997). Additionally, experiential learning accommodates students' different learning style preferences and challenges them to explore other ways of learning (Siegel et al., 1997) and thus develops a deeper understanding of what they are learning and why they are doing it (Dellaportas & Hassall, 2013). In this regard, lecturers should design and facilitate instructional approaches like blended learning, computer-aided instruction and role-play because these approaches favour students with Visual learning style which is positively correlated with the Teaching Presence of the Community of Inquiry framework (Chang-Tik, 2018). According to Kolb and Kolb (2005, 2017) experiential learning requires a hospitable learning space that is conducive to learning and it is also a psychological safe space for lecturers to challenge students and for students to feel safe to explore new ideas. Importantly, through experiential learning students enter the real-world situations and according to Stahl et al. (2006) this type of learning is also known as "situated learning" where learning is situational and may include socio-cultural aspects.

The simulated trading of financial assets is commonly used in finance units to incorporate active learning and introduce students to the experiential learning cycle (Cheung & Zhong, 2017; Smith & Gibbs, 2020). Before the simulated trading activity, students are exposed to the relevant concepts and theories (CE), after which they would compare and contrast the new experience(s) against the old one(s) (RO). Next, students are exposed to the simulated trading activity, which requires them to consider the various alternative solutions to a stated problem (AC). In the context of the simulated trading activity, the stated problem could involve the rate of return net of costs that students need to achieve, or another goal such as the diversification of student portfolios. During the simulated trading, students actively experiment (AE) by testing various strategies and methods they can use to achieve the stated goal. In some cases, students are allowed to perform several rounds of mock trading, which would enable them to experience the learning cycle more than once and deepen their understanding of the problem and possible solutions (Marriott et al., 2015; Smith & Gibbs, 2020).

The implementation of simulated trading in finance units has been shown to enhance engagement and learning experiences, leading to better student performance (Cheung & Zhong, 2017; Smith & Gibbs, 2020). The common critique of simulated trading, however, is its failure to address broader factors beyond the trading of financial assets and its lack of social interaction (Feuerstein, 2019). More recently, Black (2000) followed the approach in Lovell-Troy (1989) to implement a more comprehensive approach of active learning in a finance unit where different active learning strategies are matched with various levels of learning objectives within the Bloom's taxonomy. Figure 6.1 shows the relationship between the learning activities and the learning objectives that the activities are designed to achieve. The incorporation of active learning must consider the level of the learning objectives that the unit needs to achieve (Black, 2000; Lovell-Troy, 1989). It must also help lecturers to carefully design learning activities so that lower-level knowledge and skills are mastered to ensure the success of active learning within the experiential learning cycle (Black, 2000; Smith & Gibbs, 2020). Accepting a constructive alignment perspective from Biggs (1996), the learning activities, objectives and assessment should align to one another. However, for the alignment to be constructive, active learning plays a significant role with a strong emphasis on social interactions (student–student and student–lecturer; Thoms & Eryilmaz, 2014; Vuopala et al., 2016) and collaboration over individual study and practice. Therefore, the simulated trading activities are designed to allow discussion of assignments and other assessable work (Park et al., 2015; Woods & Bliss, 2016) and to motivate students to be more participatory and prone to exchange ideas with peers (Sims, 2003).

Experiential learning cycle	Learning Objectives	Activities
Concrete experience (CE)	Knowledge	Theory lectures, required readings, handouts, content exams
Reflective observation (RO)	Comprehension	Applied lectures, problem exams, moves, guided discussions, role play, theory papers
Abstract conceptualisation (AC)	Application	Simulation, highly structured exercises, spreadsheet exercises, highly structured case studies
Active experimentation (AE)	Analysis	Debate, analysis papers, moderately structured exercises, moderately structured case studies
	Synthesis	Presentations, field projects, research projects
	Evaluation	Suggested readings, argumentative discussion, unstructured case studies

Fig. 6.1 Educational objectives and teaching techniques (*Source* Adapted from Black [2000, p. 309])

A less discussed active learning strategy in finance pedagogy is role-play. This strategy is considered a form of simulation (Feinstein et al., 2002) where students mimic a system, entity, phenomenon, or process (Lean et al., 2006). It is noteworthy that role-play activities can be combined with other active learning strategies (e.g., structured cases, analysis papers, and presentations), and can also be collaborative. The collaborative aspects of role-plays create interactive active learning (Chi, 2009) that allows for cooperative problem-solving. More importantly, students can benefit from the knowledge construction process (Baker, 2002).

This chapter first discusses the case for implementing a collaborative active learning (CAL) strategy, namely, role-play, in International Financial Management (IFM), a second-year finance unit taught at the School of Business, Monash University Malaysia. The unit aims to equip students with the knowledge and skills that finance managers need to deal with the financial aspects of international firms. The unit is taught in blended mode whereby lecture videos are posted weekly for twelve weeks. These videos are supplemented with virtual tutorial sessions held on an online meeting platform the week after the posting of the lecture videos. The tutorial sessions include discussions of the numerical analysis, structured case discussions, and structured discussions on recent international business trends where students are provided with articles from leading business news outlets to read before the discussions.

The chapter then details the preparations involved in setting up the role-play that was implemented in the unit in the first semester of 2021. This is followed by a description of the actual implementation of the role-play and the results attained through its use, particularly regarding the achievement of the unit's learning outcomes. The chapter concludes with recommendations for improvements to the role-play in future implementations.

Description of the CAL

One of the learning outcomes for the IFM unit is for students to be able to apply critical thinking, problem-solving, and presentation skills to the materials taught in the unit. The materials discuss the challenges and opportunities for companies that operate internationally, the mechanisms of the foreign exchange market, the various factors that explain exchange rate movements, the methods that firms can implement to manage transaction exposure that arises from conducting business transactions using multiple currencies, and international investing and financing decisions for both the short- and long-term horizon. Given the analytical nature of international finance and the broad coverage of the material in the unit, there is a need to design a task to assess student success in making effective use of the knowledge they acquire from the unit. A role-play activity designed in the format of a group assignment can assist students to showcase the skills and knowledge they have developed from their understanding of the material in the unit. If so, role-play—even though of low fidelity—in simulated task environments can appeal to students acquiring knowledge, skills and attitudes that are needed in the students' future profession (van Merrienboer et al., 2017).

The role-play assessment requires students to form groups of business management "consultants" that pitch business strategies to a company that operates internationally. A company may engage a consulting firm to formulate and implement business strategies in response to challenges that it faces, and several consulting firms may be invited to pitch business strategies to the company. The company then chooses the firm it believes best understands its business and that offers the most effective strategies that are aligned with the interests of the company. During the role-play assessment, each group acts as a consulting firm, and each student plays the role of an individual business consultant. For the assessment, the lecturer selects one public listed company that operates internationally. The international operations of the chosen company will challenge students to apply the knowledge and skills acquired from the IFM unit to manage the company's finance functions, including its interaction with the foreign exchange market. The rationale for selecting a public listed company is that it will be easy for students to research the company as market regulators require listed companies to provide public disclosure of all relevant company information.

Each group must propose at least two business strategies for the selected company, and one of the strategies must focus on the company's financial management. To produce these strategies, students need to work collaboratively within their group to gather relevant information about the company and its business environment. Students can obtain such information from the Management Discussion and Analysis section of the company's most recent annual report, as well as from online/offline news articles. Students can understand the business environment in which the company operates from news articles and expert opinions. Incorporating each student's research, each group then formulates relevant business strategies it would recommend to the company to implement. The process of researching the company and proposing business strategies mimics the role that consulting firms play when engaged by a company. To complement the assignment brief, the lecturer provides the groups with a video explaining the process of pitching their strategies and offering tips on how to research a listed company. This will assist students who are not familiar with the strategy pitch process and the process of conducting independent research on a listed company.

Each group is required to submit a 10-minute strategy pitch in video format. Ideally, a live presentation would be the best way to mimic the delivery of a strategy pitch performed by an actual consulting firm. However, scheduling live presentations is a significant challenge because the students enrolled in the unit may have different majors and can be at various stages in the completion of their degree. As for group composition, each group consists of five to six students to allow for good group dynamics and to ease the distribution of tasks. According to Yildiz Durak (2022), group studies and group dynamics may contribute positively to the development of academic self-efficacy of the students during learning activities with the support of the group members. To perform at a satisfactory level, the students need to first understand the selected company's business and its current challenges. Next, the students need to propose business strategies for the company to pursue and explain their benefits along with risk analysis. Finally, the students need to prepare visual aids that will support the presentation delivered in the video. The video must be at a level where the markers do not have issues understanding the content of the presentation. Satisfactory results from the role-play assignment indicate that the students have met the unit's learning objective of applying critical thinking, problem-solving, and presentation skills to solve real-world issues faced by companies today.

Procedures

Preparation

Following Black (2000), the lecturer carefully structures the delivery of materials before the students engage in the role-play assessment. This allows the students to achieve the various learning objectives, namely, knowledge, comprehension, and (partly) application. The knowledge and comprehension objectives are achieved through student exposure to weekly pre-class videos, followed by weekly virtual tutorial sessions that discuss numerical questions, structured cases, and recent international business trends that are relevant to the unit. The last two aspects of the weekly tutorial sessions are specifically designed to familiarise the students with the skills of searching for credible information and information sources and then to critically analyse them. The role-play assessment is announced during the first week of the 12-week semester, and students must submit the pitch video in week 10.

To allow students to reflect on their learning and gauge their understanding of the concepts and knowledge of the overall unit materials, an assessment for learning activity is embedded in the unit in the form of a weekly ticket submission. Students use the submission (see an example in Fig. 6.2) to reflect on two things they learned and one question they have each week.

The lecturer responds to common questions posed in the ticket submissions in a weekly podcast and allocates marks to students based on the frequency of their submission of tickets during the semester. A mark of five is provided if students submit at least 10 tickets during the 12-week

Ticket submission on Week 4 materials (The Parity Conditions)
The 2 things I learn: 1. The relationship between relative inflation rate and the exchange rate. 2. The relationship between the interest rate differential between two countries and the expected exchange rate. The 1 question I have: In real life, do people look at the interest rate differential & forward premium diagram to determine whether arbitrage is profitable?

Fig. 6.2 An example of ticket submission

semester. In the context of assessment for learning, the use of scaffolding in the delivery of materials that involves reflection of the topics learned, and feedback from lecturers and peers are all tailored to help students in self-assessment which is accepted as being at the heart of assessment for learning (Swaffield, 2011). In addition to ticket submission, formative assessments in the form of bi-weekly online tests are administered from Week five to Week nine to ensure that students have a solid understanding of the theories and concepts taught in the unit.

The lecturer assists in the formation of the groups for the activity and assessment using the group selection activity in the university's learning management software (LMS). Students are free to form a group with other students who enrol in the same tutorial session. The number of group members in each group ranges from five to six, depending on the number of students enrolled in each tutorial session. To facilitate group formation, the tutorial sessions held in the first two weeks include small group discussions whereby students can get to know their potential group members. Students can form their groups starting in week three and can use the group messaging function in the LMS to establish and maintain contact with their group members.

Referring back to Fig. 6.1, the role-play assessment in the IFM unit allows students to achieve at least the learning objectives of the application of knowledge. Skills at this level are considered lower-order thinking skills in Bloom's taxonomy. However, as the role-play progresses, students must analyse relevant information about the company and identify the company's challenges. They then explore and discuss business strategies that their group should propose to the company, as well as the best ways for the company to implement the strategies. The satisfactory completion of these activities demonstrates the acquisition of analysis and synthesis, both being higher-order thinking skills within Bloom's taxonomy. When performing their roles as business consultants, students will have to engage in moderately structured data gathering. Given that each group is composed of five to six members, data collection can be undertaken in pairs, allowing students to help one another and promoting collaborative work within the group. It is important to note that collaboration alone does not always lead to effective group work; there is a need to have a regulatory mechanism to direct students' attention to the tasks and group awareness (Lai, 2021; Panadero & Järvelä, 2015). To this end, according to Panadero and Järvelä (2015), group awareness is a vital factor in students' collaborative learning and Lai (2021) asserts that the regulatory mechanism consolidates the learning awareness by providing students a platform to set learning goals and monitor their learning process. Besides group awareness, interdependence and task cohesion are crucial interpersonal elements to promote learning processes; the interaction of these elements together with group members' commitment and shared responsibility will drive the students to collective learning processes (Van den Bossche et al., 2006). In addition, as groups begin analysing possible business strategies and their implementation, members will engage more intensely and comprehensively with one another, work collaboratively within their group, and involve themselves in discussions and debates to examine the overall competitiveness of the group's strategy pitch. In this regard, according to Hattie (2009), for students to learn effectively in groups they need well-structured group work, and group work strategies. In addition, the cognitive demands of group in solving problems require them to accommodate construction, co-construction and constructive conflicts among themselves in order to achieve mutually shared cognition (Van den Bossche et al., 2006). Consequently, Mercer (2008) and Wells (2007) argue the importance of social collaboration in promoting learning. In other words, to achieve a high-level of collaboration students need to have personal responsibility towards their work, show willingness and effort towards collaboration (Hamalainen & Hakkinen, 2010).

In terms of the assessment of the role-play, the assessment criteria consist of two components. First, each group will be assessed according to the learning process at the early stage of the role-play activity. The assessment will consider the learning process for each group, group dynamics, and the ability of each group to obtain early feedback before the final selection of the business strategies. For this part of the assessment, each group must produce a one-page summary describing the relevant issues facing the company and outlining the group's recommended business strategies and plans for their implementation. Figure 6.3 shows an example of a one-page summary submission. The purpose of the early feedback is to enhance student learning; therefore, it is not solely corrective in nature. The tutors request for clarifications and more information on the students' works (epistemic feedback) with the intentions of advising them on how to improve and expand on their ideas (suggestive feedback; Alvarez et al., 2011). In line with the assessment for learning concept there is an emphasis on peer formative feedback, which is a form of collaborative learning (Van Gennip et al., 2009; Vonderwell et al., 2007) that promotes reflective dialogue (Kelly et al., 2007; Tucker et al., 2009; Vonderwell et al., 2007) and stimulates students to play an active role in their learning and assessment.

Each group must also submit a peer-evaluation review to capture group dynamics. After these submissions, each group must organise a fifteen-minute meeting with their tutor to discuss the group's progress. Before meeting with their group, the tutor must read the one-page summary and the peer- evaluation results summarised by the lecturer. The tutors are briefed beforehand to ask indirect questions to probe into group dynamics and confirm the contents of the one-page summary and peer- evaluation submissions of their assigned group. The tutors are required to report any irregularities to the lecturer. For example, there may be cases where a peer-evaluation submission does not accurately capture the dynamics within a group. Or the peer-evaluation submission may not accurately reflect the actual contribution of each group member. In these cases, the tutor would need to probe and discover the reason for the discrepancy. To do so, the tutors are briefed beforehand to ask group members, particularly those who are shy or quiet, questions about things like (1) the distribution of tasks within a group; (2) how the one-page summary was developed and the how the ratings of group members were determined in developing the peer evaluation submission; and (3) the quality of work of group members whose peers had identified them as low or poor contributors.

The tutors are also briefed to encourage group members to work together for the production of the pitch video. They are advised not to provide direct answers to students' questions about technical content but

Problems	Strategies or Suggestions
Declining revenue from flights • global lockdown and travel restrictions in placed to contain the virus • Revenue for the airline business in 2020 dropped by 75% while capacity reduced by 71%	**Accelerate digital transformation to expand non-airline businesses to generate new revenue streams to the group** 1. **Teleport** • utilize the unused passenger carrier for cargo • expand on partnership with other airlines to allow more cargo belly space availability 2. **Airasia App** • Transform from a digital airline into a lifestyle brand "for everyone" • Venture into new lines of businesses, such as travel agency, other lifestyle products, e-commerce, and fintech
Run out of money to meet their obligations • Liabilities exceeded its assets by RM1.84 billion and the cash burn rate at RM120 million monthly • Lawsuit from Malaysia Airports Holdings Bhd (MAHB) of RM 78 million and BOC Aviation Ltd of USD 23 million	**Airasia implement low cost strategy while fundraising** 1. **Fixed costs down 52%.** • AirAsia has reduced staff costs by 35% in FY20 via headcount rationalisation and voluntary salary cuts. • Substantial fixed costs reduction of 52% in FY2020, surpassing the Group's target of 50%. 2. **Fundraising** • AirAsia has successfully raised RM336mn via issuance of 470mn new shares in two tranches in 1Q21.
Over-hedging in fuel derivative contracts. • Locked in higher price while the fuel price slumped in 2020 (Result: higher cost of fuel). • However, consumption of fuel reduced and below the expected consumption in hedging contracts. • Fuel swap losses ○ **3Q 2020**:RM281 million ○ **4Q 2020**:RM391 million	**Restructure the fuel hedging contracts and use financial derivatives to reduce exposure in hedging.** 1. **Restructure 70% of the fuel hedging position** • Borrowed from fuel hedge counterparties for settlement of fuel hedges crystallised (4Q 2020:RM582.86 million). • Expected to reduce fuel unit cost by 15% in 2021. 2. **Collar hedge** • Call option gives protection against higher price while the put option covers the cost of the call option. • It helps to hedge against rising prices and limit the loss of price reduction

Fig. 6.3 An example of a one-page summary submission (*Note* On average, 1 U.S. dollar was worth 4.25 Malaysian ringgit in 2020)

are encouraged to provide alternative suggestions or aspects to consider when responding to students' questions. Finally, the tutors are briefed to ask the groups to consider the tutor's feedback when finalising the pitch video. With regard to the anonymous peer-evaluation of group dynamics, it may help to promote reflection, group processing, and individual accountability (Aggarwal & O'Brien, 2008; Brooks & Ammons, 2003; Oakley et al., 2004) as well as to reduce social loafing and free riding (Aggarwal & O'Brien, 2008). On the other hand, group dynamics may exert pressure on the group members to arrive at a consensus and thus may cause some members to agree to decisions they do not support to avoid conflicts (Beebe & Masterson, 2003).

The groups and their members will be awarded a maximum of six marks for the first part of the role-play assessment if they fulfil the following requirements: (1) they submit a meaningful one-page pitch summary; (2) they submit a completed peer-evaluation form; and (3) all group members are present at the meeting with the tutor, excluding those who have a valid reason for not attending.

The second part of the role-play assessment evaluates the quality of the pitch video that each group submits. The lecturer prepares a marking rubric to assess four aspects of the strategy pitch, namely: (a) the quality and relevance of the strategies presented; (b) the implementation plan and the risks associated with the implementation of the strategies; (c) the quality of the visual aids used in the video, and (d) the quality of the presentation. The lecturer allocates a total of 14 marks across the four aspects of the marking rubric. To minimise bias in evaluating the videos, the tutors will assess the videos of the groups whose one-page summary they do not review. Overall, the assessment criteria for the role-play include an assessment of the learning process and of the outcomes that the students deliver. According to Jonsson and Panadero (2017) rubric make it clear to the students the requirements of the assessment tasks and the transparency of the assessment process in terms of expectations and criteria. Therefore, students are more likely to have positive perceptions of the assessment tasks, which in turn have potential impacts on their learning. This is because rubric make it easier to provide and interpret constructive feedback (Schamber & Mahoney, 2006).

Implementation

The role-play assessment was implemented in the first semester of 2021 with 214 students that were enrolled in the unit. About 74% of the students were Malaysian, while the rest were international students from Indonesia, China, Sri Lanka, Japan, and several other countries. In terms of gender, 53% of the students were female. The unit used blended teaching and learning activities that incorporated virtual face-to-face teaching and online learning activities. Specific to Australian universities, the teaching period of one semester is 12 weeks, and there is a one-week mid-semester break for students to undertake independent study. At the beginning of every teaching week, students were required to access the pre-class videos that introduced the materials for the week. The videos included short quizzes and required students to do additional reading from the prescribed textbook.

Students were expected to attend and participate in the virtual tutorial sessions that followed up the pre-class videos. Each tutorial session had around twenty-five students that were divided into two sections. The first section discussed the application of concepts and numerical exercises, while the second section allowed students to work in virtual groups to discuss recent events and structured case studies. The group discussions were conducted using the breakout room function of a virtual meeting platform. Each group was given access to an online collaboration platform called Padlet (https://padlet.com/) to compile and present their work. There were 11 virtual tutorial sessions in the semester, and group activities were undertaken in 10 sessions. One virtual tutorial did not have a group work component; instead of group work, the tutors conducted practical international capital budgeting exercises using Microsoft Excel. In addition, starting from week two, students were required to reflect on their learning activities and submit them in the form of weekly tickets. Figure 6.2, mentioned previously, presents an example of information contained in a ticket submission.

The group activities in the first two weeks of the virtual tutorials were designed to facilitate the formation of groups for the role-play assessment. Starting from week three, students could join or leave a group using the group selection function in the LMS. The students formed a total of 40 groups composed of five to six members each. It is noteworthy that for the group work in the virtual tutorial sessions, the tutors would assign students to groups that were different from their role-play assessment groups to encourage social interactions. Most students managed to form their groups without outside assistance, but a small number of students were too shy to join a group and required the assistance of a tutor to put them into one of the existing groups.

The lecturer selected AirAsia Group *Berhad* as the target client for the role-play assessment. AirAsia is a renowned budget airline group with a strong presence in ASEAN. The company operates internationally and receives excellent coverage from the press. Its multi-country operations were significantly affected by the COVID-19 pandemic and required major changes to cope with the pandemic's effects and uncertainties.

Results

As mentioned previously, each group had to discuss its one-page summary of company issues and recommended strategies to address them with their tutor. As well, the tutors were required to observe group dynamics during the meeting and from the peer-evaluations the students completed before attending the meeting. Given that almost all groups were formed by the students themselves, the dynamics within these groups were good. The tutors did, however, detect issues related to the technical content of the summaries. These issues resulted from the inability of some students to understand technical concepts found during their research of the company and did not seek assistance from the tutors or lecturer. To assist groups with such content issues, the tutors held one additional meeting with the affected groups. The meeting would ensure that the group was on the right track to proceed with the production of the presentation video.

As for the pitch video, all groups submitted their video on time, and six groups submitted their video before the deadline. To mitigate bias in the assessment of the videos, the tutors assessed the videos of the groups whose one-page summary they had not reviewed. The tutors observed good quality video production, and most students displayed good presentation skills. Some groups showed exemplary collaborative work by delivering a lively presentation with a seamless transition between speakers.

Given the ten-minute time limit for each video, most groups did well in summarising the issues facing AirAsia and in proposing strategies to address them. The tutors had assisted the groups to refine their proposed strategies to ensure that the strategies were consistent and addressed the issues facing the company. Overall, the pitch videos showed that students had a good appreciation of the issues that uncertainty brings to a company's international operations. In the case of AirAsia, the uncertainty is exacerbated by the restrictions that the pandemic has brought to international travel. The groups showed a good understanding of the issues facing AirAsia in these circumstances and proposed sound strategies for the company to consider and implement. The proposed strategies can be grouped into general business strategies and finance-related strategies. Examples of the former include the adoption of pivoting strategies for AirAsia to intensify its pursuit of other business lines, including fintech initiatives and logistics services that would take advantage of artificial intelligence. The finance-related strategies presented by the groups included debt refinancing, hedging using forex derivatives, and investing in new business initiatives as part of a pivoting strategy. These strategies were accompanied by implementation plans and risk analyses.

After the video submissions, three groups had issues with non-contributing members and raised the issue with the lecturer. Upon investigation, the non-contributing members of two of the groups admitted their lack of participation in the role-play assessment. They identified stress related to coping with the pandemic and the transition to emergency online learning as factors in their behaviour. In these two cases, the lecturer asked the group members to rate the performance of the non-contributing members. The lecturer then moderated the mark for those members based on their performance rating. In the third group with a non-contributing member, the problem appeared to involve communication issues within the group. Based on the feedback provided by all members of the group, there was no moderation of the student's mark. This approach of using a grading scheme that penalises unproductive group members is in line with Davies' (2009) suggestion. Likewise, according to Ellingsen and Paltseva (2016) in order to reduce the problem of free riders there is a need for better coordination and monitoring of tasks within a group.

The inclusion of the collaborative component in the role-play assessment allowed students to develop their knowledge by sharing with and teaching each other. Anecdotal evidence from the meetings of the groups with their tutors indicates that students worked through questions and issues that they had during the project themselves, with minimal prompts from the tutor. Some groups had issues in reconciling the predictions coming from the theories they learned in the classroom against the predictions that they observed in the news and market commentaries. When this happened, the tutors prompted the groups to recall the assumptions behind the theories and ask the groups to contrast these assumptions with the current situations. The prompt enabled the students to collaborate and to construct knowledge in the groups. Moreover, the collaborative component allowed students to achieve one of the higher-order thinking skills, namely analysis.

In reflecting on student performance and feedback regarding the role-play assessment, two changes are recommended for implementation during future role-play. The first change is for groups to deliver a live presentation instead of a video presentation, as live presentations allow tutors and lecturers to quickly capture and ascertain group dynamics. Live presentations also allow them to provide immediate feedback to the students. In addition, the live presentation allows the tutors and lecturers to provide personalised feedback to the group, which according to Zheng et al. (2022) may significantly improve the collaborative knowledge-building level as well as better co-regulated behavioural patterns. The second recommended change is to have a second peer evaluation conducted at the end of the assessment. This would help to discourage the likelihood that groups would experience a problem with free riding, non-contributing members.

Conclusions

The implementation of collaborative active learning in an analytical unit can assist students to develop higher-order thinking skills identified in Bloom's taxonomy. The successful implementation of active learning requires the careful scaffolding of unit materials to address the different stages of the experiential learning cycle. Including a collaborative component in active learning in the form of an assessment assists students to achieve the abstract conceptualisation (AC) and active experimentation (AE) educational objectives within the experiential learning cycle. The knowledge and experience that students acquire during these stages of the experiential learning cycle will help them to understand how to apply the knowledge that they obtain in the classroom setting and will assist them in acquiring application and analysis skills that are considered higher-order thinking skills. The role-play assessment approach that incorporates different stages of the experiential learning strategy, draw in scaffolding of the unit materials, peer formative feedback and using rubrics to internalise a better understanding of expectations and performance, are all integrated at the heart of assessment for learning (Swaffield, 2011).

The business strategy pitch assessment exposed students to how international companies apply financial decisions. It also allowed students to integrate the learning from the unit materials into a company's operations. The collaborative component in the role-play activity and assessment allowed students to work collaboratively and participate in the knowledge construction process. The assessment assisted students to achieve the unit learning outcomes and was well-accepted by the students. The strategy pitch submitted by at least four groups exceeded the expectations of the markers as the strategies and their implementation plans were well presented.

References

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: Definition, rationale and a call for research. *Higher Education Research & Development, 34*(1), 1–14. https://doi.org/10.1080/07294360.2014.934336

Aggarwal, P., & O'Brien, C. L. (2008). Social loafing on group projects: Structural antecedents and effect on student satisfaction. *Journal of Marketing Education, 30*(3), 255–264. https://doi.org/10.1177/0273475308322283

Akimov, A., Kobinger, S., & Malin, M. (2018). Determinants of student success in finance courses. *Journal of Financial Education, 44*(2), 223–245.

Alvarez, I., Espasa, A., & Guasch, T. (2011). The value of feedback in improving collaborative writing assignments in an online learning environment. *Studies in Higher Education, 37*(4), 387–400. https://doi.org/10.1080/03075079.2010.510182

Ashraf, R., Fendler, R., & Shrikhande, M. (2013). Impact of personality types and learning styles on performance of finance majors. *Journal of Financial Education, 39*(3/4), 47–68.

Baker, M. (2002). Forms of cooperation in dyadic problem-solving. *Revue D'intelligence Artificielle, 16*, 587–620. https://doi.org/10.3166/ria.16.587-620

Beebe, S. A., & Masterson, J. T. (2003). *Communicating in Small Groups*. Pearson Education Inc.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32*(3), 347–364. https://doi.org/10.1007/BF00138871

Black, C. (2000). Finance education: An experiential approach in an open Learning environment. *Industry and Higher Education, 14*(5), 305–316. https://doi.org/10.5367/000000000101295219

Brooks, C. M., & Ammons, J. L. (2003). Free riding in group projects and the effects of timing, frequency, and specificity of criteria in peer assessments. *Journal of Education for Business, 78*(5), 268–272. https://doi.org/10.1080/08832320309598613

Cagle, J. A. B., Glasgo, P. W., & Hyland, D. C. (2010). Spreadsheets: Do they improve student learning in the introductory finance course? *Journal of Financial Education, 36*(3/4), 35–52. https://doi.org/10.2307/41948646

Cashin, W. E. (1985). *Improving lectures*. Article 14. https://eric.ed.gov/?id=ED267721

Cavanagh, M. (2011). Students' experiences of active engagement through cooperative learning activities in lectures. *Active Learning in Higher Education, 12*(1), 23–33. https://doi.org/10.1177/1469787410387724

Chang-Tik, C. (2018). Impact of learning styles on the community of inquiry presences in multi-disciplinary blended learning environments. *Interactive Learning Environments, 26*(6), 827–838. https://doi.org/10.1080/10494820.2017.1419495

Cheung, O. L., & Zhong, L. (2017). Economics and finance using simulation games to engage students in online advanced finance courses. In R. C. Alexander (Ed.), *Best Practices in Online Teaching and Learning across Academic Disciplines* (pp. 248–265). George Mason University. http://ebookcentral.proquest.com/lib/monash/detail.action?docID=6151047

Chi, M. T. H. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science, 1*(1), 73–105. https://doi.org/10.1111/j.1756-8765.2008.01005.x

Chiang, C., Wells, P. K., & Xu, G. (2021). How does experiential learning encourage active learning in auditing education? *Journal of Accounting Education, 54*, 100713. https://doi.org/10.1016/j.jaccedu.2020.100713

Davies, W. M. (2009). Groupwork as a form of assessment: Common problems and recommended solutions. *Higher Education, 58*(4), 563–584. https://doi.org/10.1007/s10734-009-9216-y

Dellaportas, S., & Hassall, T. (2013). Experiential learning in accounting education: A prison visit. *The British Accounting Review, 45*(1), 24–36. https://doi.org/10.1016/j.bar.2012.12.005

Ellingsen, T., & Paltseva, E. (2016). Confining the coase theorem: Contracting, ownership, and free-riding. *The Review of Economic Studies, 83*(2), 547–586. https://doi.org/10.1093/restud/rdw001

Feinstein, A., Mann, S., & Corsun, D. L. (2002). Charting the experiential territory: Clarifying definitions and uses of computer simulation, games, and role-play. *Journal of Management Development, 21*(10), 732–744. https://doi.org/10.1108/02621710210448011

Feuerstein, A. (2019). Students and stocks: A critical reading of the stock market Game™. *The Social Studies, 110*(4), 180–187. https://doi.org/10.1080/00377996.2019.1610936

Fox, A., & Stevenson, L. (2006). Exploring the effectiveness of peer mentoring of accounting and finance students in higher education. *Accounting Education, 15*(2), 189–202. https://doi.org/10.1080/06939280600595145

Freeman, M., & Mckenzie, J. (2001). Aligning peer assessment with peer learning in large classes: The case for an online self and peer assessment system. In B. David, R. Cohen, & J. Sampson (Eds.), *Peer learning in higher education: Learning from & with each other* (pp. 156–169). Routledge.

Hamalainen, R., & Hakkinen, P. (2010). Teacher's instructional planning for computer-supported collaborative learning: Macro-scripts as a pedagogical method to facilitate collaborative learning. *Teaching and Teacher Education, 26*(4), 871–877. https://doi.org/10.1016/j.tate.2009.10.025

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., ... Hull, K. (2021). "I like and prefer to work alone": Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), 12. https://doi.org/10.1187/cbe.19-12-0271

Huxham, M. (2005). Learning in lectures: Do 'interactive windows' help? *Active Learning in Higher Education, 6*(1), 17–31. https://doi.org/10.1177/1469787405049943

Jonsson, A., & Panadero, E. (2017). The use and design of rubrics to support assessment for learning. In D. Carless, S. M. Bridges, C. K. Y. Chan, & R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 99–111). Springer Nature.

Kelly, P., Gale, K., Wheeler, S., & Tucker, V. (2007). Taking a stance: Promoting deliberate action through online postgraduate professional development. *Technology, Pedagogy and Education, 16*(2), 153–176. https://doi.org/10.1080/14759390701406760

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*(2), 193–212. https://doi.org/10.5465/amle.2005.17268566

Kolb, A. Y., & Kolb, D. A. (2017). *The experiential educator: Principles and practices of experiential learning*. Experience Based Learning Systems.

Lai, C.-L. (2021). Effects of the group-regulation promotion approach on students' individual and collaborative learning performance, perceptions of regulation and regulation behaviours in project-based tasks. *British Journal of Educational Technology, 52*(6), 2278–2298. https://doi.org/10.1111/bjet.13138

Lam, M. (2007). Learning while doing: Applying team-based learning in finance classes. Proceedings from the *Northeast Business & Economics Association* (pp. 127–130).

Lean, J., Moizer, J., Towler, M., & Abbey, C. (2006). Simulations and games: Use and barriers in higher education. *Active Learning in Higher Education, 7*(3), 227–242. https://doi.org/10.1177/1469787406069056

Lovell-Troy, L. A. (1989). Teaching techniques for instructional goals: A partial review of the literature. *Teaching Sociology, 17*(1), 28–37. https://doi.org/10.2307/1317922

Lucas, U. (1997). Active learning and accounting educators. *Accounting Education, 6*(3), 189–190. https://doi.org/10.1080/096392897331433

Marriott, P., Tan, S. M., & Marriott, N. (2015). Experiential learning—A case study of the use of computerised stock market trading simulation in finance education. *Accounting Education, 24*(6), 480–497. https://doi.org/10.1080/09639284.2015.1072728

McCullough, K., & Munro, N. (2018). Finance students' experiences of lecture-based active learning tasks. *Innovations in Education and Teaching International, 55*(1), 65–73. https://doi.org/10.1080/14703297.2016.1189843

Mercer, N. (2008). Talk and development of reasoning and understanding. *Human Development, 51*(1), 90–100. https://doi.org/10.1159/000113158

Oakley, B., Felder, R. M., Brent, R., & Elhajj, I. (2004). Turning student groups into effective teams. *Journal of Student Centered Learning, 2*(1), 9–34. https://docplayer.net/123130-Turning-student-groups-into-effective-teams.html

Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist, 20*(3), 190–203. https://doi.org/10.1027/1016-9040/a000226

Park, J. H., Schallert, D. L., Sanders, A. J. Z., Williams, K. M., Seo, E., Yu, L.-T., … Knox, M. C. (2015). Does it matter if the teacher is there?: A teacher's contribution to emerging patterns of interactions in online classroom discussions. *Computers & Education, 82*, 315–328. https://doi.org/10.1016/j.compedu.2014.11.019

Prosser, M., & Trigwell, K. (2014). Qualitative variation in approaches to university teaching and learning in large first-year classes. *Higher Education, 67*(6), 783–795. https://doi.org/10.1007/s10734-013-9690-0

Schamber, J. F., & Mahoney, S. L. (2006). Assessing and improving the quality of group critical thinking exhibited in the final projects of collaborative learning groups. The *Journal of General Education, 55*(2), 103–137. https://www.jstor.org/stable/27798043?seq=4#metadata_info_tab_contents

Seiver, D. A. (2013). Incorporating a real-time FX trading platform in an international business finance class. *Journal of Financial Education, 39*(1/2), 53–65.

Siegel, P. H., Omer, K., & Agrawal, S. P. (1997). Video simulation of an audit: An experiment in experiential learning theory. *Accounting Education, 6*(3), 217–230. https://doi.org/10.1080/096392897331451

Sims, R. (2003). Promises of interactivity: Aligning learner perceptions and expectations with strategies for flexible and online learning. *Distance Education, 24*(1), 87–103. https://doi.org/10.1080/01587910303050

Smith, C. M., & Gibbs, S. C. (2020). Stock market trading simulations: Assessing the impact on student learning. *Journal of Education for Business, 95*(4), 234–241. https://doi.org/10.1080/08832323.2019.1643279

Stahl, G., Koschmann, T. D., & Suthers, D. D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 409–426). Cambridge University Press.

Stephen, S.-A. (2015). Enhancing the learning experience in finance using online video clips. *Journal of Financial Education, 41*(1), 103–116.

Swaffield, S. (2011). Getting to the heart of authentic assessment for learning. *Assessment in Education: Principles, Policy & Practice, 18*(4), 433–449. https://doi.org/10.1080/0969594X.2011.582838

Taylor, L., McGrath-Champ, S., & Clarkeburn, H. (2012). Supporting student self-study: The educational design of podcasts in a collaborative learning context. *Active Learning in Higher Education, 13*(1), 77–90. https://doi.org/10.1177/1469787411429186

Thoms, B., & Eryilmaz, E. (2014). How media choice affects learner interactions in distance learning classes. *Computers & Education, 75*, 112–126. https://doi.org/10.1016/j.compedu.2014.02.002

Tucker, R., Fermelis, J., & Palmer, S. (2009). Designing, implementing and evaluating a self and peer assessment tool for e-learning environments. In C. Spratt, & P. Lajbcygier (Eds.), *E-learning technologies and evidence-based assessment approaches* (pp. 170–194). Information Science Reference.

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Van Gennip, N. A. E., Segers, M. S. R., & Tillema, H. H. (2009). Peer assessment for learning from a social perspective: The influence of interpersonal variables and structural features. *Educational Research Review, 4*(1), 41–54. https://doi.org/10.1016/j.edurev.2008.11.002

van Merrienboer, J. J. G., McKenny, S., Cullinan, D., & Heuer, J. (2017). Aligning pedagogy with physical learning spaces. *European Journal of Education, 52*(3), 253–267. https://doi.org/10.1111/ejed.12225

Vonderwell, S., Liang, X., & Alderman, K. (2007). Asynchronous discussions and assessment in online learning. *Journal of Research on Technology in Education, 39*(3), 309–328. https://doi.org/10.1080/15391523.2007.10782485

Vuopala, E., Hyvonen, P., & Jarvela, S. (2016). Interaction forms in successful collaborative learning in virtual learning environments. *Active Learning in Higher Education, 17*(1), 25–38. https://doi.org/10.1177/1469787415616730

Wells, G. (2007). Semiotic mediation, dialogue and the construction of knowledge. *Human Development, 50*(5), 244–274. https://doi.org/10.1159/000106414

Woods, K., & Bliss, K. (2016). Facilitating successful online discussions. *Journal of Effective Teaching, 16*(2), 76–92.

Yildiz Durak, H. (2022). Flipped classroom model applications in computing courses: Peer-assisted groups, collaborative group and individual learning.

Computer Applications in Engineering Education. Advance online publication. https://doi.org/10.1002/cae.22487

Zepke, N. (2013). Threshold concepts and student engagement: Revisiting pedagogical content knowledge. *Active Learning in Higher Education, 14*(2), 97–107. https://doi.org/10.1177/1469787413481127

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education*, *47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

CHAPTER 7

Scavenger Hunt Activity to Reinforce Engineering Fundamentals

Ee Von Lau and Alpha Agape Gopalai

Simple games help to save both time and money and are easier to develop and, in some cases, more impactful for a particular type of learning than elaborately developed complex learning games.

—Karl M. Kapp (2012)

Introduction

Traditional lectures have always been perceived to be an effective platform for delivering large amounts of content to students in a set period. This approach is prevalent in traditional subject matters within engineering such as thermodynamics. However, this delivery method presents

E. V. Lau (✉) · A. A. Gopalai
School of Engineering, Monash University Malaysia, Jalan Lagoon Selatan, 47500 Subang Jaya, Selangor, Malaysia
e-mail: lau.ee.von@monash.edu

A. A. Gopalai
e-mail: alpha.agape@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_7

a challenge in teaching and learning as it results in the lack of student engagement, and often leading to a passive and superficial learning (Bransford et al., 1999). This is seen in students' performance variation between higher and lower order assessment questions. Only a few students in a cohort are able to respond convincingly to assessment questions that test for higher-order thinking.

Passive learning methods are commonly seen as inadequate to students' learning because they fail to encourage student motivation and enthusiasm (Udovic et al., 2002). An alternative to passive learning is active learning. Active learning requires students to be responsible for their learning and in-depth understanding by providing avenues for applying information learned after being exposed to a specific content (Chickering & Gomson, 1991; Jones et al., 2017; Powner & Allendoerfer, 2008). In addition, active learning engages students in the learning process, requires them to reflect on the actions taken (Prince, 2004), takes responsibility for their own learning, and constructs new understanding from meaningful interactions with peers based on what they already know (Chi, 2009). Presently, researchers have found that collaborative active learning strategies as a teaching method can significantly improve students' understanding and retention of course material (Carr et al., 2015). This is because the main idea of collaboration involves collaborative knowledge construction (Arvaja, 2007), negotiation of shared meanings (Pea, 1993), elaboration (Van Boxtel et al., 2000), mutual explaining (Webb, 1989) and reasoning (Bargh & Schul, 1980). In a study on active learning versus traditional teacher-centred instruction in a thermodynamic class, the results demonstrated the power of active learning, with students in active learning classes having fewer misconceptions on the topic learnt and achieving higher learning order skills as compared to traditional methods (Sesen & Tarhan, 2011).

Despite the notable advantages of active learning, some educators are still reluctant to make the change. This is predominantly because the idea of converting to an active learning lesson often entails unwarranted work above and beyond what has already been established. However, a scavenger hunt is one active learning technique that can be incorporated relatively quickly with minimal technology and effort. Scavenger hunts are exceptionally well suited for engineering subject matter because they can act as a follow-up activity or assessment to test students' grasp of the fundamental concepts of a particular topic being taught (Jones et al., 2017). If well planned and structured, the scavenger hunt can also be designed to enhance teaching to develop or apply the engineering fundamentals taught.

Scavenger hunts are activities that can be implemented and easily adapted for different course contents by altering the structure of the questions. Using such active learning techniques as a learning tool is not a novel concept and has been implemented in many other fields (Chalmers, 2003; Holzinger et al., 2011; Kassens & Enz, 2018; Klopfer et al., 2005). There have been large bodies of literature covering the implementation and evaluation of scavenger/treasure hunt activities as an active learning activity in the life sciences. For example, Tinnon (2014) evaluated the feedback of implementing a scavenger hunt as a teaching strategy in introducing pharmacological concepts and ethical concerns in the nursing faculty. The study results demonstrated an overall positive response which encouraged the faculty to implement this strategy in their pharmacology courses. Another study by Griffin et al. (2000) studied the implementation of a scavenger hunt as an active learning technique for three different biology units. The students of these three biology units were required to answer a set of feedback questions to gauge the effectiveness of the scavenger hunt. The study demonstrated positive student responses across all feedback questions. However, weaknesses such as inclement weather affecting the scavenger hunt had been indicated.

There were also instances where scavenger hunts were used in the teaching and learning of economics (Kassens & Enz, 2018), finance (Serna & Taylor, 2019), music (Wells, 2012), medical (Owen, 2017) and intercultural communication (Santoso, 2020). Additionally, both scavenger and treasure hunt have also been implemented in university orientation programmes (Erenli, 2013; Gray et al., 2011; Kubasik et al., 2016; Pike & Alpi, 2015). The results of a study by Gray et al. (2011) indicated that students were generally more engaged and enjoyed such an approach. Compared to traditional orientation methods, students who participated in the treasure hunt scored higher on a set of graded questions than a conventional orientation tour (Marcus & Beck, 2003). A more recent variation reported a library-based scavenger hunt as a means of literature search in multiple databases, serving the dual purpose of introducing new users to library resources while demonstrating the library as a welcoming place on campus (Stark et al., 2021).

Based on this literature, an incredibly unique feature of the scavenger hunt activity is its scalability. It is not limited to class size and can be implemented as an individual or group activity. However, group-based scavenger hunts provide additional advantages such as peer learning as students must work together to solve questions/challenges at each station (Chalmers, 2003). Such activities encourage higher order learning levels, as they are required to internalise fundamental concepts before applying and explaining the concepts to their peers. In this regard, Boud (2001) concurs that peer learning involves reciprocal interaction between students and it is mutually beneficial through sharing of ideas and knowledge and Topping (2007) adds that peer learning provides constructive feedback and suggestions which may have positive impact on their learning. In this regard, the constructionist-based peer learning has the potential to enhance the two key competencies of the twenty-first century skills—metacognitive awareness and collaborative skills (Carvalho & Santos, 2022).

Additional benefits of scavenger hunts as an active learning tool include encouraging students to practice and develop their problem-solving skills by decomposing large problems into their relevant sub-domains without the instructor's input (Chalmers, 2003). Incidentally, the aim of education is not only to provide knowledge and skills but also to teach collaboration and problem solving among students (Arvaja et al., 2009; Craft, 2008). Further gamification of the activity, such as awarding monetary prizes to students who have obtained the highest number of correct answers, could be used as an incentive to encourage participation and put in extra effort to solve complex questions (Chalmers, 2003). Gamification has revolutionised educational and pedagogical tools, resulting in an increased learners' interest in learning, motivation and collaborative active engagement with the content being taught (Lu et al., 2015).

Typically, scavenger hunts have very low technological barriers for entry when introducing elements of gamification. Many studies used what was already available to them. For example, Chalmers (2003) merely used problem sets and made the process of completing them competitive, while Kassens and Enz (2018) used games that participants were already familiar with in their approach to their scavenger hunt. However, technology can be introduced to enhance the scavenger hunt experience by enhancing the gamification element. Alajaji and Alshwiah (2021) introduce e-quizzing tools in their scavenger hunt when training early childhood teachers. In an earlier study, Lu et al. (2015) experimented with augmented reality to provide entertaining activities for students to interact within an environment that students can explore to learn. A more recent study using augmented reality was Li (2020), where a mobile learning scavenger hunt game was designed to facilitate students' content learning in higher education. Santoso (2020) reported an out-of-classroom experience with their version of scavenger hunt. In this study, students had to travel to a nearby island for three days to encounter numerous cultures from locals and foreigners residing in that island. Students did their scavenger hunt exercise within their groups and recorded the results in vlogs during the trip.

The variations of scavenger hunts are boundless and are only limited by the creativity of the educator. However, successful implementation of this activity is significantly influenced by the element of gamification. As a result, gamification has been a focus in collaborative active learning (CAL). However, educators find it challenging to apply gamification effectively to promote students' interest in learning, engagement and collaborative engagement (Rapp et al., 2019). This chapter describes a combination of gamification with quiz elements with the main principles of a scavenger hunt to create an exciting learning environment in a core engineering program subject, Thermodynamics.

Design of Learning Activities

Purpose and Design of Scavenger Hunt

The idea of gamification in education is a developing approach for increasing learners' motivation and engagement through game design elements within educational environments (Dichev & Dicheva, 2017). Motivation is among the important predictors of student academic achievements, which influences student effort and time engaged in learning (Linehan et al., 2011). Given that games, known to engender motivation and engagement, are notably popular, the proposal to incorporate game mechanics and principles to motivate the learner is appealing. Gamification can be adopted to support learning in a variety of contexts and subject areas. In subjects that generally involve quizzes or e-quizzing—scavenger hunts can be easily incorporated as a gamification method to enhance teaching and learning strategies.

To understand the scavenger hunt concept, it is important to note that it adds game elements/strategies to an educational context to enhance learning and collaboration while encouraging engagement, creativity, and positive behaviour. The game elements/strategies have to be appropriately integrated while providing a clear function. There are numerous elements to consider when designing such CAL, including: (a) encouraging students to engage in the game; (b) coordinating proper flow and sequence of events that maintains students' understanding and engagement; (c) storytelling to motivate students; and (d) frequent feedback (Alajaji & Alshwiah, 2021). In addition, there are three dimensions of engagement in peer feedback and they are interconnected. Therefore, when the students' affective engagement like self-esteem is unduly challenged it may also affect the students' behavioural and cognitive engagement (Yu et al., 2019). To this end, providing guided support to students on how to give feedback to one another (content, process, ethics, etc.) may be useful (Evans & Waring, 2011). Scavenger hunts can be designed using various methods, whereby a commonly applied technique is a multilevel approach where various clues are hidden in different locations, eventually leading to a prize. Another similar process involves a series of barcodes (or QR codes) in which each of these is linked with a quiz or riddle, which then leads to another barcode and finally, to a prize.

Course/Subject Expectation

Besides reconciling prior understandings with emerging understandings via cognitive activity, the scavenger hunt activity further embarks on the active learning concept to complement in-class lessons for core engineering subjects. Besides encouraging and ensuring students' independent study, this activity is designed to enhance students' learning experience and learning outcomes. The scavenger hunt activity is conducted towards the end of the teaching semester to aid in revising the unit. This approach provides a fun way of examining gaps in knowledge, whereby they are tasked to solve problems posed. Clues to the scavenger hunt are randomly distributed and can be unlocked by solving observational questions relating to thermodynamics. These clues lead to more complex questions/problems for students to solve, which relate to the First and Second Law of thermodynamics and its application to heat engines and refrigeration cycles. These problems are to be solved collaboratively among the students. The scavenger hunt activity aims to apply theories and concepts learned in class through a competitive environment.

The knowledge required to solve these problems was covered in the ten weeks of this CAL activity. These in-class teaching could use various teaching methods, including blended modes and online tools and software, which will not be discussed here. However, several didactic lectures providing students with basic information can be converted into a scavenger hunt approach. By being actively involved in searching for information independently, there is a higher likelihood of retaining the information (Gray et al., 2011).

Student/Activity Expectation

Collaborative learning relies on engaging group structures to support students working together while maximising individual learning. In a scavenger hunt activity, students work in groups to solve a puzzle or problem. In its application in the engineering subject context, the scavenger hunt introduces students to problem solving skills and sections of the course content through a critical-thinking competition that requires students to solve clues while collaborating with peers to solve higher-order problems which progresses them to the next clue. An additional element of competition was included in the scavenger hunt in which teams were required to strategize to possibly gain an advantage in solving the various clues and problems, i.e. additional points were given for solving questions accurately, providing solid arguments/justification on working out the problems and solving the problems promptly.

As such, students are also required to prepare themselves and study independently before the activity. The instructors or educators would not provide any learning aide or assistance before the activity to encourage students to demonstrate ownership over the revision of the unit's content. The better-prepared students are, the better the quality of their discussion during the activity. This motivates the groups to come prepared so that they get to take part in internal discussions when attempting questions. Additionally, the teaching team rewards (Cash voucher) the group with the best answer collected in the shortest time. Therefore, with these in place, students were motivated to discuss and seek peer feedback within their groups to solve the problems presented at each station. During these peer discussions, students would naturally engage in peer assessment (within their group). According to Race (2001), peer assessment involves students in making assessment decisions which may be formative, help to internalise the characteristics of quality work and deepen their learning experience. In doing so, it helps students to collaborate effectively, and to provide constructive feedback (Prins et al., 2005).

Procedure

Planning and Pre-Activity

It is essential to plan thoroughly on the scavenger hunt activity when conducted to reinforce and complement existing passive learning methods, particularly for core engineering subjects, and how the activity will enhance their fundamental knowledge, while at the same time ensuring collaborative engagement of students and to provide a fun learning experience.

However, given all these potential benefits, there have been minimal studies focusing on implementing active learning techniques such as scavenger hunts in engineering sciences. This chapter provides an overview of the development and execution of a scavenger hunt activity for a fundamental engineering subject, i.e. Thermodynamics. The feedback, challenges and future suggestions for improvements upon completing this scavenger hunt are also included in the subsequent sections.

Before conducting the scavenger hunt, the fundamental aspects and concepts in the Thermodynamics subject were taught using traditional in-class delivery style or blended teaching modes. Here, essential concepts as well as complex concepts in which students failed to grasp are identified, such that these would be included in the scavenger hunt. This is crucial as the scavenger hunt is a short-paced activity unless conducted several times.

Students were assigned to groups before participating in the scavenger hunt. A random mixture of student types is matched and allocated into their teams, in which their personalities would ideally complement each other during the collaborative activity. This heterogeneous grouping allows a rich exchange of information among the group members (Lou et al., 1996; Zhang et al., 2016) and it is also consistent with transactive collaboration (Wegner, 1987). This can be done via online team-maker tools available such as CATME (www.catme.org) and Random Team Generator (www.randomlists.com). Appropriate active learning materials were designed for this activity, requiring students to draw on the aforementioned fundamentals. Although some questions may be solved by a single high-performing individual, the contributions of all members of the team in collaboratively solving different parts or segments of the question would encourage speed as well as assure accuracy of answers. Learning materials were designed into appropriate exercises with the aid of online tools (e.g. PuzzleMaker, discoveryeducation.com, etc.) and software that can modify learning material into scavenger hunt exercises to further encourage collaborative engagement.

In this active learning activity (scavenger hunt), the authors printed the map of the campus grounds onto a piece of translucent paper, such that students could use this as a map to facilitate the hunt for the locations of the hidden "clues". The scavenger hunt would begin by getting students to draw a thermodynamic power cycle (to a scale given) based on information provided at the start of the activity. Students are then instructed to overlay the thermodynamic power cycle onto the map of the campus ground. Students who sketch the power cycle accurately will have information on the location of the clues in the hunt—and so begin their scavenger hunt. This method has proven to be an interactive way of learning fundamental theories like the sketch of a thermodynamic power cycle. It is through this sketch the interactive processes are structured and thus enhance collaboration among students (Kobbe et al., 2007; Kollar et al., 2006) through evoking and empowering the interactive learning processes (Kobbe et al., 2007).

Preparation and Creation

This fast-paced, 50-min activity requires students to be focused and the ability to work quickly. Reflection and discussion need to take place quickly to achieve an accurate answer in the shortest possible time. Students are expected to solve five questions in this 50-min activity.

Materials to facilitate active learning were designed to get students to draw on the fundamentals covered in class. True to a scavenger hunt, the clues and questions were then placed around the campus. Students were then given hints, which would take them to various locations within the campus. Major hints in the scavenger hunt relied on students' ability to accurately draw and identify the elements in the thermodynamic charts/diagrams. These charts/diagrams are crucial concepts of the Thermodynamic unit and were covered extensively in class.

Potential locations to house clues must be thoroughly checked and monitored. During the execution of the scavenger hunt, facilitators (tutors from the subject) were identified and stationed at the locations to monitor the challenges for two main reasons, namely (a) provide immediate feedback when necessary and (b) ensure that the clue site remains secure as they may be removed by third party persons when the scavenger hunt is in progress (Erenli, 2013).

Execution

During the execution of the scavenger hunt, students are made to "move" around the university campus while consistently drawing on the knowledge of the respective concepts covered in class to progress further or the next location of "clue". While learning can ensue independently, collaborative learning would inevitably occur more quickly and effectively to solve the problem questions due to their human nature to complete the scavenger hunt in the shortest possible time to win. During the activity, students were heard exchanging information and materials, thus processing information more efficiently, while providing help and assistance to group mates. Certain problem questions were also designed to enhance collaborative and interdependence work, for example, some questions were structured in the form of a crossword puzzle, whereby the clues can be solved individually, however, their answers would only be correct if it matches and fit together in the final bigger crossword picture. The question structure built into the scavenger hunt helps to maximise student collaboration (Donkin & Kynn, 2021). Additionally, the incentive, preparation before the hunt, immediate feedback from the tutors and peer assessment collectively acts as impetus for the successful completion of the hunt.

In this scavenger hunt, added incentive monetary prizes were awarded to students who obtained the highest number of correct answers in the shortest possible time. This served as an incentive to come prepared (individual learning) for the scavenger hunt. Besides that, awarding monetary prizes to students who have obtained the highest number of correct answers could be used as an incentive to encourage participation and put in extra effort to solve complex questions, rather than skipping or ignoring them.

Upon completing the scavenger hunt, the groups must submit their solved challenges/problem questions. These solved challenges were then evaluated, and feedback would be provided to the group. On the other hand, students were asked to provide voluntary feedback on the activity through an anonymous online constructed feedback form used to gauge the effectiveness of the scavenger hunt towards student learning. The online feedback form consisted of both coded responses and open-ended questions. For feedback of this nature to be effective towards student learning it has to bridge the gap between the actual level of performance in the scavenger hunt and the desired learning outcomes (Biggs, 2003; Taras, 2006).

Feedback/Assessment

The team with the most accurate, well-argued and timely submissions is the team that will win the challenge. These constraints were introduced to ensure that the activity sought to facilitate peer feedback and evaluation of ideas among the group while discussing the questions, possible approaches and solutions. Students were heard discussing their proposed approach and alternatives based on the strategies taught in class—either validating an idea on how a specific thermodynamic analysis should be carried out or suggesting an alternative approach to the question. In the process, students brought up concepts and considerations covered in class during the lectures to justify their views and practice. The collaboration among the students can create positive emotions and together with the motivation to win can contribute a strong engagement in the co-construction of knowledge (Jones & Issroff, 2005). However, the activity did not stop there. Teams were also required to submit their final submissions for further evaluation of their finalised approach to problem-solving such that educators can provide verbal feedback to the teams after the event. As a result, all submissions will be checked for a clear presentation of arguments and concepts.

In a post-scavenger hunt activity class lecture/presentation, feedback in the form of common mistakes identified as well as good practices observed in the students' submissions were summarised and highlighted. During this post-activity presentation, solutions to the problem questions were also discussed thoroughly, to ensure students applied the correct concepts while solving them earlier during the scavenger hunt. Additionally, students are also welcomed to share their problems faced and were further discussed in this session. One of the feedback items highlights the difficulty level of the questions which could be made more complex to encourage higher order learning, which is an essential component of CAL, as seen from the common feedback below. Furthermore, the common pitfalls and shortcomings in the submissions were highlighted, such that erroneous views/understanding that may have surfaced during team discussions during the activity can be ironed out. In other words, besides providing corrective feedback students were asked for explanations and clarifications (epistemic feedback) and advice was given for improvement of ideas (suggestive feedback; Alvarez et al., 2011). Besides providing feedback to students as post-activity, an evaluation of the collaborative process by the educator should be made, to increase the effectiveness of future implementation of the CAL (van Leeuwen & Janssen, 2019).

Common feedback received from students relating to the aspects of the scavenger is documented below. Feedback was collected using a Google Form to avoid/reduce oral feedback because students have to be careful with oral feedback which inevitably depends on the provider's tone and manner, and cannot be retracted (Brookhart, 2008). The feedback collected is meant to inform the teaching team on aspects to improve on and retain in the scavenger hunt activity in its next offering as described under Future Implications section.

> "*Better rewards!*" "*Prevent sabotaging*" "*More difficult questions would have been more challenging*" "*Hints are too direct*" "*More hidden clues should be prepared such that students can search for the clues to increase the thrill and excitement*" "*Please discuss the solution and answers after the activity*" "*The scavenger hunt could use less paper. As each question was printed on a piece of paper, and there were many printed sheets of paper for each question, this resulted in a waste of paper*" "*Accuracy of location of clues*"

On the other hand, some important, open-ended feedback from students describing the scavenger hunt's best aspects is described below. In particular, some positive feedback highlighted the need for cooperative learning and application of required concepts to solve the problem questions during the activity, which indirectly provides positive interdependence and collaborative learning (Johnson & Johnson, 2009).

> "*Interesting way to learn*" "*This activity trains critical thinking and ability to solve questions under pressure*" "*Exploring the university campus*" "*It was fun!*" "*Encouraged active learning*" "*There are prizes to be won, which more or less motivates the team to work hard and solve questions*" "*Different teaching method*" "*It was very engaging and allowed us to revise and apply what we learnt*" "*It was a fun way to apply what we have learnt in a healthy, competitive manner*" "*Working together with other students*" "*The idea was great! It was a much more fun way to force some revision on us without making it boring*"

This activity was not assessed in our implementation. The activity was purely voluntary and was mainly targeted at helping the students identify gaps in their knowledge. Students who chose not to participate would not access the specific set of questions/problems that the teams had attempted. A small monetary award was also awarded to the top three performing groups in this scavenger hunt activity. The award was in terms of cash vouchers to either purchase food/grocery. The additional monetary prize was provided as an incentive to the team which obtained the highest number of correct answers within the shortest possible time. This reward also served as an incentive for students to come prepared for the scavenger hunt. The questions/problems posed at each station were meant to get students to draw on the knowledge they should have gained through the in-class and laboratory sessions. Additionally, from the collected submissions, the educator would be able to identify concept areas in which students are less proficient in which they require more time towards working out a solution. Thus, highlighting topics that they ought to focus on in preparation for the final assessment/exam.

To further enhance the experience of this scavenger hunt when executed again, the use of QR codes can be included. These QR codes can be placed at various locations of the clues. Students discovering the clues can then scan the QR code and be linked to various platforms such as Quizizz, Kahoot, Badges, etc. The QR code can also enhance interaction by requiring students, for example, to upload "selfies" and worked solutions to designated folders as proof that they have completed a particular challenge (Kubasik et al., 2016). In addition, the facilitator stationed would be able to focus on providing any immediate feedback as he would not have to be worried about the QR code being removed from the location. Submissions would be more secure and straightforward as timestamps can be included seamlessly with technological tools such as cloud-based systems (Erenli, 2013; Kubasik et al., 2016). Implementing this would also allow for real-time assessments of participation and other documentation, which can ease the execution of the scavenger hunt (Kubasik et al., 2016).

Implementation

Student Experiences and Outcomes

Upon completion of the scavenger hunt activity, students and educators participated in a class discussion to reflect upon their experiences in the CAL activity. It was generally agreed that the value of learning through the scavenger hunt was recognised. Students appreciated that the game provided a unique learning experience to explore out-of-classroom. A majority of the students participated in the scavenger hunt without preparing or revising the fundamental concepts of the subject before the scavenger hunt activity. This resulted in valuable time lost as students had to refer back and forth to their references such as textbooks and lecture notes. Nonetheless, although unprepared, the students gained a better understanding while looking for the answer, indirectly learning and enhancing the learning in the subject. This is also in agreement with Griffin et al. (2000) and according to Boud and Molloy (2013) to place students as active learners seeking to produce work that meets the criteria within the knowledge domain, there is a need to help develop their capacity and disposition to operate effectively.

Students' perceptions have been highly positive from scavenger hunt studies conducted. Gamification takes advantage of people's competitive behaviour and motivation to obtain rewards, therefore positively influencing their behaviour, attitudes and perceptions. Students receive instant feedback through their team discussions to help them understand content better and consequently achieve higher test scores. In contrast, team collaboration was found to intrinsically motivate students to help others to complete the scavenger hunt activity sooner. Opportunities to discuss openly (without the educator's presence) during the collaborative activity also eliminate the fear of expressing and voicing opinions. Bicen and Kocakoyun (2018) also noted that students can improve their knowledge and abilities in certain areas, and the gamification results enable them to see where they rank among their peers.

In general, gamification positively impacts students' understanding and retention of information while enabling them to develop better thinking skills. The scavenger hunt activity provides students with the opportunity to work with their peers, discuss learning material, search for answers, receive feedback through a scoring system and leader boards, complete tasks, overcome challenges, and use technology in a competitive environment. Learning information in such a way is more interesting and enduring than the traditional classroom. Besides understanding the taught subject, further or independent in-depth learning can also occur through this CAL activity.

Challenges

Reflecting upon the implementation of the scavenger hunt revealed that while the scavenger hunt did prove to be an effective CAL, there is room for improvements. As the time element is portrayed as one of the winning factors to the scavenger hunt assessment, students often prioritise speed over accuracy during the activity. They become reckless and may omit non-crucial steps such as skipping reading instructions, making simple mistakes and making inappropriate assumptions while participating in the activity, particularly when solving the engineering problems. This recklessness undoubtedly affects their performance negatively (Alajaji & Alshwiah, 2021), lower overall scores, and not implementing the desired collaborations that were initially intended. In addition, randomised assignments of teammates may also dampen the collaborative learning process as students may be overly polite and unwilling to challenge peers' misconceptions. The distribution of group tasks may also be biased when students do not delegate the activity fairly among themselves or members indulging in *social loafing* (Nokes-Malach et al., 2015), leading to fewer teamwork efforts. One potential solution to this is to base grouping on individual personality traits while also considering the level of preparedness among the team members. In addition, according to Fransen et al. (2011) team effectiveness depends on task characteristics, shared intentions, team formation, role assignment within a team, decision making strategies, and interdependency. To this end, students have to deal constructively different opinions from group members and thoroughly consider each other ideas and comments (constructive conflict) through mutual understanding and mutual agreement (Dillenbourg & Traum, 2006) in order to reach a shared cognition (Van den Bossche et al., 2011).

Although not indicated in any of the feedback, outdoor treasure hunts conducted in a large area involving moderate to high physical activity, could potentially cause issues for students with disabilities. In an outdoor scavenger hunt study by Tipton and Kupritz (2017), the authors suggested tweaking the scavenger hunt to include students with disabilities. This could be achieved by ensuring the scavenger hunt is not in a 'race' type format. Furthermore, the study pointed out that eliminating a 'race' type format in a scavenger hunt not only includes students with motor-related disabilities but encourages other students to pick the best answer to a question instead of the quickest answer, which would be expected in a race type format.

Using technological tools to create and enrich the scavenger hunt experience may impose a setback to students as they would need high-speed Internet while undertaking the quizzes online, especially when the students are physically moving around outdoors. Some programs used to generate the quizzes would spontaneously restart when the connection is lost, or the page may suddenly become unresponsive during a game which could lead to frustration and demotivation to continue in participation (Alajaji & Alshwiah, 2021).

Besides foiling the collaborative effects intended by the active learning activity, implementing the scavenger hunt activity itself is a pure challenge to the educator. The educator would have to perform both roles as teacher and game designer, whereby the gaming features and education content need to complement each other for the learning to be effective (Li, 2020). The key to the successful development of a scavenger hunt needs to include a stimulating and engaging activity for the student to participate in and meet the objectives of the scavenger hunt, including enhancing the knowledge. Educators need to ensure sufficient facilitators during the scavenger hunt activity who can also provide immediate feedback and assist with any inquiries or technical difficulties. Lastly, questions have to be designed such that they are not easily found on their smart devices, such that students would be "forced" to walk to the location to find out the answer (Gray et al., 2011).

Future Implications

The use of scavenger hunts is seen to facilitate active learning and improve student engagement as students are inadvertently forced to be responsible for and actively involved in their own learning (Tinnon, 2014). Nonetheless, this can only be achieved if students are committed to the scavenger hunt activity. As such, monetary rewards can be implemented to encourage students' direct participation in the CAL activity. A study by Chalmers (2003) indicated that offering financial rewards could be utilised as an incentive to put in extra effort when faced with a challenging question. This is in agreement by Kassens and Enz (2018), who suggested that rewards such as gift cards that are attractive to a broad audience could encourage active participation. This could be primarily helpful in increasing attendance and participation if the treasure hunt was an optional activity for students. Nonetheless, reward interdependence tends to be addictive, resulting in withdrawal behaviour towards learning when these rewards are absent. Devaluation of the objective of the scavenger hunt may also occur as the rewards become expected and prioritised over the purpose of learning. Finally, providing monetary rewards may lead to less collaborative work and possible misunderstanding if student members do not share common goals to achieve the reward (Johnson & Johnson, 2009).

To improve the scavenger hunt activity experience, educators can adopt technology tools such as incorporating QR codes into the scavenger hunt to reduce the wastage of resources and lessen the worldwide impact of the paper industry. Additionally, technologies such as Augmented Reality (AR) can be utilised in the treasure hunt, potentially improving the experience and increasing enjoyment (Lu et al., 2015). With students' permission, the scavenger hunt can be easily integrated with social media and other forms of mobile technologies, capitalising on the skillset and comfort of the digital natives (Kubasik et al., 2016). Story-based scavenger hunt applications with more exploratory playful game design elements such as quests or achievements have a higher potential to engage users, as these increase entertainment and motivation to students (Hutzler et al., 2017).

The authors are aware that introducing new learning activities as part of the formal syllabus is bound to incur a certain amount of negative perception and hesitance among the students. The authors have introduced the scavenger hunt activity as a non-assessed learning activity to mitigate students' resistance towards this activity and provide better collaborative learning while motivating students' involvement. Through the feedback collected, the authors are working to improve this learning activity and hope to implement this learning activity as one of the in-class formative assessments to help students self-evaluate and reflect on how well they have learned concepts relating to thermodynamics. In addition, the problem questions structured for the scavenger hunt need to be designed such that it provides collaborative success and promotes positive interdependence among the team members via increased task complexity (Johnson & Johnson, 2009; Nokes-Malach et al., 2015). This was also reflected in the written feedback by students who completed the scavenger hunt activity, requesting for more complex problem questions in Feedback/Assessment.

Undoubtedly, gamification increases motivation for learning and engagement with peers while educators learn to transform and innovate their teaching methods. The collaborative, critical thinking and problem-solving skills gained during the scavenger hunt activity are transferable to other contexts and lifelong learning. On a different note, educators too have new perceptions of their teaching methods and strategies (Alajaji & Alshwiah, 2021).

Conclusion

The scavenger hunt is an excellent pedagogical tool as it facilitates CAL among students in small groups. Based on the literature and our implementation, scavenger activities can be easily implemented and adapted for various educational fields with similar benefits to students. The positive student reception towards the scavenger hunt includes being more engaged and better skilled in problem-solving, motivated to study independently while seeking peer feedback within their group, and learning to work together collaboratively. The gamification element in the scavenger hunt activity also takes advantage of students' competitive behaviour, positively influencing them to score better. The out-of-classroom nature of the scavenger hunt activity also provides a unique learning experience to most students.

Therefore, there is no doubt that the scavenger hunt can be modernised significantly with the latest technologies to suit the digital netizens and the current landscape of education in the wake of a pandemic. One of the main challenges, however, is to properly design the approach and questions such that they complement teaching and, at the same time, enhance students' learning enthusiasm. The level of difficulty of the challenge should also be moderated such that it maintains the level of motivation within students to continue and persist in the scavenger hunt. According to Donkin and Kynn (2021), the students' motivation to learn is related to what they perceive is the practical value of the knowledge. Nevertheless, students are often found to prioritise speed over accuracy during the activity due to the time and reward elements of this scavenger hunt, resulting in careless mistakes and reckless behaviour, neglecting the objective of the collaborative learning element. Another challenge in CAL is the question of whether to randomise team members or not. While randomising team members may provide a more balanced student distribution, this may dampen the collaborative learning process intended due to unfamiliarity with peers. Finally, one of the other key challenges that may be faced while implementing the scavenger hunt is its out-of-classroom nature which requires much physical activity, which may cause issues for students with disabilities.

In this chapter, the scavenger hunt activity conducted for an engineering subject (Thermodynamics) demonstrated the benefit and the positive student reception towards implementing more scavenger hunts as an active learning technique implemented in other core engineering units. After all, good engineering education is built on good group work; hence the scavenger hunt represents an excellent educational experience, particularly for engineering students in higher educational institutions.

References

Alajaji, D., & Alshwiah, A. A. (2021). Effect of combining gamification and a scavenger hunt on pre-service teachers' perceptions and achievement. *Journal of Information Technology Education: Research, 20*, 283–308. https://doi.org/10.28945/4809

Alvarez, I., Espasa, A., & Guasch, T. (2011). The value of feedback in improving collaborative writing assignments in an online learning environment. *Studies in Higher Education, 37*(4), 387–400. https://doi.org/10.1080/03075079.2010.510182

Arvaja, M. (2007). Contextual perspective in analysing collaborative knowledge construction of two small groups in web-based discussion. *International Journal of Computer-Supported Collaborative Learning, 2*(2/3), 133–158. https://doi.org/10.1007/s11412-007-9013-5

Arvaja, M., Hämäläinen, R., & Rasku-Puttonen, H. (2009). Challenges for the teacher's role in promoting productive knowledge construction in computer-supported collaborative learning contexts. In J. O. Lindberg, & A. D. Olofsson (Eds.), *Online learning communities and teacher professional development: Methods for improved education delivery* (pp. 263–280). IGI Global. https://doi.org/10.4018/978-1-60566-780-5.ch015

Bargh, J. A., & Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology, 72*(5), 593–604. https://doi.org/10.1037/0022-0663.72.5.593

Bicen, H., & Kocakoyun, S. (2018). Perceptions of students for gamification approach: Kahoot as a case study. *International Journal of Emerging Technologies in Learning (iJET), 13*(02), 72. https://doi.org/10.3991/ijet.v13i02.7467

Biggs, J. (2003). *Teaching for quality learning at university*. Open University Press.

Boud, D. (2001). *Peer learning in higher education: Learning from and with each other*. Kogan Page.

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education, 38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and school*. National Academy Press. https://doi.org/10.17226/9853

Brookhart, S. M. (2008). Feedback that fits. In M. Scherer (Ed.), *Engaging the whole child: Reflections on best practices in learning, teaching, and leadership* (pp. 166–175). ASCD.

Carr, R., Palmer, S., & Hagel, P. (2015). Active learning: The importance of developing a comprehensive measure. *Active Learning in Higher Education, 16*(3), 173–186. https://doi.org/10.1177/1469787415589529

Carvalho, A.R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*. Article 100070. https://doi.org/10.1016/j.caeo.2021.100070

Chalmers, M. (2003). The scavenger hunt as an interactive teaching tool to develop research skills interface. *The Journal of Education, Community and Values, 3*(6). http://bcis.pacificu.edu/journal/2003/06/chalmers.php

Chi, M. T. H. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science, 1*(1), 73–105. https://doi.org/10.1111/j.1756-8765.2008.01005.x

Chickering, A., & Gamson, Z. (1991). Seven principles for good practice in undergraduate education. *New Directions for Teaching and Learning, 1991*(47), 63–69. https://doi.org/10.1002/tl.37219914708

Craft, A. (2008). Studying collaborative creativity: Implications for education. *Thinking Skills and Creativity, 3*(3), 241–245. https://doi.org/10.1016/j.tsc.2008.09.006

Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education, 14*(9). Article 9. https://doi.org/10.1186/s41239-017-0042-5

Dillenbourg, P., & Traum, D. (2006). Sharing solutions: Persistence and grounding in multimodal collaborative problem solving. *Journal of the Learning Science, 15*(1), 121–215. https://doi.org/10.1207/s15327809jls1501_9

Donkin, R., & Kynn, M. (2021). Does the learning space matter? An evaluation of active learning in a purpose-built technology-rich collaboration studio. *Australasian Journal of Educational Technology, 37*(1), 133–146. https://doi.org/10.14742/ajet.5872

Erenli, K. (2013). Gamify your teaching – Using location-based games for educational purposes. *International Journal of Advanced Corporate Learning, 6*(2), 22–27. https://doi.org/10.3991/ijac.v6i2.2960

Evans, C., & Waring, M. (2011). Exploring students' perceptions of feedback in relation to cognitive styles and culture. *Research Papers in Education, 26*(2), 171–190. https://doi.org/10.1080/02671522.2011.561976

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(2011), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Gray, S., Lindsay, E., & Walraven, J. (2011). Orienthunt: The development of a scavenger hunt to meet the needs of a first year engineering orientation. Proceedings from *Australasian Association for Engineering Education Conference* (pp. 543–549). Fremantle, Western Australia.

Griffin, M. S., Dew, N., & Kronberg, J. R. (2000). Scavenger hunts: Chasing down scientific answers. *The Journal of College Science Teaching, 30*(3), 188–191.

Holzinger, K., Holzinger, A., Fassold, M., & Lehner, M. (2011). Archaeological scavenger hunt on mobile devices: From e-education to e-business – A triple adaptive mobile application for supporting experts, tourists and children. *Proceedings from International Conference on e-Business*. https://doi.org/10.5220/0003527301310136

Hutzler A., Wagner R., Pirker J., & Gütl C. (2017). MythHunter: Gamification in an educational location-based scavenger hunt. In D. Beck et al. (Eds.), *Immersive learning research network. iLRN 2017, Communications in computer and information science* (Vol. 725). Springer. https://doi.org/10.1007/978-3-319-60633-0_13

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher, 38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Jones, A., & Issroff, K. (2005). Learning technologies: Affective and social issues in computer-supported collaborative learning. *Computers and Education, 44*(4), 395–408. https://doi.org/10.1016/j.compedu.2004.04.004

Jones, J. A., Smith, S., & Royster, M. (2017). The scavenger hunt as an active learning technique. *NACTA Journal, 61*(1), 94–95.

Kassens, A. L., & Enz, M. (2018). Chasing economic knowledge: Using an economics themed scavenger hunt to learn and build comradery. *Journal of Economics and Economic Education Research, 19*(4), 1–6. https://bit.ly/3qAsrYL

Klopfer, E., Perry, J., Squire, K., Jan, M., & Steinkuehler, C. (2005). Mystery at the museum: A collaborative game for museum education. *Proceedings* *from 2005 Conference on Computer Support for Collaborative Learning*. Taipei, Taiwan.

Kobbe, L., Weinberger, A., Dillenbourg, P., Harrer, A., Hamalainen, R., & Hakkinen, P. (2007). Specifying computer-supported collaboration scripts. *International Journal of Computer-Supported Collaborative Learning, 2*(2/3), 211–224. https://doi.org/10.1007/s11412-007-9014-4

Kollar, I., Fischer, F., & Hesse, F. W. (2006). Collaboration scripts e a conceptual analysis. *Educational Psychology Review, 18*(2), Article 159e185. https://doi.org/10.1007/s10648-006-9007-2

Kubasik, M. A., Van Dyke, A. R., Harper-Leatherman, A. S., Miecznikowski, J. R., Steffen, L. K., & Smith-Carpenter, J. (2016). A cloud-based scavenger hunt: Orienting undergraduates to ACS national meetings. *Journal of Chemical Education, 93*(11), 1957–1960. https://doi.org/10.1021/acs.jchemed.6b00445

Li, L. (2020). Augmented reality facilitated scavenger hunt for mobile learning. *Journal of the Scholarship of Teaching and Learning, 20*(2), 113–121. https://doi.org/10.14434/josotl.v20i2.25777

Linehan, C., Kirman, B., Lawson, S., & Chan, G. (2011). Practical, appropriate, empirically-validated guidelines for designing educational games. *Proceedings from ACM Annual Conference on Human Factors in Computing Systems* (pp. 1979–1988). Vancouver, Canada.

Lou, Y., Abrami, P. C., Spence, J. C., Poulsen, C., Chambers, B., & d'Apollonia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research, 66*(4), 423–458. https://doi.org/10.2307/1170650

Lu, Y., Chao, J. T., & Parker, K. (2015). HUNT: Scavenger hunt with augmented reality. *Interdisciplinary Journal of Information, Knowledge, and Management, 10*, 21–35. https://doi.org/10.28945/2207

Marcus, S., & Beck, S. (2003). A library adventure: Comparing a treasure hunt with a traditional freshman orientation tour. *College & Research Libraries, 64*(1), 23–44. https://doi.org/10.5860/crl.64.1.23

Nokes-Malach, T. J., Richey, J. E., & Gadgil, S. (2015). When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review, 27*, 645–656. https://doi.org/10.1007/s10648-015-9312-8

Owen, M. I. (2017). A case study scavenger hunt for senior nursing students. *The Journal of Nursing Education, 56*(3), 191–191. https://doi.org/10.3928/01484834-20170222-13

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions. Psychological and educational considerations* (pp. 47–87). Cambridge University Press.

Pike, C., & Alpi, K. M. (2015). Hunting for knowledge: Using a scavenger hunt to orient graduate veterinary students. *Issues in Science and technology Librarianship*. http://istl.org/15-summer/refereed1.html

Powner, L., & Allendoerfer, M. (2008). Evaluating hypotheses about active learning. *International Studies Perspectives, 9*(1), 75–89. https://doi.org/10.1111/j.1528-3585.2007.00317.x

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Prins, F. J., Sluijsmans, D. M. A., Kirschner, P. A., & Strijbos, J.-W. (2005). Formative peer assessment in a CSCL environment: A case study. *Assessment & Evaluation in Higher Education, 30*(4), 417–444. https://doi.org/10.1080/02602930500099219

Race, P. (2001). *A briefing on self, peer and group assessment (Assessment series guides number 9).* Generic LTSN.

Rapp, A., Hopfgartner, F., Hamari, J., Linehan, C., & Cena, F. (2019). Strengthening gamification studies: Current trends and future opportunities of gamification research. *International Journal of Human-Computer Studies, 127*, 1–6. https://doi.org/10.1016/j.ijhcs.2018.11.007

Santoso, M. N. (2020). The Scavenger hunt: A technique for enhancing culture learning and intercultural communication practice. *Register Journal, 13*(1), 99–122. https://doi.org/10.18326/rgt.v13i1.99-122

Serna, K. L., & Taylor, Z. W. (2019). Conducting a text messaging scavenger hunt to promote financial aid literacy among community college students. *Community College Journal of Research and Practice, 43*(4), 311–314. https://doi.org/10.1080/10668926.2018.1467352

Sesen, B. A., & Tarhan, L. (2011). Active-learning versus teacher-centered instruction for learning acids and bases. *Research in Science & Technological Education, 29*(2), 205–226. https://doi.org/10.1080/02635143.2011.581630

Stark, R. K., Opuda, E., McElfresh, J., & Kauffroath, K. (2021). Scavenging for evidence: A systematic review of scavenger hunts in academic libraries. *The Journal of Academic Librarianship, 47(*2). Article 102345. https://doi.org/10.1016/j.acalib.2021.102345

Taras, M. (2006). Do unto others or not: Equity in feedback for undergraduates. *Assessment & Evaluation in Higher Education, 31*(3), 365–377. https://doi.org/10.1080/02602930500353038

Tinnon, E. (2014). Scavenger hunt: A creative teaching strategy to introduce pharmacological concepts and ethical concerns. *Teaching and Learning in Nursing, 9*(3), 104–107. https://doi.org/10.1016/j.teln.2014.03.004

Tipton, W., & Kupritz, V. (2017). Using the outdoor scavenger hunt to teach theories of organizational communication. *Communication Teacher, 31*(2), 79–84. https://doi.org/10.1080/17404622.2017.1285411

Topping, K. (2007). Trends in peer learning. *Educational Psychology, 25*(6), 631–645. https://doi.org/10.1080/01443410500345172

Udovic, D., Morris, D., Dickman, A., Postlethwait, J., & Wetherwax, P. (2002). Workshop biology: Demonstrating the effectiveness of active learning in an introductory biology course. *BioScience, 52*(3), 272–281. https://doi.org/10.1641/0006-3568(2002)052[0272:WBDTEO]2.0.CO;2

Van Boxtel, C., Van der Linden, J., & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction, 10*(4), 311–330. https://doi.org/10.1016/S0959-4752(00)00002-5

Van den Bossche, P., Gijselaers, W., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science, 39*(3), 283–301. https://doi.org/10.1007/s11251-010-9128-3

Van Leeuwen, A., & Janssen, J. (2019). A systematic review of teacher guidance during collaborative learning in primary and secondary education. *Educational Research Review, 27*, 71–89. https://doi.org/10.1016/j.edurev.2019.02.001

Webb, N. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research, 13*(1), 21–39. https://doi.org/10.1016/0883-0355(89)90014-1

Wegner, D. M. (1987). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behavior* (pp. 185–208). Springer-Verlag.

Wells, V. (2012). Hunting for QR codes: Linking students to the music collection. *Music Reference Services Quarterly, 15*(3), 137–148. https://doi.org/10.1080/10588167.2012.700831

Yu, S., Zhang, Y., Zheng, Y., Yuan, K., & Zhang, L. (2019). Understanding student engagement with peer feedback on master's theses: A Macau study. *Assessment & Evaluation in Higher Education, 44*(1), 50–65. https://doi.org/10.1080/02602938.2018.1467879

Zhang, L., Kalyuga, S., Lee, C., & Lei, C. (2016). Effectiveness of collaborative learning of computer programming under different learning group formations according to students' prior knowledge: A cognitive load perspective. *Journal of Interactive Learning Research, 27*(2), 171–192. https://doi.org/10.1016/j.chb.2010.03.038

CHAPTER 8

Future-Proofing Healthcare Skills Education: Technology-Enhanced Collaborative Learning and Peer Teaching Strategies for Large Student Cohorts in Anatomy Practicals

Arkendu Sen and Lakshmi Selvaratnam

Teaching is the Highest Form of Understanding.

–Aristotle (384–322 BC)

Background

Understanding human anatomy and the organisation of body structure is an integral part of becoming a skilled doctor. It requires hands-on learning of the three-dimensional, visually complex human body and its

A. Sen (✉) · L. Selvaratnam
Jeffrey Cheah School of Medicine & Health Sciences, Monash University Malaysia, Subang Jaya, Malaysia
e-mail: arkendu.sen@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_8

internal organs, typically explored in practical laboratory settings. Globally, with the introduction of integrated medical curricula, there has been a marked shift away from cadaveric dissection-based anatomy study traditionally carried out for centuries. Practical anatomy is now increasingly taught to medical and healthcare students in non-dissection settings, as in Malaysia—due to cost, scarcity of cadavers, various socio-cultural taboos and the advent of increasingly sophisticated digital technologies (Patel et al., 2015; Sugand et al., 2010). At the same time, crowded curricula and insufficient expert medical teachers have resulted in sizeable student cohorts during anatomy practical sessions with fewer timetabled opportunities to master complicated body structures or practise related clinical anatomy skills, resulting in an alarming deterioration in effective learning (Singh et al., 2015; Sugand et al., 2010). The recent Covid-19 pandemic has also caused global disruption in healthcare education with an almost overnight transformation to virtual or online learning for anatomy curriculum delivery (Evans & Pawlina, 2021).

Healthcare education has seen rapid changes this past decade, driven in part by significant technological advances impacting medical research and patient management and disruptive transformations in the global information technology landscape. The next-generation health workforce must possess adequate knowledge and skills to negotiate the complex digital health domain now emerging to ultimately improve health outcomes (Wong et al., 2021). The educational goals for training healthcare professionals have increasingly shifted to include embedding learning technology during essential knowledge acquisition, in improving psychomotor skills and team training (Guze, 2015). Thus, the fundamental requirement of incorporating education technology in medical education has been an overarching factor in the design and development of our Anatomy practical curriculum delivery. The authors are also mindful that inappropriate selection of digital technologies may adversely impact higher education goal achievement (Lacka et al, 2021). Furthermore, any education programmes involving teamwork should provide learning opportunities that are practical and authentic to participants (Pawlina & Drake, 2016), and so, experiential learning has formed a significant hallmark of our practical strategies. According to Crawford

L. Selvaratnam
e-mail: lakshmi.selvaratnam@monash.edu

et al. (2011) experiential learning allows students to apply knowledge that comes from doing something and that the reflective practice associated with it encourages active learning (Harvey et al., 2016; Lucas, 1997). In addition, experiential learning enables students to apply concepts to experiences that they may confront in their professional career (Dellaportas & Hassall, 2013).

One of the critical changes in modern healthcare delivery is the adoption of multi-disciplinary or multi-speciality approaches for managing patients in hospital settings. Effective teamwork involving a diverse group of healthcare professionals is recognised as a significant element of patient care that improves patient safety and health outcomes (Buljac-Samardzic et al., 2020). The complexity of modern hospital healthcare for patients highlights the need for doctors and other healthcare professionals to collaborate and communicate clearly with each other (Eddy et al., 2016). Thus, collaboration skills need to be instilled early in medical students' career, especially in the preclinical phase of undergraduate medical education. In this regard, collaboration starts with the articulation of self-constructed meanings (Stahl, 2000) by describing the problem situation using one's prior knowledge and self-reflection. Subsequently, it evolves into the co-construction of meanings among the group members where they build on others' ideas and thoughts (Mercer, 1996) through the processes of negotiation of shared meaning, mutual explaining and reasoning and elaboration.

Hence, whilst embracing the interactive technology of the twenty-first century, any new practical approaches being developed in healthcare education must focus on instilling lifetime learning through active participation within the collaborative learning environment.

Aims

To overcome the above challenges, innovative strategies sought by the authors aimed to:

Enhance students' core knowledge, competencies in anatomy and prepare for future clinical teamwork, through a series of guided collaborative learning and peer teaching-demonstration activities, with the support of a multimedia learning lab. This includes building in attributes of a competent medical graduate to be developed during basic medical training, as required by the Australian Medical Council (www.amc.org.au).

Design and Preparation

Designing Collaborative Active Learning Strategies in Anatomy Practicals

The anatomy practical education approach was planned and organised according to various stages: pre-practical, in-class (or in-practical) and post-class (or post-practical). Two original and award-winning, key in-practical methods for practical teaching and learning of Anatomy, referred to as Guided Collaborative Learning (GCL) and Student Peer Teaching-Demonstrations (SPTD), were pioneered and iteratively developed from 2008 onwards at our Medical School. These practical activities were conducted within a network supported learning laboratory—the Medical Anatomy and Pathology E-Learning (MAPEL) Lab, co-developed by the authors (https://www.monash.edu.my/jcsmhs/facilities/mapel-lab). The MAPEL Lab was designed and formally launched in 2012 and further adapted for its current purpose-built location in 2014 as a state-of-the-art learning space and campus showcase. This Lab provides an ambient learning environment that incorporates a wide range of physical learning resources, learning software, integrated multimedia and education technology enhancements. The GCL and SPTD practical strategies for learning human anatomy were designed to actively engage mass student cohorts (ranging between 130–160 students) in clinical contexts and professional practice correlations and to ensure our graduates workplace readiness, as required by the medical accreditation bodies for both Malaysia and Australia.

Another critical strategy was combining the social elements of peer learning with two important aspects of modern anatomy learning within one sizeable, open plan technology-supported learning space, i.e. the MAPEL Lab. The first aspect is to combine peer learning with access to both digital resources such as high-speed internet access and anatomy education software—which clearly attract our 21st-century digital natives (Prensky, 2001). The second aspect is to combine peer learning with physical resources such as human anatomy models and plastinated (dry human cadaveric) specimens—which the students can physically hold, manipulate and explore. Thus, the lab environment was purposefully designed with multiple large oval tables, comfortably seating 6–8 students on swivel chairs. Models and specimens are placed on these tables for hands-on study, together with integrated microscopes and desktop computers for accessing the Internet and digital anatomy resources; all these allow interaction of students within small groups, facilitated by tutors rotating within the networked MAPEL Lab equipped with full video and audio multicast facilities.

The workflow in learning anatomy involving lectures, pre-learning resources, GCL and STPD and post-practical reviews/assessment is summarised in Fig. 8.1.

During active learning, students are usually engaged in building and understanding facts, concepts, and skills by completing tasks and activities. However, in healthcare education, this is often limited to adopting interactive techniques and applied learning (Swanwick et al., 2019). Acquiring knowledge through social interactions and cognitive discussions is central to teaching and learning in medicine (Duit & Treagust, 1998; Swanwick et al., 2019). In a similar vein, the active learning pedagogical strategies are based on constructivism that posits people build knowledge by acting and reflecting on incidents and experiences around them (Wright et al., 2019). Therefore, there is a strong emphasis on social interactions and cognitive discussions over individual study (Chi & Wylie, 2014; Gibbs, 1994). For practical skills learning, peers working in collaborative groups offer alternative solutions, sustain reasoning activities, and assist in the integration of knowledge (Vygotsky, 1978), thus forming the basis of designing Group Collaborative Learning (GCL). The design of Group Collaborative Learning (GCL) **i**ncorporated collaborative learning where student peers, during the discussions in the practical**,** offered alternative solutions, sustain reasoning activities, and assist in integrating knowledge (Vygotsky, 1978).

To incorporate such principles of social interaction in GCL, the Medical Anatomy and Pathology E-Learning (MAPEL Lab) infrastructure, multimedia computers and furniture were innovatively designed, making it one of the pioneering teaching spaces of its kind in this part of the world and routinely showcased as an exemplar practical classroom (Sen & Passey, 2013). To incorporate such principles of social interaction, the MAPEL Lab infrastructure and furniture were ergonomically designed so that seating arrangements at the oval tables and easy access to learning resources such as models and specimens facilitated various types of seamless interaction: student peer to peer, student peers with resources, student/peers with tutors etc. The Lab creates a space where the lecturers can better support students in deeper learning through facilitation, technology support and foster small group collaboration (Brooks, 2012),

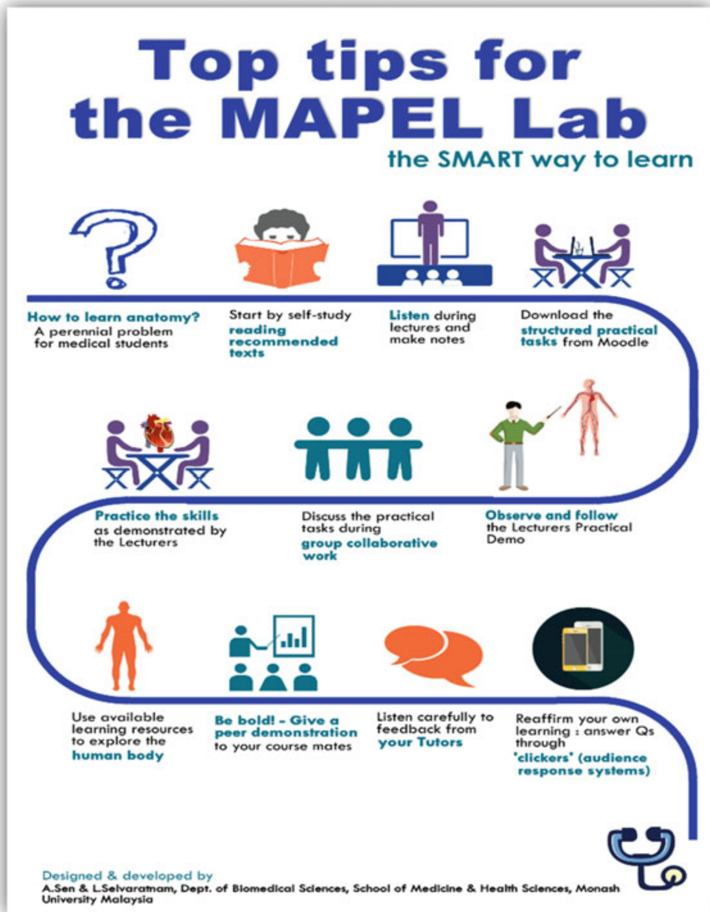


Fig. 8.1 Summary of workflow design for anatomy practical learning in the MAPEL Lab (infographic by Lakshmi Selvaratnam [2015])

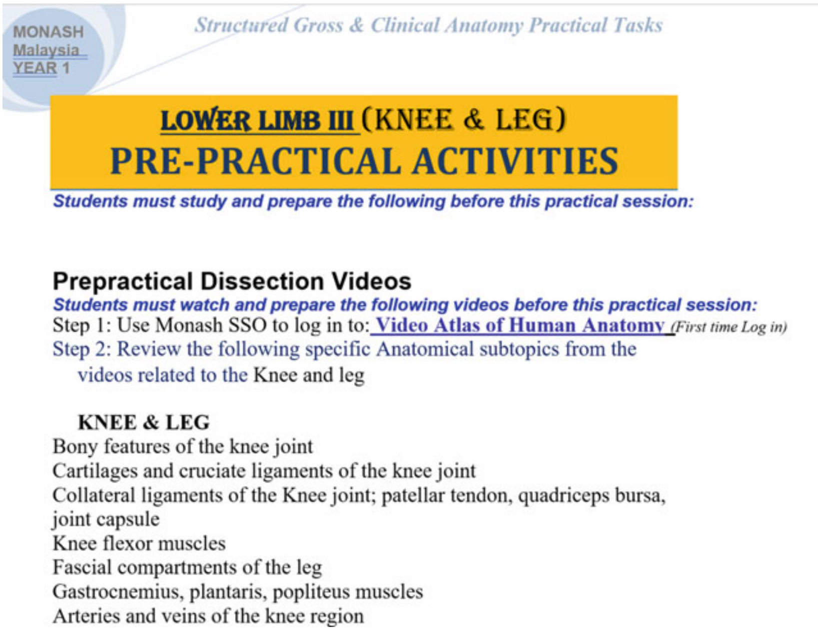
which emphasises that learning and knowledge construction are affected by interaction and collaboration in line with the social constructivist learning theory (Krange & Ludvigsen, 2008).

This enabling Lab environment facilitates the multimodal representation of content, instructional procedures, student-centred discovery and various types as well as multiple foci of student interactions at the various student group tables. The conducive and comfortable setting makes for a positive student experience while producing more effective gains in higher-order learning. The varied formats of visualisation make anatomy learning attractive, motivating and support deep learning.

Pre-Practical Activities

For pre-practical learning activities, these included lecture materials in the form of uploaded PowerPoint slides from face-to-face (synchronous) lectures or video-recorded lectures (asynchronous), accessed through links in the Moodle learning management system at our university. These lecture materials were developed by anatomy tutors from our Medical School and included critical conceptual information for both gross anatomy and clinical anatomy. Other pre-learning materials comprised a variety of learning resources ranging from textbooks/reference books, online websites and computer-aided learning resources (e.g., 3D rotatory anatomy images, links to augmented reality anatomy objects, Fig. 8.2).

As part of the active learning methods used for GCL and SPTD, e-workbook activities in the form of Gross and Clinical Anatomy Practical (GCAP) tasks were designed by the authors to purposefully incorporate practical activities harnessing visual, auditory and kinaesthetic learning modalities as well as embed educational objectives based on cognitive process domains (such as 'remember, understand, apply, analyse, evaluate & create') (Anderson & Krathwohl, 2001). Although the value of learning styles has garnered some debate (Pashler et al., 2008), there is also evidence that interactive/non-interactive multimodal learning aids are preferred by undergraduate medical students and are particularly important for the visuospatial understanding of anatomy (Hernández et al., 2020; Samarakoon et al., 2013). Overall, the practical tasks were formatted to include pre-practical, in-practical and post-practical activities and were hosted on the Moodle learning management system in a timely manner. However, research has shown that certain personalities and learning styles may prefer the high-technology learning environment (Ellis, 2016) while others are not mentally prepared to do so or they may engage at a different pace (Nicol et al., 2018). In a similar vein, Carvalho and Santos (2022) caution on the unexpected technical issues


MONASH
Malaysia
YEAR 1

Structured Gross & Clinical Anatomy Practical Tasks

LOWER LIMB III (KNEE & LEG)

PRE-PRACTICAL ACTIVITIES

Students must study and prepare the following before this practical session:

Prepractical Dissection Videos

Students must watch and prepare the following videos before this practical session:

Step 1: Use Monash SSO to log in to: Video Atlas of Human Anatomy *(First time Log in)*

Step 2: Review the following specific Anatomical subtopics from the videos related to the Knee and leg

KNEE & LEG

Bony features of the knee joint
Cartilages and cruciate ligaments of the knee joint
Collateral ligaments of the Knee joint; patellar tendon, quadriceps bursa, joint capsule
Knee flexor muscles
Fascial compartments of the leg
Gastrocnemius, plantaris, popliteus muscles
Arteries and veins of the knee region

Fig. 8.2 Sample GCAP tasks with pre-practical activities with reference to bite-sized videos on cadaveric dissection

like lecturers and students not having experience to deal with digital technologies, the Internet connection problems and teaching and learning in a totally remote learning environment, which may have a negative impact of some students' ability to cope with unexpected and challenging situations happening during collaborative learning tasks.

As in GCAP tasks, the structured practical tasks are intentionally designed so medical students can learn both core and applied anatomy skills and facilitate their learning through various visuospatial and kinaesthetic learning aids. Multimodality supports a universal design for learning by communicating concepts in the most effective ways and making sure everyone obtains exactly what they need. According to the cultural psychology research findings, individual learning differences may emerge from cultural factors like thinking style (Lun et al., 2010) and learning style (Joy & Kolb, 2009). Multimodal resources also add interest and break up routine styles of learning. The rationale for adopting multimodal methods for our practicals was twofold: 1) to capture the students' different learning styles and 2) for reinforcement of concepts and learning across different modes. Such an experiential approach inspires medical students as they see how their learning of human anatomy translates into real-world clinical practice. The multimodal approach also has been shown to produce more effective gains in basic and higher-order learning (Rosen & Salomon, 2007) and improve retention rates (Kozma, 2003).

The GCAP tasks utilised multimodal approaches and clinical scenarios for understanding a topic such as anatomy of the knee: for instance, this would include using one's haptic senses of touching, orientating and exploring depth in a knee model or cadaveric specimen (Fig. 8.3a), identification of key structures of the knee, visual comparison with clinical/radiological images of a patient's knee (Fig. 8.3b), palpating/feeling the knee as during clinical examination (on consenting student peers) and listening (audio) for abnormal sounds (crepitus) due to knee disease through studying video/audio links.

In-Practical Activities

Group Collaborative Learning (GCL)

The social affordances (Valenti & Gold, 2010) of GCL include both face-to-face interactions and technology interactions (via table desktop computers or students' BYOD (Bring your own device). This allows for a bidirectional relationship between technology use and creation of a social space for group members. The resultant conducive environment serves to motivate student learning through increasing participation, engagement, interactivity and collaboration (Jeong & Hmelo-Silver, 2016).

It is well recognised that different media forms have different affordances (Jeong & Hmelo-Silver, 2016; Laurillard, 2002). Hence, Group Collaborative Learning as practised by students utilises many media forms to provide rich and varied learning experiences (Sen & Selvaratnam, 2012): *Narrative media*, e.g. image/description of an anatomical structure or clinical anatomy case scenario; *Interactive media*—computer-assisted anatomy modules (under institutional licence) accessed online; *Communicative media* that facilitate exchanges between teacher and student; *Adaptive media*—for annotating pictures/histology virtual slides and *Productive media* e.g. production of schematic diagrams or PowerPoint slides/mini-video presentations for sharing. According to Hakkinen and Hamalainen (2012), this is important because the current learning

(a) 3. KNEE JOINT

3.1. Functionally knee joint is a modified hinge joint – Explain how concerning shifting of its axes of movement

3.1.1. Briefly discuss the key factors that contribute to the stability of the knee joint.

- REVIEW interactively the overview of structures of the Knee here (3.1) – click on each component to know the details
- Review the layered dissections of the Knee joint in Recommended CAL (Computer Assisted Learning) Resource (Lower Limb module, "System") Nos. 12 – 14 to perform the following:

3.2. Identify the **knee joint line**

3.2.1. What is the normal "Q" angle of the Knee joint ?

3.2.1.1. How does it differ between sexes?

3.3. List & identify the **muscles that flex and extend the Knee** joint.

- REVIEW interactively the locking (7.1) /unlocking (7.4) of Knee here :

3.4. Demonstrate and explain on an articulated knee, the **locking and unlocking of the knee joint**.

3.4.1. Which muscle is involved in unlocking?

- Perform a virtual dissection in the recommended CAL (Computer Assisted Learning) Resource to explore the knee region: Right knee joint (frontal view) module

Prepared by A/P Dr A Sen & A/P Dr Selvaratnam/ 2021 Page 5

(b) 7. RADIOLOGY

- Refer to radiological images in textbooks, & the following radiological websites here

7.14. Identify and correlate the key features of the distal end of femur and proximal Tibia and Fibula in the following

7.14.1. Plastic embedded sagittal section of the Knee joint

7.14.2. X-ray of the Knee joint (AP & Lateral views)

7.15. Study the following:

7.15.1. Review interactively X-ray of the Knee joint here (AP & Lateral views)

7.15.2. MRI of the Knee joint: Coronal and Axial images

7.15.3. Fractures of Tibia & Fibula

Prepared by A/P Dr A Sen & A/P Dr Selvaratnam/ 2021 Page 10

Fig. 8.3 (a) Sample GCAP task with in-practical activities involving hands-on manipulation of self/peer volunteers and reference to interactive digital resources. (b) Sample GCAP task with in-practical activities involving visual/multi-modalities integrating applied clinical/radiological correlations and links to physical and digital resources trajectories take different formats (formal—informal, physical—virtual) and they are supported by the communication media and informational media.

Student Peer Teaching-Demonstration (SPTD)
Student Peer Teaching-Demonstration (SPTD) comprises an adaptation of an active learning method (Johnson et al., 1998), more specifically of peer instruction involving active learning that engages students in solving problems, sharing ideas, giving feedback and more importantly, teaching practical skills to each other. The crucial role of teaching in learning, including peer teaching, has been immortalised in Aristotle's words that "Teaching is the highest form of understanding" and this forms a key element of our practical strategy and still holds true today. In the modern context of higher education, knowledge integration and extension occur through teaching and practice applications within learning communities which support active learners and critical thinkers (Boyer, 2004; Lee, 2014). Furthermore, these peer teaching demonstrations reinforce knowledge and skills learnt by students in GCL and aim to attain a higher level of competency by teaching and demonstrating to their peers in keeping with the medical graduates' attributes as practitioners and health advocates involved in improving healthcare quality whilst working in professional teams (Australian Medical Council, 2012; Myron et al., 2018). The impact of peer teaching on student learning compared to traditional, tutor-related didactic teaching has reported improvements in student mastery of both conceptual reasoning and problem-solving (Crouch & Mazur, 2001). However, for peer instruction to be effective in active learning, educators' ability to adapt innovative teaching methods and evidence-based implementation is paramount (Schell & Butler, 2018). Furthermore, during peer instruction, students are in control of their learning, and they self-regulate the discussion (Arico & Lancaster, 2018). As such, they must be empowered to seek clarification for better understanding in relation to their prior knowledge and finally reconstruct meanings in their own terms (Green, 2019).

Our novel GCL and SPTD methods support various modes of active learning (Naismith et al., 2004; Graffam, 2007) relevant for the future evolving needs of the medical profession, particularly in a post-pandemic world (since these methods are readily translatable into online synchronous and asynchronous formats which our team has adapted and conducted for 2 years since the Covid-19 outbreak in early 2020). Typically, however, teaching and learning activities have been designed to be hands on and experiential so that students within our technology-enhanced learning lab are motivated to follow *behaviourist learning* through real-life clinical scenarios highlighted by tutors during the clinical/anatomical demonstrations streamed in real-time from the demonstration console and; collaborative *learning* whereby student groups manipulate physical resources and digital content.

Team Teaching by Professional Practice Experts, Facilitation and Feedback

The social constructivist theory emphasises the importance of social interaction between students and teachers to stimulate effective learning (Bandura, 1977). Group collaborative learning also requires quality facilitation by expert tutors. To ensure clinical knowledge/skills integration with basic medical sciences (Standring, 2009), clinical anatomists and practising/active surgeons have been employed as anatomy tutors to facilitate our practicals. These expert tutors have multiple roles. For one, they give valued input as needed to student teams during their GCL discussions of practical tasks. These tutors also conduct live demonstrations to identify high-resolution, detailed features of plastinated human specimens or lifelike anatomy models to the whole cohort via videocasting utilising large TV displays/ceiling-to-floor screens from the demonstration console/podium at the front of the MAPEL Lab. Furthermore, during peer teaching demonstrations (SPTD) by selected student groups to the class, tutors give valuable and immediate feedback on student presentations or demonstrations and highlight the relevance of anatomy in future clinical practice and authentic settings. The use of SPTD which is an active, collaborative learning approach enables the students to learn together and the tutors to facilitate their learning (Carstensen et al., 2020) by providing immediate feedback for procedural learning and delayed feedback for tasks well within the students' capability (William, 2011).

Post-Practical Activities

Peer Group Evaluations of SPTD Presentations

These evaluations were designed to be conducted weekly by non-presenting student groups who assessed the presenting groups carrying out SPTD (Fig. 8.5). The authors developed a rubric consisting of 7 elements with an evaluatory range to streamline feedback evaluation of student teamwork and assess the quality of their oral presentations/hands-on demonstrations (Hafner & Hafner, 2003). This peer group evaluation rubric was shared with all groups to understand the learning process, its participatory culture and to appreciate tutor expectations (Kollar & Fischer, 2010). Results were collated after the Part B components of each practical and cumulative scoring per group could be calculated for the whole academic year.

Preparation of Assessment Process: Objective Structured Clinical Anatomy Review (OSCAR)

Student assessment is helpful to gain an objective measure of knowledge, comprehension and skills and attitudes. The challenge then was to devise the most appropriate tool for reviewing Anatomy understanding using an integrated yet practical assessment approach through proper incorporation of multimedia technology with anatomy learning resources. The Objective Structured Clinical Anatomy Review (OSCAR) was thus designed as a novel formative assessment strategy with the following aims: to test student comprehension of key anatomy principles and relevant clinical anatomy; act as an anatomy revision aid at the end of each body systems-based study module and to provide prompt learning feedback on student competence in applying anatomical principles in future clinical settings. Formative assessment in anatomy enables students to identify their strengths and gaps in knowledge and contributes to deeper learning, at the same time allowing the educators to revise their teaching when required (Evans, 2020). The OSCAR is usually conducted as a practical assessment in the MAPEL Lab, still it can be switched to a fully online format, especially relevant during the Covid-19 pandemic (Sadeesh et al., 2021).

Preparation for the OSCAR involved designing station questions (up to 30 per circuit; both first and second-order type) to test anatomy topics covered that same semester and crafted to embrace visuospatial, and interactive learning aids particularly relevant in medical practice. A detailed floor plan with OSCAR stations (represented by tables and computers/laptops) including the route of students with bell timing was drawn up.

Before the OSCAR, plastinated specimens and models were placed on the planned stations, tagged appropriately with marker labels and double checked by the tutor team. Stations could also include tagged clinical case photos, radiographs and images from anatomical software. Arrangements for sequestering students before the OSCAR and quarantining afterwards had to be planned, to ensure the validity of the formative practical assessment.

Implementation

The practical activity-based approaches that we designed are implemented in the following format on a biweekly basis per year cohort across Years 1–2.

Student Groupings

Anatomy practicals are conducted twice a week for Year 1 and 2 cohorts, each comprising 130–160 medical students. To maintain effective interaction and team dynamics, all students are pre-assigned to groups of 10–12 students, the same groups as those for their problem-based learning sessions, and each headed by a student leader. The pre-assigned groupings allow for the University equity policy to be maintained, such that the groups are based on having an even mixture of gender, international and domestic students, high and low achievers etc. According to Zhang et al. (2016) and Lou et al. (1996) heterogeneous grouping is more effective in obtaining information from other group members due to different knowledge base when compared with homogeneous grouping.

- Students are expected to study and prepare topics in the Practical Guide before each practical session. Practical tasks highlight key gross anatomy concepts and applications relevant to their future clinical practice, topics which are commonly assessed.
- For each Student Group, a leader is chosen. He or she will then distribute topics/activities amongst the members. The leader is rotated weekly.
- Each Student Group should ensure members bring adequate textbooks and atlases (print copies or e-books) or other learning resources.
- Individual student preparedness and active contribution to learning are essential for a group to be effective in collaborative learning.

- Professionalism and MAPEL Lab guidelines are expected to be maintained during practical sessions, including any loan and return of models according to stipulated times.

Pre-Practical Activities

Students will access their Gross & Clinical Anatomy Practical (GCAP) Tasks for each week via the e-Workbook/Moodle Learning Management System. In collaborative learning it is pertinent that students come prepared with their self-constructed meanings of the GCAP tasks so that they can engage constructively in the group discussions. The Moodle Learning Management system allows effective integration of learning resources with e-learning activities (Chia et al., 2017) for practical preparation. They are encouraged to work individually at first and then within their groups to corroborate each other's understanding. Students can review the given practical learning objectives, carry out any suggested pre-practical activities and study from the resources given in the Practical guide and recommended textbooks/validated websites. Members are given the flexibility to share their group learning during face-to-face group discussions and through online discussion groups and collaborative documents via a shared user interface. This is to shift away from a teacher-centred approach where, according to Owens et al. (2020), students may not come prepared, rather, expecting information to be provided.

In-Practical Activities

During implementation, GCL and SPTD activities follow a defined Practical Schedule (Table 8.1) utilising available practical resources—both physical and online—and this is adhered to by students and tutors to maintain appropriate time management.

Guided Collaborative Learning (GCL) (Refer to Fig. 8.4)

1. Part A will focus on key concepts and principles of Gross Anatomy.
2. Students are encouraged to view highlighted dissection videos of the relevant topic and discuss and review any dissections/prosections (as available).
3. During Part B, the practical will be conducted in a similar format but focus on Surface Anatomy, Radiology & Clinical Anatomy. Students

Table 8.1 Practical schedule for gross/clinical anatomy (an exemplar)

Conduct of Activity	*Time (min)*
Part A Session (Gross Anatomy):	120
• Students can view dissection videos	10
• Guided collaborative learning (GCL) with structured practical (GCAP) tasks on critical concepts/basic principles of gross anatomy	70
• Hands-on exploration, identification and manipulation of plastinated specimens/models/virtual dissection software)	
• Tutors will be facilitating the session with respective groups	
• Feedback queries from students on areas of difficulty or clarification	5
• Tutor demonstration of relevant plastinated specimens/models; respond to any queries	35
Part B Session (Clinical Anatomy)	120
• Guided Collaborative Learning (GCL) with structured practical (GCAP) tasks on critical concepts in clinical anatomy including surface anatomy, radiology, procedural and surgical anatomy	70
• Tutors will be facilitating the session with respective groups	
• Tutor's demonstration of relevant plastinated specimens/models/radiographs/clinical or surgical procedure images, animations or videos	10
• Announcement & preparation: student group allocation of tasks	5
• Student Peer Teaching Demonstrations (SPTD) by student groups of selected practical tasks presented live/real-time to the whole cohort	20
• Peer teaching feedback	
• Polling software/audience response system used for questions and answers; with feedback to the whole cohort facilitated by tutors	15

Fig. 8.4 Students in GCL sessions in deep discussion using models, books, multimedia technology etc. with facilitation by clinician tutors (green arrows, right)

should explore clinical anatomy/application resources to address the tasks.

4. Students within each group should explore the GCAP Tasks as far as possible, in the form of self-directed discussion with hands-on models, plastinated specimens, consenting peers etc.
5. Tutors will play a facilitatory role by rotating amongst groups and being available for clarification.
6. Tutors will also clarify concepts and demonstrate any practical skill queries to the whole class by broadcasting from the "Tutor Demonstration Console".

Practical Resources

For the study of bones & joints, muscles, viscera & neurovascular structures students may:

- Use articulated skeletons & bone sets, anatomical models, plastinated cadaveric specimens, fixed/potted specimens, textbooks, atlases and multimedia as available
- Review labelled anatomy posters and images of prosections displayed in the MAPEL Lab
- Review dissection videos or software; digital repository of plastinated specimens and models; illustrated catalogue of models (hard copies/online).

For the study of Surface/Clinical/Procedural anatomy students may:

- Where possible, palpate or map out on themself or on willing and consenting peer volunteers from within their group or on models/plastinated specimens.
- Use dermatographic pencils or washable markers for mapping surface anatomy on consenting volunteers
- Carry out surface anatomy examination in groups of at least 3 persons and strictly follow guidelines for peer examination as laid out in clinical skills.

For the study of Radiology/Cross-sectional Anatomy students may:

- Refer to radiological images (e.g., plain films, CT/MRI scans) in textbooks, atlases, multimedia and real films (as available)
- Refer to plastinated cross-sections/corresponding digital radiographs
- Refer to online (computer-aided learning) resources.

Student Peer Teaching-Demonstrations (SPTD) (Refer to Fig. 8.5)

1. During Part B, student groups will be selected randomly and rotated each week to demonstrate from the Tutor Demonstration Console to the whole class on assigned practical tasks.
2. Student Peer Teaching-Demonstration of tasks by student groups should incorporate anatomical learning resources available, including plastinated specimens, models, bone sets, willing peer volunteers and education technology tools/multimedia (Fig. 8.5). In addition, students need to develop the digital and media information literacy skill, one of the essential twenty-first century skills (Binkley et al., 2012). Such group presentations should integrate the following technology aids, wherever possible:
    - Visualiser
    - Digital whiteboard/drawing tools

Fig. 8.5 Student Involvement in SPTD

- Camera
- Microphones (mobile/cordless)
- Tutor Demonstration Console
- Computers and anatomy software
- Designated websites and databases under Monash University Library
- E-Books (Anatomy textbooks and practical atlases)
- Other audio-visual aids as necessary.

Clockwise from Left:

- Students involved in SPTD sessions using anatomy resources-models/specimens/Atlas and various multimedia technology (visualizer, camera etc.) with facilitation by clinician tutors (green arrow, right).
- SPTD with Surface marking (external representation of internal body) skills on consenting fellow students.
- Live video capture and broadcast of SPTD with students' demonstration of "real world" practical skills
- Student Peer Teaching-Demonstration (SPTD) will involve different members of each group taking ownership to present various tasks based upon specified criteria.
- Student groups should actively work together to produce quality presentations/demonstrations with hands-on use of models/specimens strongly encouraged. In addition, group members are expected to collaborate and assist in answering queries from the floor or from tutors.
- All peer teaching will be moderated and facilitated by the tutors, with clarifications given as needed.

Learning Feedback
According to Winstone et al. (2017) and Timms et al. (2016), for feedback to be effective in supporting learning, students must engage with it by decoding its meaning, translating it into action and recognising its value. In other words, students must develop feedback literacy (Carless & Boud, 2018). Nevertheless, feedback will be provided to students on their learning during each of the following stages of the practicals:

1. Peer and tutor verbal feedback during GCL and self-directed group discussions
2. Tutor verbal and hands-on feedback during SPTD presentations.
3. Peer group feedback on SPTD presentations by non-presenting groups; evaluations displayed concurrently and cumulatively for each practical across the academic year
4. Automated feedback on In-practical knowledge gains using polling software/audience response systems

- o Using these polling systems, objective questions are posed to the whole cohort involving multiple-choice questions (MCQs), extended matching questions (EMQs).
- o Topics range from basic practical identification type, second-order questions to the more complex scenario/problem-solving questions.
- o Students have the flexibility to discuss within their groups before answering.
- o Tutors ensure clarifications of critical/challenging questions and address misconceptions.

Post-Practical Activities

Peer Group Evaluations of SPTD Presentations

Evaluations of group presentation/demonstrations during SPTD will be conducted by non-presenting groups and fun prizes awarded for the top groups at the end of the academic year to recognize their teamwork-led efforts. On a scale of 0–5, the evaluation criteria included the following seven items (Hafner & Hafner, 2003). According to Crisp (2012) peer evaluation should cover not just the declarative knowledge, but also on the functional and procedural knowledge components.

(1) Accuracy of the content of the presentation
(2) Cohesiveness and smooth flow of the presentation
(3) Use of specimens and models
(4) Integration of anatomy with clinical correlation
(5) Use of audio-visual aids (microphones, visualiser, camera)
(6) Response to questions
(7) Overall delivery of presentation.

Assessment: Objective Structured Clinical Anatomy Review (OSCAR)

For this formative practical assessment, students were guided into the MAPEL Lab to begin answering station questions on answer scripts as short answers following their designated circuit clockwise. After a minute the electronic countdown timer prompted the students to rotate in an orderly fashion through all stations until the OSCAR was completed. Answer scripts were collected for review by the tutor team before their briefing and feedback session to the whole cohort that followed the OSCAR. Through participation in the OSCARs and the ensuing briefing by the tutor team, students gain valuable formative feedback which provides reassurance, promotes reflection and serves as a guide to their future learning. If so, both the lecturers and students should have a shared understanding of what feedback is and how to use it formatively, particularly, lecturers need to have an insight into students' expectations and perceptions of feedback (Bader et al., 2019). To this end, Poulos and Mahony (2008) concur that for formative feedback to be effective, students have to act on it.

Outcomes

Evaluation of Practical Strategy

Upon implementation of the GCL, SPTD and OSCAR, using Kirkpatrick's methodology (Kirkpatrick, 1994; Rouse, 2011), we evaluated the guided learning and student-led teaching demonstration strategies with a focus on 3 levels which are variously called 'Reaction,' 'Learning' and 'Behaviour'.

- Using Kirkpatricks methodology in combination with 360 evaluations of our practical strategy, GCL/SPTD was assessed quantitatively and qualitatively at levels of (a) "Reaction" through Formal teaching evaluations—University/Faculty-wide unit evaluations (Student Evaluation of Teaching and Units [SETU] Scores and student feedback; (b) Learning (summative exam grades, student evaluation [qualitative & quantitative] of impact on their learning), and (c) Behaviour (student peer assessment using a structured questionnaire and tutor/lecturer reviews [qualitative]).
- Formal Teaching Evaluations

The scores from independently administered SETU unit evaluations across the Faculty of Medicine with its affiliated Schools of Medicine at our Malaysia Main Campus (where we introduced this new practical strategy in our MAPEL lab) and the Australia Clayton Campus were analysed in relation to the key question on 'Lab/Practicals', which typically received a 65% response rate from the total number of students attending the sessions; Unit evaluations demonstrated distinct improvement (by 5 to 18%) after the practicals were implemented over the years at our Main campus. In the first year of GCL/SPTD introduction at Monash Malaysia Main Campus, SETU evaluation scores increased to 4.33/5.00. For the first time, the branch Campus scores ranked higher than the other campuses (same anatomy syllabus and assessment/but traditional anatomy practical teaching). Considering that more than half the practicals for this Unit comprise anatomy, this is indicative of a distinct improvement in the student experience for anatomy practicals.

Furthermore, our own (authors) contribution to the students' Anatomy learning through this practical strategy is exemplified by consistently very high educator evaluation scores, averaging 4.75–4.85 out of 5.00, in Monash Questionnaire Series on Teaching (MonQueST/SETU) evaluations by students in recent years (2020) while delivering the novel practical strategy.

Tutor/Educator Peer Reviews

Formal reviews by senior faculty involved in this course also indicate the effectiveness of the GCL/SPTD teaching innovation. A Consultant General Surgeon (based in Melbourne) and former Deputy Director, Centre for Human Anatomy Education, Faculty of Medicine, Monash University Australia reported that:

> *Learning objectives: very well done; Use of illustrations & examples done well and that students' learning behaviour, attention & interest maintained.... participants' involvement encouraged... students appeared motivated.*

Giving a Malaysian perspective, Consultant Orthopaedic Surgeon and Past-President, Malaysian Orthopaedic Association, while facilitating GCL/SPTD as part of our tutor team observed that:

> *There was a remarkable improvement in the student participation when [this] was introduced. Their activity during the sessions was more focused*

> *and productive.... they took the peer [teaching] seriously and made sincere efforts in improving their presentation.*

Finally, we were extremely encouraged and honoured by comments from a distinguished and most renowned Medical Education pioneer/guru and Editor of 'Medical Teacher': "*This is an excellent approach…. integration of clinical components with team-based learning encourages collaborative learning……a new concept in traditional anatomy practicals*".

Student Evaluations
Most importantly, student feedback demonstrates their engagement and how it translates into effective learning. Typical student comments indicating this connection include the following:

- "*Practical tasks: really good [helps] to look thoroughly [at] the topic. Group Discussion: helps us to clarify any doubts……please continue every week. [The] Peer demonstration helps when I present to the whole class because I make sure I learn my part*".
- *"OSCAR is good" …. "Can we have OSCAR every week?" … "Very very stimulating and increases the desire to study more about anatomy… (tough stuff, though*)"
- "*…ability to keep students engaged in one of medicine's most difficult and complex subjects is exemplary…dedicated, enthusiastic and entertaining…. definitely contributes positively to our learning and development…stimulates my learning by giving us relevant clinical facts; has made anatomy so interesting and fun filled learning process*".

What is reassuring is that the impact and practical significance of learning clinical anatomy through our innovative GCL/SPTD strategy has been appreciated by medical students in later clinical years and even beyond as a doctor. This is exemplified by a final year medical student (who went through GCL/SPTD in year 1 and Year 2) recollecting that:

> *Year 1-2 anatomy teaching is indeed useful…; more so the extra emphasis that is put on clinical relevance/application of theoretical anatomy knowledge—… most useful during clinical years. Clinicians will always be asking questions on clinical anatomy, not [just] only during surgical postings. The anatomy practicals were useful to bring together all the bits & pieces of knowledge and*

also consolidate lectures. It was also a fun opportunity to learn as a group, open up & also teach others

Peer group evaluation of SPTD presentations by non-presenting groups was also very optimistic concerning the overall delivery and accuracy, the use of resources, audiovisual technology and clinical anatomy correlations during presentations (scoring between 3.8–4.7/out of 5).

Student evaluations of GCL/OSCAR indicated their high level (over 80–90%) of support for the strategies and resources that strongly and positively impacted their learning ($n = 92$ students).

Student Grades

A comparison of student achievement based on end-of-year exam scores for Year 1 before and after the implementation of the new program showed that mean scores for gross anatomy improved from 59% (before) to 66% after its introduction, an improvement of 7%, reflecting improved learning amongst student cohorts that was sustained with time.

Publications, Education Awards & Intellectual Property

Our insights into such innovative, practical learning have been shared with the broader educational researchers' community through peer-reviewed publications (Selvaratnam and Sen (2009), Selvaratnam et al. (2012), Selvaratnam et al. (2017), Sen and Selvaratnam (2009); Sen et al. (2016); Sen et al., 2020; Sen & Leong, 2020; Sen & Selvaratnam, 2010a, 2010b, 2010c, 2011a, 2011b, 2012, Wan et al., 2022) especially about Technology Enhanced Learning.

The Lab and novel education strategies framing our anatomy practical curriculum delivery have received recognition through numerous education awards, namely by Australian higher education bodies (Australian Government AAUT/OLT Citation Award [2012] as reported in the government Hansard), Monash University (Vice Chancellor's Excellence in Teaching Citation [2010], Faculty Dean's Award for Excellence in Teaching [2014, 2010] and Pro Vice-Chancellor's [PVC's] Award for Teaching Excellence [2009, 2011, 2014]), international higher education bodies (Ron Harden Innovation in Medical Education Award, 2015, 2011) and as a Malaysian innovation with commercialisation potential (Silver Award ITEX, 2018).

Our novel MAPEL Lab provides a state-of-the-art and conducive learning environment not only for studying anatomy but has also become a multi-usage facility and used by other medical disciplines, for open days showcase, public education and postgraduate surgical training workshops.

The basis of these GCL and SPTD pedagogies has contributed to developing intellectual property for a networked ecosystem of multi touch tabletops in an e-learning resource lab, resulting in the authors being granted a Utility Innovation (patent), a first in the field of Education Technology for Monash University (Utility Innovation IP/Co-inventors: Sen et al., 2020).

Conclusions

This novel technology-enhanced, task-based, collaborative model of GCL/SPTD serves to promote medical students from passive listeners to active problem-solvers and lifelong learners (Rosenberg et al., 2006), translating Aristotle's philosophy "Teaching is the highest form of understanding" into practice. Integrating educational technology through PCs, Digital resources, physical models etc. allows a seamless multitude of interactions—peer to peer, peer to tutor, peer to resources—within the same group and across cohorts. The effectiveness of this model is due to the affordances of such interactions within a technology-enhanced laboratory.

The GCL, SPTD and OSCAR model's effectiveness is reflected in the positive outcomes in all our evaluation goals of reaction, learning and behaviour. Student receptiveness towards this practical approach manifested in the overall improvement in student/team-directed learning, motivation and engagement—essential skill sets required later when engaging in regulated continuous professional development as future practising doctors (Yam et al., 2016). Although some senior tutors were initially hesitant to step away from traditional dissection-based approaches, overall, once trained and familiar with the teaching format, tutors readily accepted the new, technology-enhanced methods. The unit evaluation scores showed that the practical innovation, since its inception, has been sustained over time. It also indicates its effectiveness against our main campus following the same curriculum but with a traditional mode of delivery.

Though analyses on technology-enhanced learning and active learning methods in healthcare disciplines have been studied (Dori & Belcher, 2005; Gutmann et al., 2015), the likes of GCL/SPTD have yet to be reported as a proper method of long-term practical training in healthcare education involving team-based approaches within large student cohorts, the practice of GCL/SPTD in our campus has been made possible, due to the innovative and enabling learning environment provided by the integration of authentic learning resources within the technology-supported MAPEL lab. Hence, this practical activity-based approach goes beyond basic peer teaching strategies to focus on the critical visual, haptic and immersive experience of explorations of demonstrations using human body specimens, models and peer volunteers, by student groups to their cohort peers. Improvement of summative scores shows that SPTD reinforces knowledge/skills learnt in GCL. By taking on teaching/demonstrating roles, students can attain a higher level of competency in practical skills (Australian Medical Council, 2012). A key design highlight of this Anatomy practical strategy has been the incorporation of clinical anatomy for each practical guide including tasks that allow competencies in clinical skills to develop during such basic science (Anatomy) practicals—a true example of authentic learning with added skills development during preclinical teaching and learning. Further, these practical activities are facilitated by actual industry players and healthcare professionals—clinician tutors. Integration of authentic tasks and facilitation and input by workplace practitioners or those with prior practice experience should be the aim of educators when trying to design their practical programmes using this model. Whilst this strategy and all its associated activities have sustained well for over a decade of implementation in the physical learning environment of the MAPEL Lab, interestingly these last two years of the Covid-19 pandemic have seen their successful conversion to a fully online format with the same learning outcomes as during pre-pandemic times.

Overall, this multi-award-winning educational innovation could readily be applied as a role model for practical learning and engages students in professional collaborations demanded in today's clinical practice, strongly supporting GCL/SPTD as a future-forward, effective strategy for practical skills training in medical and healthcare education.

References

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessment: A revision of Bloom's taxonomy of educational objectives*. Longman.

Arico, F. R., & Lancaster, S. J. (2018). Facilitating active learning and enhancing student self-assessment skills. *International Review of Economics Education, 29*(2018), 6–13. https://doi.org/10.1016/j.iree.2018.06.002

Australian Medical Council. (2012). *Standards for assessment and accreditation of primary medical programs by the AMC*. http://www.amc.org.au

Bader, M., Burner, T., Iversen, S. H., & Varga, Z. (2019). Student perspectives on formative feedback as part of writing portfolios. *Assessment & Evaluation in Higher Education, 44*(7), 1017–1028. https://doi.org/10.1080/02602938.2018.1564811

Bandura, A. (1977). *Social learning theory*. General Learning Press.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defning twenty-frst century skills. In P. Grifn, B. McGaw, & E. Care (Eds.), *Assessment and teaching of 21st century skills*. Springer.

Boyer E. L. (2004, June 1). Chapter 2: Enlarging the perspective. *Physical Therapy, 84*(6), 571–575. https://doi.org/10.1093/ptj/84.6.571

Brooks, D. C. (2012). Space and consequences: The impact of different formal learning spaces on instructor and student behavior. *Journal of Learning Spaces, 1*(2), https://files.eric.ed.gov/fulltext/EJ1152694.pdf

Buljac-Samardzic, M., Doekhie, K. D., & van Wijngaarden, J. D. H. (2020). Interventions to improve team effectiveness within health care: a systematic review of the past decade. *Human Resources for Health, 18*(1)**,** Article 2. https://doi.org/10.1186/s12960-019-0411-3

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & Evaluation in Higher Education, 43*(8), 1315–1325. https://doi.org/10.1080/02602938.2018.1463354

Carstensen, S. S., Kjaer, C., Moller, S., & Bloksgaard, M. (2020). Implementing collaborative, active learning using peer instructions in pharmacology teaching increases students' learning and thereby exam performance. *European Journal of Pharmacology, 867*, Article 172792. https://doi.org/10.1016/j.ejphar.2019.172792

Carvalho, A. R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*, Article 100070. https://doi.org/10.1016/j.caeo.2021.100070

Chi, M. T. H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist, 49*(4), 219–243. https://doi.org/10.1080/00461520.2014.965823

Chia, Y. L., Sen, A., Tha, K. K., & Lee. C. Y. (2017). An effective e-learning module for gastrointestinal disease pharmacology. In *INTED2017 Proceedings* (pp. 1572–1580). International Assoc Tech, Education & Dev. ISBN: 978-84-617-8491-2. https://doi.org/10.21125/inted.2017.0500

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics, 69*(9), 970–977. https://doi.org/10.1119/1.1374249

Crawford, L., Helliar, C., Monk, E., & Stevenson, L. (2011). SCAM: Design of a learning and teaching resource. *Accounting Forum, 35*(1), 61–72. https://doi.org/10.1016/j.accfor.2010.08.008

Crisp, G. (2012). Assessment in virtual learning spaces. In M. Keppell, K. Souter, & M. Riddle (Eds.), *Physical and virtual learning spaces in higher education: Concepts for the modern learning environment* (pp. 199–218). IGI Global.

Dellaportas, S., & Hassall, T. (2013). Experiential learning in accounting education: A prison visit. *The British Accounting Review, 45*(1), 24–36. https://doi.org/10.1016/j.bar.2012.12.005

Dori, Y. J., & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate students ' understanding of electromagnetism concepts? *The Journal of the Learning Sciences, 14*(2), 243–279. https://doi.org/10.1207/s15327809jls1402_3

Duit, R., & Treagust, D. F. (1998). New perspectives on language in science. In B. Fraser., & K. Tobin (Eds.), *International handbook of science education* (pp. 27–38). Kluwer Academic.

Eddy, K., Jordan, Z., & Stephenson, M. (2016). Health professionals' experience of teamwork education in acute hospital settings: A systematic review of qualitative literature. *JBI Database of Systematic Reviews and Implementation Reports, 14*(4), 96–137. https://doi.org/10.11124/JBISRIR-2016-1843

Ellis, R. A. (2016). Qualitatively different university student experiences of inquiry: Associations amongst approaches to inquiry, technologies and perceptions of the learning environment. *Active Learning in Higher Education, 17*(1), 13–23. https://doi.org/10.1177/1469787415616721

Evans, D. J. R. (2020). Designing and using formative assessment in anatomy. In: L. K. Chan, & W. Pawlina (Eds.), *Teaching anatomy* (pp 431–441). Springer Nature. https://doi.org/10.1007/978-3-030-43283-6_42

Evans, D., & Pawlina, W. (2021). Effects of Covid-19: The need to assess the real value of anatomy education. *Anatomical Sciences Education, 14*(2), 129–131. https://doi.org/10.1002/ase.2061

Gibbs, G. (1994). *Improving student learning: Theory and practice*. The Oxford Centre for Staff Development.

Graffam, B. (2007). Active learning in medical education: Strategies for beginning implementation. *Medical Teacher, 29*(1), 38–42. https://doi.org/10.1080/01421590601176398

Gutmann, J., Kühbeck, F., Berberat, P. O., Fischer, M. R., Engelhardt, S., & Sarikas, A. (2015). Use of learning media by undergraduate medical students in pharmacology: A prospective cohort study. *PLOS ONE 10*(4), Article e0122624. https://doi.org/10.1371/journal.pone.0122624

Guze, P. A. (2015). Using technology to meet the challenges of medical education. *Transactions of the American Clinical and Climatological Association, 126*, 260–270. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4530721/

Green, S. (2019). What students don't make of feedback in higher education: An illustrative study. *Journal of English for Academic Purposes, 38*(2019), 83–94. https://doi.org/10.1016/j.jeap.2019.01.010

Hafner, J., & Hafner, P. (2003). Quantitative analysis of the rubric as an assessment tool: An empirical study of student peer-group rating. *International Journal of Science Education, 25*(12), 1509–1528. https://doi.org/10.1080/0950069022000038268

Hakkinen, P., & Hamalainen, R. (2012). Shared and personal learning spaces: Challenges for pedagogical design. *Internet and Higher Education, 15*(4), 231–236. https://doi.org/10.1016/j.iheduc.2011.09.001

Harvey, M., Coulson, D., & McMaugh, A. (2016). Towards a theory of the ecology of reflection: Reflective practice for experiential learning in higher education. *Journal of University Teaching & Learning Practice, 13*(2), 2.

Hernández, E.H., Moreno-Murcia, J.A., & Espín, J. (2020). Teachers' interpersonal styles and fear of failure from the perspective of physical education students. *PLoS ONE 15*(6). Article e0235011. doi: https://doi.org/10.1371/journal.pone.0235011

Jeong, H., & Hmelo-Silver, C. E. (2016). Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help? *Educational Psychologist, 51*(2), 247–265. https://doi.org/10.1080/00461520.2016.1158654

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). *Active learning: Cooperation in the college classroom*. Interaction Book Co.

Joy, S., & Kolb, D. A. (2009). Are there cultural differences in learning style? *International Journal of Intercultural Relations, 33*(1), 69–85. https://doi.org/10.1016/j.ijintrel.2008.11.002

Kirkpatrick, D. L. (1994). *Evaluating training programs: The four levels*. Berrett-Koehler Publishers Inc.

Kollar, I., & Fischer, F. (2010). Peer assessment as collaborative learning: A cognitive perspective. *Learning and Instruction, 20*(4), 344–348. https://doi.org/10.1016/j.learninstruc.2009.08.005

Kozma, R. B. (2003). Technology and classroom practices. *Journal of Research on Technology in Education, 36*(1), 1–14. https://doi.org/10.1080/15391523.2003.10782399

Krange, I., & Ludvigsen, S. (2008). What does it mean? Students' procedural and conceptual problem solving in a CSCL environment designed within the field of science education. *International Journal of Computer-Supported Collaborative Learning, 3*(1), 25–51. https://doi.org/10.1007/s11412-007-9030-4

Lacka, E., Wong, T. C., & Haddoud, M. H. (2021). Can digital technologies improve students' efficiency? Exploring the role of virtual learning environment and social media use in higher education. *Computers & Education, 163*(2). https://doi.org/10.1016/j.compedu.2020.104099

Laurillard, D. (2002). *Rethinking university teaching. A conversational framework for the effective use of learning technologies*. Routledge.

Lee, W. O. (2014). The changing knowledge functions of university in the 21st Century: Implications for learning and teaching in higher education. *International Journal of Chinese Education, 3*(1), 7–29. https://doi.org/10.1163/22125868-12340028

Lou, Y., Abrami, P. C., Spence, J. C., Poulsen, C., Chambers, B., & d'Apollonia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research, 66*(4), 423–458. https://doi.org/10.3102/00346543066004423

Lucas, U. (1997). Active learning and accounting educators. *Accounting Education, 6*(3), 189–190. https://doi.org/10.1080/096392897331433

Lun, V.M.-C., Fischer, R., & Ward, C. (2010). Exploring cultural differences in critical thinking: Is it about my thinking style or the language I speak? *Learning and Individual Difference, 20*(6), 604–616. https://doi.org/10.1016/j.lindif.2010.07.001

Mercer, N. (1996). The quality of talk in children's collaborative activity in classroom. *Learning and Instruction, 6*(4), 359–377. https://doi.org/10.1016/S0959-4752(96)00021-7

Myron, R., French, C., Sullivan, P., Sathyamoorthy, G., Barlow, J., & Pomeroy, L. (2018). Professionals learning together with patients: An exploratory study of a collaborative learning Fellowship programme for healthcare improvement. *Journal of interprofessional care, 32*(3), 257–265. https://doi.org/10.1080/13561820.2017.1392935

Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2004). *Mobile technologies and learning*. Futurelab

Nicol, A. A. M., Owens, S. M., Le Coze, S. S. C. L., MacIntyre, A., & Eastwood, C. (2018). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education, 19*(3), 253–265. https://doi.org/10.1177/1469787417731176

Owens, D. C., Sadler, T. D., Barlow, A. T., & Smith-Walters, C. (2020). Student motivation from and resistance to active learning rooted in essential science practices. *Research in Science Education, 50*, 253–277. https://doi.org/10.1007/s11165-017-9688-1

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest, 9*(3), 105–119.

Patel, S., Mauro, D., Fenn, J., Sharkey, D., & Jones, C. (2015). Is dissection the only way to learn anatomy? Thoughts from students at a non-dissecting based medical school. *Perspectives on Medical Education, 4*(5), 259–260. https://doi.org/10.1007/s40037-015-0206-8

Pawlina, W., & Drake, R. L. (2016). Authentic learning in anatomy: A primer on pragmatism. *American Association of Anatomists, 9*(1), 5–7. https://doi.org/10.1002/ase.1592

Poulos, A., & Mahony, M. J. (2008). Effectiveness of feedback: The students' perspective. *Assessment and Evaluation in Higher Education, 33*(2), 143–154. https://doi.org/10.1080/02602930601127869

Prensky, M. (2001). Digital natives, digital immigrants Part 1. *On the Horizon, 9*(5), 1–6. https://doi.org/10.1108/10748120110424816

Rosen, Y., & Salomon, G. (2007). The differential learning achievements of constructivist technology-intensive learning environments as compared with traditional ones: A meta-analysis. *Journal of Educational Computing Research, 36*(1), 1–14. https://doi.org/10.2190/R8M4-7762-282U-554J

Rosenberg, J. L., Lorenzo, M., & Mazur, E. (2006). Peer instruction: Making science engaging. In J. L. Mintzes & W. H. Leonard (Eds.), *Handbook of College Science Teaching* (pp. 77–86). NSTA Press.

Rouse, D. N. (2011). Employing Kirkpatrick's evaluation framework to determine the effectiveness of health information management courses and programs. *Perspectives in Health Information Management, 1*(8). Article 1c. https://bok.ahima.org/doc?oid=301270#.YeKQ2dFBw2w

Sadeesh, T., Prabavathy, G., & Ganapathy, A. (2021). Evaluation of undergraduate medical students' preference to human anatomy practical assessment methodology: a comparison between online and traditional methods. *Surgical and radiologic anatomy: SRA*, *43*(4), 531–535. https://doi.org/10.1007/s00276-020-02637-x

Samarakoon, L., Fernando, T., & Rodrigo, C. (2013). Learning styles and approaches to learning among medical undergraduates and postgraduates. *BMC Medical Education, 13*. Article 42. https://doi.org/10.1186/1472-6920-13-42

Schell, J. A., & Butler, A. C. (2018). Insights from the science of learning can inform evidence-based implementation of peer instruction. *Frontier in Education*, *3*(33). https://doi.org/10.3389/feduc.2018.00033

Selvaratnam, L., & Sen, A. (2009). GCL & PTD: Innovations in clinical anatomy education. *Proceedings from 6th Australia & New Zealand Association Clinical Anatomists* (p. 23). Melbourne.

Selvaratnam, L., & Sen, A., et al. (2012). Tapping technology to give formative feedback for practical learning in medicine. In J. Lee (Ed.), *Proceedings from 20th International Conference on Computers in Education* (pp. 75–78). Singapore.

Selvaratnam, L., Wan, K. L., Dhanoa, A., Imran, Md N. M., & Sen, A. (2017). Transformation to virtual education technology will ensure histopathology stays relevant for 21st century medical students. *Proceedings from 12th International Medical Education Conference* (p. 124). KL, Malaysia.

Sen, A., & Passey, D. (2013). Globalisation of next generation technology enhanced learning environments (TELEs) for learning: Contexualizations in the Asia-Pacific region. *Proceedings from IEEE Fifth International Conference on Technology for Education* (pp. 111–118). Kharagpur, India.

Sen, A., & Selvaratnam, L. (2009). Innovations in clinical anatomy learning: guided team-based learning and technology enhanced reciprocal peer teaching demonstration. *Proceedings from 6th Asia Pacific Medical Educational Conference* (pp. 233–234). Singapore.

Sen, A., & Selvaratnam, L. (2010a). Innovative ICT practices in health science education: SPTD for practical learning in health sciences. *Proceedings from 15th ICE2010a* (pp. 86–87). Brunei.

Sen, A., & Selvaratnam, L. (2010b). Innovative ICT practices in health sciences education: Student peer teaching demonstration for practical learning in health sciences. Proceedings from *15th International Conference in Education* (ICE 2010b). University Brunei Darussalam, Brunei.

Sen, A., & Selvaratnam, L. (2010c). Technology enhanced teaching demonstration as an innovative method of peer assisted learning of practical skills. *Proceedings from International Conference of Education, Research and Innovation* (pp. 86–87). Spain.

Sen, A., & Selvaratnam, L. (2011a). Visionary pedagogical model to enhance learning of practical skills in a large cohort through collaborative learning & peer teaching-demonstration educational technology system. Proceedings from *Computer Assisted Learning (CAL) Conference*. Manchester, UK.

Sen, A., & Selvaratnam, L. (2011b). Visionary pedagogical model to enhance learning of practical skills in a large cohort through collaborative learning and peer teaching demonstration educational technology system. *Proceedings from The CAL (Computer Assisted Learning) Conference*. Manchester, UK.

Sen, A., & Selvaratnam, L. (2012). Affordances of an innovative ecosystem of multiple tabletops and anatomy resources for supporting collaborative practical learning. In J. Lee et al. (Eds.), *Proceedings from 20th International Conference on Computers in Education* (pp. 79–82).

Sen, A., & Leong, C. K. C. (2020). Technology-enhanced learning. In A. Tatnall (Ed.), *Encyclopedia of Education and Information Technologies* (pp. 1719–1726). Springer. https://doi.org/10.1007/978-3-319-60013-0_72-1

Sen, A., Selvaratnam, L., & Zaini, A. (2020). An ecosystem of networked teacher and student multitouch tabletops with integrated resources. Malaysian Utility Innovation. No. UI 2013702264. Grant No. MY-177519-A on 17 September 2020. Monash University Malaysia Sdn. Bhd. Depty Registrar of Patents

Sen, A., Selvaratnam, L., Wan, K. L., Khoo, J. J., & Rajadurai. P.A. (2016). Virtual histopathology – Essential education tools to ensure pathology competence for tomorrow's medical interns. *Proceedings from International Association of Technology, Education & Development*. Spain.

Singh, R., Tubbs, R. S., Gupta, K., Singh, M., Jones, D. G., & Kumar, R. (2015). Is the decline of human anatomy hazardous to medical education/profession? A review. *Surgical and Radiologic Anatomy, 37*(10), 1257–1265. https://doi.org/10.1007/s00276-015-1507-7

Stahl, G. A. (2000, June). *A model of collaborative knowledge building*. Paper presented at the 4th International Conference of the Learning Sciences, Ann Arbor, MI.

Standring, S. (2009). New focus on anatomy for surgical trainees. *ANZ Journal of Surgery, 79*(3), 114–117. https://doi.org/10.1111/j.1445-2197.2008.04825.x

Sugand, K., Abrahams, P., & Khurana, A. (2010). The anatomy of anatomy: A review for its modernisation. *Anatomical Sciences Education, 3*(2), 83–93. https://doi.org/10.1002/ase.139

Swanwick, T., Forrest, K., & O'Brien, B. C. (2019). *Understanding medical education: Evidence, theory, and practice*. Association for the Study of Medical Education.

Timms, M., DeVelle, S., & Lay, D. (2016). Towards a model of how learners process feedback: A deeper look at learning. *Australian Journal of Education, 60*(2), 128–145. https://doi.org/10.1177/0004944116652912

Valenti, S. S., & Gold, J. M. M. (2010). Social affordances and interaction I: Introduction. *Ecological Psychology, 3*(2), 77–98. https://doi.org/10.1207/s15326969eco0302_2

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard Univ. Press.

Wan, K. L. & Sen, A. Selvaratnam, L., & Khoo, J. & Rajadurai, P. (2022). Visual-spatial dimension integration in digital pathology education enhances anatomical pathology learning. *BMC Medical Education*, Springer Nature. https://doi.org/10.1186/s12909-022-03545-x

William, D. (2011). What is assessment for learning? *Studies in Educational Evaluation, 37*(1), 3–14. https://doi.org/10.1016/j.stueduc.2011.03.001

Winstone, N. E., Nash, R. A., Parker, N., & Rowntree, J. (2017). Supporting learners' agentic engagement with feedback: A systematic review and a taxonomy of recipience processes. *Educational Psychologist, 52*(1), 17–37. https://doi.org/10.1080/00461520.2016.1207538

Wong, B. L. H., Khurana, M. P., Smith, R. D. et al. (2021). Harnessing the digital potential of the next generation of health professionals. *Human Resource Health*, *19*, 50. https://doi.org/10.1186/s12960-021-00591-2

Wright, M. C., Bergom, I., & Bartholomew, T. (2019). Decreased class size, increased active learning? Intended and enacted teaching strategies in smaller classes. *Active Learning in Higher Education, 20*(1), 51–62. https://doi.org/10.1177/1469787417735607

Yam, C. H. K., Griffiths, S. M., Liu, S., Wong, E. L. Y., Chung, V. C. H., & Yeoh, E. K. (2016). Medical regulation: Ten key trends emerging from an international review. *Journal of Medical Regulation*, *102*(1), 16–27. https://doi.org/10.30770/2572-1852-102.1.16

Zhang, L., Kalyuga, S., Lee, C., & Lei, C. (2016). Effectiveness of collaborative learning of computer programming under different learning group formations according to students' prior knowledge: A cognitive load perspective. *Journal of Interactive Learning Research*, *27*(2), 171–192. https://doi.org/10.1016/j.chb.2010.03.038

CHAPTER 9

Online Collaborative Active Learning in Psychology

Adriana Ortega and Raymond Jambaya

It is the Long History of Humankind (and Animal Kind, Too) that Those Who Learned to Collaborate and Improvise Most Effectively Have Prevailed.
—Charles Darwin

The authors would like to acknowledge the collaboration and practical support of Abbey Tan, Ph.D. candidate at Monash University, in implementing the online CAL in this course.

A. Ortega (✉)
Monash University Malaysia, Subang Jaya, Malaysia
e-mail: adriana.ortega@monash.edu

R. Jambaya
People Potential Pvt Ltd, Kuala Lumpur, Malaysia

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_9

Introduction

Often in Psychology, we tend to collaborate across disciplines and with our colleagues at various institutions and industries. Therefore, among the essential skills to develop for Psychology undergraduate students is collaborative working skills. In addition, as we move towards online distance learning and remote education, students struggle in engaging with passive online learning activities. If so, the introduction of active learning requires students to engage actively in the learning process and to think and reflect on what they are doing in contrast to passive learning where they are merely the recipients of information (Chiang et al., 2021). In this regard, according to Dixson (2010) there is no significant difference in students' engagement levels between those using active activities (e.g., labs and group projects, research papers, current events assignments, case studies and solving problems, and discussion forums) versus passive activities (e.g., reading, taking quizzes, watching/looking at PowerPoint slides, and video lectures). Therefore, it is possible to use a myriad of activities to engage students in online courses. However, the active learning activities help to promote student social presence. Therefore, lecturers should consider learning assignments that engage students with the content and with each other in order to avoid social isolation (Lewis & Abdul-Hamid, 2006; Ortiz-Rodríguez et al., 2005; Song & Singleton, 2004). This is because online environments challenge students' ability to deal with unexpected situations in educational context and they need the complement of social and affective premises from the lecturers and peers to maintain the motivation and engagement levels (Carvalho & Santos, 2022). Nevertheless, providing the opportunities for students to learn in a collaborative style facilitates the development of collaborative working skills (e.g., communication, organisation, shared vision and purpose, adaptability, and constructive debate) and positively impacts students' engagement and learning process. In addition, collaborative learning enhances students' productivity, fosters higher-level thinking, critical thinking, problem-solving skills, supportive, and positive relationships, and strengthens psychological health, social competence, and self-esteem (Johnson & Johnson, 2009; Webb, 1980). The collaborative learning (CL) model consists in facilitating students' joint intellectual effort during class, whether working in groups or pairs to achieve the learning outcomes (Gokhale, 1995; Smith & MacGregor, 1992); thus, involving students actively in the process of learning (Slavin, 1980).

In this chapter, we will focus on Collaborative Active Learning (CAL) strategies, especially on three of these CAL strategies: group discussion, problem-based case studies, and jigsaw. These strategies were implemented using a scaffolding method to facilitate familiarity and buying into the idea of collaborative peer-learning, and build up students' cooperative learning skills. After all, according to Tharayil et al. (2018) scaffolding is used to break down a complex cognitive task and by doing so it provides support to students in terms of better understanding of the task and subsequent task completion. The aim is to assist students building confidence while they master new skills and concepts (Sullivan, 2009). However, scaffolding is gradually reduced as students' progress in their studies. To this end, in education, scaffolding is used to describe how educators, facilitators, and teachers provide support and tools for students to master new concepts and develop new skills; bridging the gap between what students know and what they need to know. As a teaching method, scaffolding is based on the zone of proximal development theory (Vygotsky, 1978), that is, more capable students help and assist others in learning and social relations are necessary for it to happen. There are several ways in which scaffolding can be implemented; one way as described above, is to break the learning material and tasks into smaller parts and provide tools or structures with each of these smaller parts for the students to complete these tasks (Applebee & Langer, 1983; Benson, 1997; Larkin, 2002; Zhao & Orey, 1999). The aim is to empower students to learn independently; therefore, the facilitator or teacher's support is gradually removed as students become increasingly proficient in completing the tasks alone.

Scaffolding was used to deliver the online collaborative active learning tasks presented in this chapter. In line with the work of Lange (2002), a clear instructional plan (see Fig. 9.1) for each CAL strategy was developed and executed, with the instructors providing support to the students at every step of the learning process. Feedback and feedforward, and when necessary, debriefing was provided at the end of each learning session. At first, the instructors initiated the feedback and feedforward, serving as modelling. The feedback and feedforward were created and led by the instructors, serving as modelling, and later delegating the feedback to students, thus serving as peer learning. Importantly, according to Boud and Molloy (2013) feedback should be repositioned as a fundamental part of curriculum design, that is, it is a key indicator of the effectiveness of the course delivery. Specifically, it provides a curriculum space for students to engage with their peers and lecturers for communicating, for knowing, for judging and for acting. Carless et al. (2011) linked this view with the important role students play in feedback. Furthermore, students should view feedback as promoting collaborative active learning because the purpose of feedback is to support student self-regulation, and to increase the capability in making judgments and acting upon them (Boud & Molloy, 2013).

It is beneficial for students who are yet to accept the idea of collaborative learning and peer-learning to allow them to work independently and then communicate their ideas to their peers. This approach is in line with the potential of CAL that combines individual and social processes in the shared knowledge construction (Arvaja et al., 2007; Dillenbourg et al., 2009). In other words, students start off by working individually to self-construct meanings before they bring their ideas to share with the group members for further deliberations, debate, elaborations and arguments to arrive at the group shared co-constructed meaning and not just cumulatively share knowledge together (Mercer, 1996). To this end, it is important that prior knowledge is activated both at the individual and group levels as it goes hand in hand with improved knowledge integration and exchange (Erkens & Bodemer, 2019). Listening to their peers' responses and sharing their discussion fosters intentional, active listening skills. Group discussion allows students to interact with their peers and learn what peer learning and teaching is about. According to Gayton and

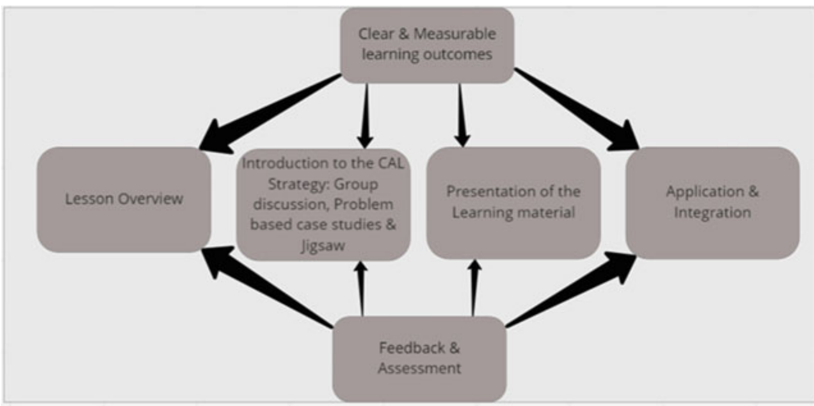


Fig. 9.1 Instructional plan sample diagram

McEwen (2007), the effectiveness of group discussion depends on the rapport and collaboration between students, thought provoking questions from the peers and dynamic interactions in the group. Furthermore, Eddy et al. (2015) reveal that peer discussions in groups depend on gender, ethnicity and nationality and the potential barriers to effective group discussion include being excluded by peers, feeling of anxiety to participate and not appreciating the significance of group discussion. Students must be given clear directions and tasks. After the activity is completed, students are encouraged to provide feedback and for instructors to guide them through this process.

Besides group discussion, the other CAL strategies in this chapter are problem-based case studies and jigsaw. First, students in psychology and health sciences often welcome problem-based case studies. It gives students opportunities to apply what they have learned, and problem-based case studies are also an effective way to reinforce key concepts and models learned during the lecture, the prescribed reading and interactive material provided for a particular topic. Second, jigsaw is a collaborative active learning strategy that helps students learn effective cooperation, manage peer collaboration, share responsibility, and foster accountability. It can consist of, for example, assigning each student a specific article or video to read/watch. Then students are assigned to a group in which each presents their part to the group as they work towards a synthesis of all the articles or videos. These strategies were implemented in a blended mode, using scaffolding methods as indicated earlier.

The Context

The CAL strategies were implemented in a 3rd-year psychology undergraduate course that covered the theoretical models used to explain the role of physical health problems in precipitating mental illness. A student project was designed to examine the impact of behaviour interventions in improving individuals' health. The course had 68 enrolled students divided into smaller groups of 35 and 33 students for the synchronous online seminars every other week.

The CAL strategies were adopted to enhance students' engagement, promote peer-learning, and facilitate the course learning outcomes. Every week for 12 weeks students had the option to engage on CAL as this was incorporated as part of the flipped classroom strategy. Because students were apprehensive about online learning, CAL strategies were implemented using scaffolding approach incorporating one CAL per week and limiting to only one online platform per week:

- Online brainstorming using either Padlet or Google share
- Online forums either using Moodle or Padlet
- Collaborative educational gamified quizzes and flashcards (e.g., Kahoot, Quizlet and Quizzes).

Instructors were available online to answer questions, provided further directions and guidance. Also, instructors addressed knowledge gaps, shared supplementary resources, monitored students' engagement and progress, and used feedback and feedforward to provide positive reinforcement for successful and unsuccessful completion of the CAL tasks. If so, the purpose of feedback is to support student self-regulated learning (Boud & Molloy, 2013) which is an important component of CAL in particular—and learning in general—are beginning to be equated to learning as a constructivist, self-regulated and collaborative process (Niemi & Nevgi, 2014). In addition, the use of online collaborative tools, including Google Docs and Google Slides was demonstrated by the instructors and supporting material was uploaded in advance to the course Moodle site.

The three CAL strategies presented in this chapter are the strategies that lead to the main assessment tasks in this course and were implemented to facilitate understanding of the lessons by enabling hands-on practice opportunities using real-life scenarios and current related topics. The implementation of these strategies is presented in the following sections of this chapter, together with the specific topics covered, learning outcomes, strategy plan, assessment, and feedback for each of these online CAL strategies.

Collaborative Active Learning Strategies in Psychology

Group Discussion

Group discussions are one CAL strategy that university students are familiar with; therefore, it was the first of three online CAL strategies used. The pre-class learning materials such as recording of the lectures, together with the lecture slides and supporting material, were uploaded onto Moodle at the start of the week throughout the 12 weeks of the semester. According to Hulleman and Harackiewicz (2009), students are motivated to act on the pre-class learning materials if they are required to make concepts from the readings relevant to their lives and also to create questions over the content read (Owens et al., 2020). The lecture material was designed for in-class discussion, which can be challenging in an asynchronous online environment. Thus, Padlet and online forums were embedded on Moodle to enable discussions amongst students. Even though there is no significant difference in students' engagement levels between those using active and passive activities in online courses (Dixson, 2010), still academic self-efficacy and social anxiety may affect students' degree of engagement in an active learning environment (Hood et al., 2021), for example in an online forum. Therefore, to mitigate the challenge of low participation level, heterogeneous grouping is encouraged consisting of different gender, ethnicity and nationality which according Eddy et al. (2015) these three factors may hinder effective group discussion. Additionally, students are persuaded to facilitate the Padlet and online forum discussion as their actions can positively impact participation (Szabo, 2015).

Although the module's topic was Health psychology and assessment, the topic set for the group discussion was *the use of digital health applications,* and the learning outcome was to *identify issues related to the use of digital health mobile applications*.

A Padlet wall was created, and the link and QR code were shared on Moodle and embedded in the learning material. An open-ended question was raised for students to address and discuss using the material provided and their experiences in using health and fitness digital health phone applications. This is because open-ended questions facilitate productive interactions among students, such as debate, argument and elaboration, more effectively than closed questions with one right answer (Van Boxtel et al., 2000).

To complete this online CAL task, students were presented with three short videos on digital health; these were uploaded to the course Moodle. The instructor provided a recorded module describing the content of this video when addressing digital health. The online CAL strategy was introduced in this video, and students were shown how to complete the task. The strategic plan for the asynchronous online group discussion consisted of (1) uploading the three videos to the Moodle site, (2) stating the open-ended question, (3) creating a Padlet wall, (4) and the presentation of the instructions of how to participate in the discussion. Also, students received a statement of the learning outcomes, the purpose and relevance of the group discussion as CAL strategy and the topic for discussion about the course's learning outcomes, in this case, health psychology. In addition, providing assurance of students' anonymity, availability of the instructor to guide, give feedback, and address students' knowledge gaps was paramount. This is because feedback is used to support student self-regulated learning and also for the creation of a curriculum space for communication among peers and with the lecturers on the reactions to the feedback provided (Boud & Molloy, 2013). A sample of the students' entries is provided in Appendix 1.

The instructor posted the first entry on the Padlet, and this served as a modelling step and icebreaker for students who were not yet gamed. The assessment and feedback for this activity centred on understanding how digital health apps are used and the constructive criticism, strength opportunities, and limitation of digital health. The instructor assessed the level of understanding by evaluating how students used the concepts learned in justifying and supporting their position or views on strength opportunities and limitations of digital health application. The instructor provided feedback on the students' entries highlighting the relevant concepts used and asked follow-up questions for the students to reflect on. This action is in accordance with Bouslama et al. (2003) recommendation that lecturers should focus on giving feedback to facilitate learning where students are coached towards reflection, cognitive co-construction in order to improve self-efficacy and performance (Tolsgaard et al., 2016). The students' entries serve as a peer-learning resource. Issues related to using digital health were identified and brought forward to be further discussed in terms of ethical, privacy and accessibility issues during the synchronous online tutorial, leading up to another lesson's learning outcome, which was to *outline the ethical problems related to assessments in health psychology.*

Although students participated by sharing their perspectives and experiences in using health and fitness digital health phone applications, they did not cooperate or interact with the other students. In this regard, the possible reasons could be the cognitive development and metacognition of students as well as the students' previous negative experiences with CAL and environmental factors like social class and cultural identity

(Stover & Holland, 2018). Therefore, the instructor's follow-up questions and feedback served as scaffolding as it led to students building upon what their peers had shared on the Padlet Wall during the online tutorials. The overall feedback after the online CAL tasks included the instructors' observation of the lack of peer feedback during the activity and how commenting and engaging in a virtual discussion enriched their learning and understanding of the topic. This observation is expected if the rapport among the students is weak and also, they are very accommodating and agreeable to their peers' contributions without much debates and questions. Indeed, this problem usually occurs when students try to avoid conflicts in order to attain a cordial learning environment and when they feel they are not in a position to challenge their peers' views (Chang-Tik & Goh, 2020). According to Van den Bossche et al. (2011), students have to address differences in opinions and to thoroughly consider each other's views and comments (constructive conflict) so that they are truly engaged in reaching a shared cognition. Otherwise, team learning is not taking place (Van Knippenberg et al., 2004). For subsequent activities, instructors incorporated directions and examples of expected actions in completing the online CAL tasks to achieve the learning outcomes included in subsequent instructional plans for other online CAL strategies implemented in the course.

Problem-Based Case Studies

Case studies and problem-based learning are CAL often used in psychology and health sciences. These strategies provide students opportunities to apply and reinforce what they have learned and make it possible to assess students in terms of students' communication, individual contributions, constructive feedback, and management of both collaborative and individual tasks (Tee, Chapter 4 this volume). Nonetheless, implementing them in a synchronous online class requires careful planning.

The topic for this CAL was behaviour change. The learning outcomes were first to identify the different approaches to behaviour change in a series of scenarios, followed by the instructor's explanation of the similarities and differences in terms of the strength and limitations of the approaches. Then students were allocated to small groups to complete two tasks. The first was to design a behaviour change intervention, and the second was to evaluate their peer's health-related behaviour change interventions. Thus, the online CAL strategy consisted of a problem-based case study to be addressed in small groups of four to five students, a 5-min presentation of the proposed intervention plan and a question-and-answer session (peer feedback). In a previous class, students were introduced to ways to use Appreciative Inquiry (AI) and constructive feedback in leveraging health behaviour change. Appreciative Inquiry (AI) is a methodology used often in organisational development in which instructors exhibit constructive feedback, inclusion, and empathy (Trinh et al., 2021). It is useful as a tool to foster change thoughts and enable individuals to reframe their perspectives or approach in problem-solving; therefore, it was included as one of the tools to be used by students in their health behaviour change projects. Specifically, AI is built on the theoretical foundation of experiential learning for creative problem solving involving large groups of people (Trinh et al., 2021). This practice is founded on two principles: social constructivism—knowledge is socially constructed and positivity—energy generated by positive feeling (Cooperrider et al., 2008). Thus, the online CAL indirectly allowed students to put into action the skills they learned in a previous lesson. Students were able to use AI when referring to their case and provide feedback to their peers who use a different approach to address the problem-based case study. By applying what they had learned about AI, students addressed the problem-based case study by focusing on strength and opportunities in an appreciative manner, and evoking students to be empathic and sensitive to the feelings and experiences of others (Discovery Phase of AI; Cooperrider et al., 2008) rather than on what the problem was; centring on generating changes in behaviour rather than solving a problem. This corresponds with the Dream Phase of AI where students view the cases from different perspectives and think appreciatively about successful past cases to be considered as norms. And when providing peer feedback, students shifted from focusing on reacting to and correcting their peers (corrective feedback) to highlighting the strength or benefits of using a different behaviour change approach (constructive feedback). This required students to intentionally appreciate the content of their peers' work rather than reacting to it. In other words, through peer feedback and interactions, students help to operationalise the ideas generated in the Dream Phase to achieve the outcomes of the behaviour change approach (Design and Destiny Phases of AI; Cooperrider et al., 2008). To this end, for feedback to be constructive, it should provide explanations and clarifications (epistemic feedback) and to include advice on how to proceed on improvement of an idea (suggestive feedback; Alvarez et al., 2011). In addition, for students to act on the feedback they must have the literacy to understand and manage feedback effectively, to make productive use of it, and to appreciate their role in the feedback literacy processes (Carless & Boud, 2018).

The learning outcome for this CAL was to design a behaviour change intervention for obtaining and maintaining a healthy weight; the strategy plan consisted of a real-life scenario with guiding questions and worksheets, peer feedback, a summary of key learning points and feedforward in line with the course learning outcomes. The strategy plan consisted of presenting the scenario, instructions, and expectations during the online class. The students were given the following problem-based case studies:

> *A 35-year-old graphic designer has tried various kinds of diets and weight loss programs. Although they managed to lose weight with some of these diets, they have not been able to maintain a healthy weight.*

And some of the guiding questions accompanying the case were.

> *(a) What needs to change? (b) What is the relevant behaviour change you propose to focus on? (c) What is the goal and what is the desired outcome? (d) How to help the client/patient to move from intention to action? (e) What could be used to guide your client in terms of nutrition and/or physical activity?*

The students were allocated into smaller groups of four to five, using Zoom Breakout Rooms. The description of the scenario worksheets and supportive material and links were provided on Google Share. Each group had a maximum of 20 min to discuss the case, design their intervention plan and prepare a 5-min presentation. To complete this online CAL, students used Google Docs and Google Slides to craft their intervention plan and presentation. Within their small groups, students used Google Docs to design their intervention and present individual collaboration, engage peer-learning, and provide constructive feedback. Each group was given a Google Doc with the problem-based case studies and guiding questions to collaboratively create their case, draft their plan and outline their presentation. Instructors monitored the engagement and performance and facilitated the peer feedback and feedforward (future-oriented ideas) in terms of evaluating their patients' (case) progress and changes in the short and long term. Feedback was given using reflective questions that enabled students to think critically about their case and plan of action. The scaffolding approach provided them with (1) opportunities to think about their relevance to their plan of action, (2) checking points to ensure their plan of action was aligned with their choice of behaviour change approach and (3) guide for their feedback to their peers using positive inquiry and probing questions. When all the small groups were ready, they presented their case and plan of action and received feedback in the form of questions from their peers. In other words, the instructor has repositioned feedback as feedback for learning where students obtain feedback from multiple sources and they collectively co-constructed meanings through dialogue among peers and with the instructor which eventually developed overtime into shared consensus (Boud & Molloy, 2013).

The instructor took note of the question asked and the strengths and common limitations of each presented plan of action and addressed them during the feedback section. This online CAL strategy constituted the building block for the main assessment task in this course, which consisted of the design, implementation and evaluation of a health behaviour change strategy. Therefore, the instructor's feedback was presented in terms of how the strengths and limitations of each of the plans of actions presented to address the problem-solving based case scenario could be incorporated in their behaviour change report. In addition, the peer feedback and the instructor's general feedback constituted the basis for the feedforward section, in terms of how to use behaviour change approach to evaluate the progress of their patients or clients (case) progress and changes at short- and long-term as well as to guide the design, implementation and evaluation of their own individual health behaviour change strategy.

Furthermore, the students' work that met learning outcomes effectively using the individual contributions and peer-learning were showcased in Moodle as part of the revision material for the final exam, and it was implemented in two online classes of 33 to 35 students. Through this strategy, students were able to learn the differences between goals and outcomes in health promotion interventions; peer feedback within the small groups was helpful in helping to identify what to focus on when designing behaviour change interventions. The use of exemplars enables students to acquire tacit understandings and according to Carless and Chan (2017) it is important to develop dialogues about exemplars so that students can learn the complexity of judging quality (Sadler, 1989). It is crucial to highlight to the students those exemplars are not model answers but samples and they should not imitate them.

The online CAL strategy took place after mid-semester; students had already completed several online small group discussion and took part in a couple more Padlet discussions. Therefore, students had actively built up their collaborative working skills while working toward a common goal, whether that goal was to identify strengths and limitations of digital health mobile applications or to create an action plan for behaviour change. Collaborative working skills include open communication, active listening, emotional intelligence, and respect for the diversity of opinion or methods to address a problem-based case study. In order to have diversity of opinions it is essential to have an open and accepting group climate to render minority dissent effective in generating cognitive complexity (Curseu et al., 2017) and divergent thoughts for better information processing (Nemeth, 2012). And the acquisition of these skills was supported by the student's progress and understanding of the expectations for their participation and performance prior to the completion of the problem-based case study. Nonetheless, instructors still led the summary of learning points and feedback sessions, as students were not comfortable contributing, commenting, or building on other groups' work and presentations. The instructors modelled AI to help students relate the situations from their positive experiences and the use of constructive feedback invited students to add their thoughts and one interesting thing they noticed or learned from their peers' presentation. This approach proved to be effective as instructors' intervention served both as an icebreaker and boost of confidence for the participating students. In this regard, the instructors tried to personalise the feedback provided, which according to Zheng et al. (2022), may significantly improve the students' collaborative knowledge-building level and promote group awareness and therefore, support cognitive development and knowledge gains of group members (Yilmaz & Yilmaz, 2020).

Leading up to this online CAL strategy, previous online lessons focused on demonstrating and practising, using Google Docs and Google Slides to complete group tasks online, the use of Appreciative Inquiry and constructive feedback as part of health behaviour change interventions. In addition, the material needed to complete this task was uploaded in advance to the course Moodle site and students were directed to it. Therefore, students had available resources to prepare for and complete the online CAL tasks.

Jigsaw

Using the jigsaw pedagogy as an online CAL activity for large groups has its challenges, as there is room for confusion, for example, carrying out the assignment requirements; a scenario that would not be present in a physical class setup. Despite this shortcoming, it is an effective way to increase student engagement as the group work facilitates peer-to-peer synthesis, analysis, and reflection of course material. According to McLoughlin and Lee (2008) Pedagogy 2.0 integrates Web 2.0 tools that support peer-to-peer networking, knowledge sharing and socio-constructivist learning approaches which are required in an online CAL activity such as jigsaw.

The approach consists of first dividing the lesson into segments; these are the pieces for the puzzle. Second, students are allocated into groups (jigsaw group), assigning a part of the lesson (a piece of the puzzle) to each jigsaw group. Third, each jigsaw group prepares their allocated segment of the lesson. Students will gather information and complete their respective reading material, brainstorm, prepare and rehearse what they will share with others. Fourth, students are then regrouped with others who have prepared different segments; these are the expert groups. In these expert groups, each student will present their part of the lesson and take-home points; discuss their segment and take notes on what others in the groups present and what has been discussed. Lastly, students return to their original jigsaw group and share what each of them has learned in the expert group and put together the puzzle pieces to see the overall target material.

The topic provided to students for this CAL activity was health inequality and chronic illness management. The learning outcomes were to (1) discuss the barriers in managing chronic illnesses, (2) outline how health inequality might impact the prevention, management and/or treatment of the assigned chronic illness and (3) illustrate how a health psychologist could help manage the assigned chronic illness.

In line with the work of Tewksbury (1995), each group was assigned chronic conditions (e.g., cardiovascular disease, high blood pressure, diabetes, cancer), these were the jigsaw groups, and their task was to investigate and identify the risk and pro-health behaviour, and related social issues in managing the chronic condition. Each jigsaw group had access to the relevant material (videos and articles) and used Google Docs to make notes and prepare their topic. After completing their tasks, students joined a different group (the expert group). In the expert group, (1) each student presented their topic, (2) combined and evaluated the information obtained, (3) discussed and summarised the information, assembling the puzzle that revealed the potential role of health psychologists in addressing health inequalities in managing chronic illnesses. Instead of being insular and detached from what other groups were doing, students needed to engage as cooperative learning groups. This enabled them to assemble and complete the puzzle, thereby revealing how health psychologists contribute to managing chronic illness and addressing health inequalities.

Furthermore, using jigsaw as a CAL activity enabled efficiency in managing time and resources to foster peer teaching and learning across the participating groups. Of note, in peer teaching and learning, students must negotiate meanings and be empowered to "talkback" in order to reconstruct understanding in their own terms (Green, 2019). The feedback provided by the instructor consisted of a summary of the key learning points related to the topic and how these linked back to what they learned during the first week about the three main objectives of health psychology.

It is important to note that prior to this online CAL task, students received a refresher lesson on how to use online collaborative tools to complete this task. Also, they were directed to the available resources for this CAL task. By providing students with guidance and resources, the potential struggle in consolidating or putting together the shared information from different groups were reduced.

Furthermore, the jigsaw was the last CAL task used in the course. Thus, their engagement and completion of the previous CAL tasks served as a scaffolding as it provided students the opportunity to learn, and practice using online collaborative learning tools and move from simple tasks to this more challenging CAL task. Therefore, beside consolidating key learning points and fostering peer teaching and learning, the jigsaw activity also served as self-assessment of CAL skills they acquired throughout the semester, and as a hands-on induction to behind the scenes in the work of Health Psychologists.

Conclusion

This chapter presented the three main online CAL strategies used and outlined the importance of scaffolding in facilitating students' familiarity to engage and complete the course content using CAL. The three CAL strategies were applied to foster peer online learning in tandem with other strategies such as a flipped classroom. For example, in the group discussion, students interacted with the online activities on the Padlet Wall. As for the problem-based case studies, students completed the online task using Google Docs, and Google Slides aided by the Appreciative Inquiry (AI) methodology. Finally, jigsaw helped link back what they learned through peer teaching and learning across participating groups.

Scaffolding and clear instructional plans facilitated better students' understanding and online engagement using CAL activities. Before each CAL session, students were presented with the outline, direction, and activity alignment to the learning outcomes. At the end of each CAL activity, instructors facilitated a debriefing session that allowed students to ask questions, encourage them to reflect on and address their contributions to the activity and how they could implement what they have learned in their final assessment task.

Despite the positive outcomes of the CAL strategies, some students' resistance and unwillingness to participate and the lack of understanding and support from the department. To illustrate, students were unprepared for the class, and they did not take ownership and responsibility for their learning. Therefore, to overcome these issues, there is a need to look at the cognitive and social dimensions of CAL. First, to ensure that students can respond fully and effectively to the pre-class learning activities. Some students are not used to self-learning, and they need extra assistance and guidance from the instructors and peers (cognitive dimension; Chang-Tik & Goh, 2020). For example, using online flashcards, reflective questions and gamified quizzes to leverage students' engagement with the pre-class learning materials and activities. Second, explaining to the students' emotions and their regulation is essential for successful learning (social dimension; Boekaerts, 2011). They should not avoid conflicts to maintain a friendly learning environment. This can be achieved through modelling constructive feedback and guiding students in how to frame and communicate their emotions and feedback using the Discovery Phase of AI.

In addition, a generous learning space (HLS) for students to feel it is psychologically safe to be curious and inquire without the risk of being judged (Kolb & Kolb, 2017). HLS include institutional and physical learning which need to be managed in advance. Often the available physical learning space is conducive for CAL; however, not so much the institutional learning space. This includes elements that influence learning from the institutional perspective (e.g. institutional policies, goals, and traditions). Thus, in line with the work of Dean and Wright (2017) and Patton (2010) instructors in collaboration with their department should play an active role in creating hospitable institutional learning space to successfully implement CAL.

Appendix 1

Digital Health

After watching the videos on mobile and digital health, use this space to share your perspective, opinions or experiences in using health & fitness app/tracker and/or on digital health.

Anonymous Mar 18, 2021 04:31 p.m.

My experience with digital health has been a mix between mobile health applications as well as devices such as fitness watches. Fitness accessories complemented by a fitness application are able to collect information from the devices and come up with recommendations for healthy habits. I have previously used a fitness watch that recorded sleep, which could be analysed and displayed on the app with information about sleep patterns and habits. I found it particularly useful as they gave advice on sleep health and ways to improve sleeping patterns, it also made me aware of the importance of having more consistent sleep for better health outcomes. Personally, I felt like it was not suitable for me towards final exams season as I tended to stay up late, hence the app was nagging me to go to sleep earlier. While I found it troublesome, I couldn't deny its usefulness in motivating me to xx my sleep schedule, as they display sleep scores to assess the quality of sleep. I found it particularly motivating when seeing a higher number every day after I wake up. I believe that sleep health is often neglected by many, especially university students, due to our assignments and commitments outside of university, winding down and staying up for some alone time has been a habit developed for me personally. However, it took tracking my sleep to make me realise that my sleep habits were far from healthy and motivated me to make a change.

Anonymous Mar 17, 2021 10:56 p.m.

I personally think that health and fitness apps/trackers can act as excellent motivators, especially for those of us who want to include more exercise into our daily lives but are unable to get started or maintain a regular schedule. Fitness apps like the ones made by Nike have various different guided runs, motivational stories about athletes, and even give you achievements for personal records like your farthest run. In addition to this, the app also checks up on you if you have not worked out in a while—something that might act as an additional motivator to pick yourself up and start exercising again. Other than fitness apps like this, I also use a period tracker to make sure that my periods remain regular. I am generally not very attentive about when I get my periods and when I don't, so having an app tracking it for me is necessary to maintain awareness of my fertility health. From the perspective of the healthcare system, I think the introduction of digital healthcare has been one of the most beneficial technological advances in recent years. Before watching the videos on mHealth, I was wondering how accessible this could be; but seeing how even older phones can be used for mHealth services, I do think it would really help national agencies keep track of the overall health of their citizens. Given the aging populations worldwide, we need to be accommodating to make sure that it is not just the physical aging process that is increasing—we also need to ensure a good quality of life for the elderly population. In order to do so, we need to know about the common health problems they face and how to counter them. mHealth services are a great way to monitor this in an efficient manner.

Anonymous Mar 14, 2021 02:49 a.m.

Personally, my experience with mHealth includes apps to track my menstrual cycle and meditation apps. I find the period trackers extremely helpful because I can plan in advance for period, and be prepared for it. In addition, meditation apps have really helped me get more into meditating on a consistent basis. On a broader level, I definitely do agree that mHealth can be an advantageous asset to the field of healthcare, especially for those who do not have access to hospitals, clinics etc. Being able to connect with healthcare professionals from the comfort of your home can save time and money and be helpful in informing you of your next steps. Conversely, I do understand the concerns on data privacy, so this does make the conversation rather nuanced. However, overall, I think mHealth can be a great gamechanger for the future of healthcare if used wisely.

Anonymous Mar 11, 2021 10:56 p.m.

In my opinion, health & fitness apps/trackers are helpful if it were to be used mindfully, that is, with the right mindset. On one hand, health & fitness apps/trackers can inform people about their stress levels or sleeping patterns by measuring their heart rates, thus, they are able to make better decisions. Also, those apps can promote motivation for people to move more. On the other hand, it is important to note that the numbers shown may not 100% accurate particularly in terms of energy expenditure. Nevertheless, I would suggest to keep an open mind, find one that you enjoy and have fun with it.

Anonymous Mar 11, 2021 12:43 a.m.

I find the period tracker useful because it helps me to observed patterns in my behaviour and changes in my sexual and fertility health. I don't worry about data sharing. Nowadays there are alternative to keep sensitive information protected and confidential. However, if I were to use digital health systems or apps with clients or patients, I'd make sure they have options and are able to and make an informed decision about whether or not to adopt digital health tools to manage their health behaviour and habits.

References

Alvarez, I., Espasa, A., & Guasch, T. (2011). The value of feedback in improving collaborative writing assignments in an online learning environment. *Studies in Higher Education, 37*(4), 387–400. https://doi.org/10.1080/03075079.2010.510182

Applebee, A. N., & Langer, J. (1983). Instructional scaffolding: Reading and writing as natural language activities. *Language Arts, 60*(2), 168–175. Retrieved from https://www.jstor.org/stable/41961447?seq=1#metadata_info_tab_contents

Arvaja, M., Salovaara, H., Hakkinen, P., & Jarvela, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning and Instruction, 17*(4), 448–459. https://doi.org/10.1016/j.learninstruc.2007.04.003

Benson, B. K. (1997). Scaffolding (Coming to Terms). *English Journal, 86*(7), 126–127.

Boekaerts, M. (2011). Emotions, emotion regulation, and self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 408–425). Routledge.

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education, 38*(6), 698–712. https://doi.org/10.1080/02602938.2012.691462

Bouslama, F., Lansari, A., Al-Rawi, A., & Abonamah, A. A. (2003). A novel outcome-based educational model and its effect on student learning, curriculum development, and assessment. *Journal of Information Technology Education, 2*(1), 203–214. https://doi.org/10.28945/323

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & Evaluation in Higher Education, 43*(8), 1315–1325. https://doi.org/10.1080/02602938.2018.1463354

Carless, D., & Chan, K. K. H. (2017). Managing dialogic use of exemplars. *Assessment & Evaluation in Higher Education, 42*(6), 930–941. https://doi.org/10.1080/02602938.2016.1211246

Carless, D., Salter, D., Yang, M., & Lam, J. (2011). Developing sustainable feedback practices. *Studies in Higher Education, 36*(4), 395–407. https://doi.org/10.1080/03075071003642449

Carvalho, A. R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*, Article 100070. https://doi.org/10.1016/j.caeo.2021.100070

Chang-Tik, C., & Goh, J. N. (2020). Social and cognitive dimensions of collaboration in informal learning spaces (CLIS): Malaysian social science students' perspectives. *Interactive Learning Environments*. Advance online publication. https://doi.org/10.1080/10494820.2020.1799029

Chiang, C., Wells, P. K., & Xu, G. (2021). How does experiential learning encourage active learning in auditing education? *Journal of Accounting Education, 54*(2021), (online). https://doi.org/10.1016/j.jaccedu.2020.100713

Cooperrider, D., Whitney, D. D., & Stavros, J. (2008). *The appreciative inquiry handbook: For leaders of change*. Berrett-Koehler.

Curseu, P. L., Schruijer, S. G. L., & Fodor, O. C. (2017). Minority dissent and social acceptance in collaborative learning groups. *Frontiers in Psychology, 8*(458), 1–9. https://doi.org/10.3389/fpsyg.2017.00458

Dean, K. L., & Wright, S. (2017). Embedding engaged learning in high enrollment lecture-based classes. *Higher Education, 74*(4), 651–668. https://doi.org/10.1007/s10734-016-0070-4

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The evolution of research on computer-supported collaborative learning: From design to orchestration. In N. Balacheff, S. Ludvigsen, T. de Jong, T. A. Lazonder, & S. Barnes (Eds.), *Technology enhanced learning: Principles and products* (pp. 3–19). Springer.

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning, 10*(2), 1–13. https://files.eric.ed.gov/fulltext/EJ890707.pdf

Eddy, S. L., Brownell, S. E., Thummaphan, P., Lan, M.-C., Wenderoth, M. P. (2015). Caution, student experience may vary: Social identities impact a student's experience in peer discussions. *CBE Life Sciences Education, 14*(4), ar45. https://doi.org/10.1187/cbe.15-05-0108

Erkens, M., & Bodemer, D. (2019). Improving collaborative learning: Guiding knowledge exchange through the provision of information about learning partners and learning contents. *Computers & Education, 128*, 452–472. https://doi.org/10.1016/j.compedu.2018.10.009

Gayton, J., & McEwen, B. C. (2007). Effective online instructional and assessment strategies. *The American Journal of Distance Education, 21*(3), 117–132. https://doi.org/10.1080/08923640701341653

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, *7*(1), 22–30. https://doi.org/10.21061/jte.v7i1.a.2

Green, S. (2019). What students don't make of feedback in higher education: An illustrative study. *Journal of English for Academic Purposes, 38*(2019), 83–94. https://doi.org/10.1016/j.jeap.2019.01.010

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., Gerrits, R., Lawford, H. Ott, B., Ross, K., Paige, O., Stowe, S., Jensen, M., & Hull, K. (2021). "I like and prefer to work alone": Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), ar12. https://doi.org/10.1187/cbe.19-12-0271

Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science, 326*(5958), 1410–1412. https://doi.org/10.1126/science.1177067

Johnson, D. W., & Johnson, R. T. (2009). An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning. *Journal of Educational Researcher, 38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Kolb, A. Y., & Kolb, D. A. (2017). *The experiential educator: Principles and practices of experiential learning*. Experience Based Learning systems.

Lange, V. L. (2002). *Instructional scaffolding*. https://bit.ly/3I19EwJ

Larkin, M. J. (2002). *Using scaffolded instruction to optimize learning*. VA: ERIC Clearinghouse on Disabilities and Gifted Education.

Lewis, C. C., & Abdul-Hamid, H. (2006). Implementing effective online teaching practices: Voices of exemplary faculty. *Innovative Higher Education, 31*(2), 83–98. https://doi.org/10.1007/s10755-006-9010-z

McLoughlin, C., & Lee, M. J. W. (2008). Future learning landscapes: Transforming pedagogy through social software. *Innovate: Journal of Online Education, 4*(5), art. 1. http://www.innovate.info/index.php?view=article&id=539

Mercer, N. (1996). The quality of talk in children's collaborative activity in classroom. *Learning and Instruction, 6*(4), 359–377. https://doi.org/10.1016/S0959-4752(96)00021-7

Nemeth, C. J. (2012). Minority influence theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology*, (Vol. 2, pp. 362–378). Sage. https://doi.org/10.4135/9781446249222.n44

Niemi, H., & Nevgi, A. (2014). Research studies and active learning promoting professional competences in Finnish teacher education. *Teaching and Teacher Education, 43*, 131–142. https://doi.org/10.1016/j.tate.2014.07.006

Ortiz-Rodríguez, M., Telg, R. W., Irani, T., Roberts, T. G., & Rhoades, E. (2005). College students' perceptions of quality in distance education: The importance of communication. *Quarterly Review of Distance Education, 6*(2), 97–105.

Owens, D. C., Sadler, T. D., & Barlow, A. T. (2020). Student motivation from and resistance to active learning rooted in essential science practices. *Research in Science Education, 50*, 253–277. https://doi.org/10.1007/s11165-017-9688-1

Patton, M. Q. (2010). *Developmental evaluation: Applying complexity concepts to enhance innovation and use*. Guilford Press.

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*(2), 119–144. https://doi.org/10.1007/BF00117714

Slavin, R. E. (1980). Cooperative learning. *Review of Educational Research, 50*(2), 315–342. https://doi.org/10.3102/00346543050002315

Smith, B. L., & MacGregor, J. T. (1992). What is collaborative learning? In A. Goodsell, M. Maher, V. Tinto, B. L. Smith, & J. T. MacGregor (Eds.), *Collaborative learning: A sourcebook for higher education* (pp. 10–30). National Center on Postsecondary Teaching, Learning, and Assessment Publishing.

Song, L., & Singleton, E. S. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *Internet & Higher Education, 7*(1), 59–70. https://doi.org/10.1016/j.iheduc.2003.11.003

Stover, S., & Holland, C. (2018). Student resistance to collaborative learning. *International Journal for the Scholarship of Teaching and Learning, 12*(2), Article 8. https://doi.org/10.20429/ijsotl.2018.120208

Sullivan, L. E. (2009). *Scaffolding. In the SAGE glossary of the social and behavioral sciences* (Vol. 3, p. 460). SAGE Publications Ltd.

Szabo, Z. (2015). Better together: Teams and discourse in asynchronous online discussion forums. *Journal of Psychological and Educational Research, 23*(1), 73–88.

Tewksbury, B. J. (1995). Specific strategies for using the "jigsaw" technique for working in groups in non-lecture-based courses. *Journal of Geological Education, 43*(4), 322–326. https://doi.org/10.5408/0022-1368-43.4.322

Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education* (Open access). https://doi.org/10.1186/s40594-018-0102-y

Tolsgaard, M. G., Kulasegaram, K. M., & Ringsted, C. V. (2016). Collaborative learning of clinical skills in health professions education: The why, how, when and for whom. *Medical Education, 50*(1), 69–78. https://doi.org/10.1111/medu.12814

Trinh, M. P., van Esch, C., Martinez, H. A., & Messer, T. (2021). Appreciating large classes: Using appreciative inquiry to foster a hospitable learning space for experiential learning. *Journal of Management Education, 45*(5), 786–819. https://doi.org/10.1177/1052562920980125

Van Boxtel, C., Van der Linden, J., & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction, 10*(4), 311–330. https://doi.org/10.1016/S0959-4752(00)00002-5

Van den Bossche, P., Gijselaers, W., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science, 39*(3), 283–301. https://doi.org/10.1007/s11251-010-9128-3

Van Knippenberg, D., De Dreu, C. K. W., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology, 89*(6), 1008–1022. https://doi.org/10.1037/0021-9010.89.6.1008

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Webb, N. M. (1980). An analysis of group interaction and mathematical errors in heterogeneous ability groups. *British Journal of Educational Psychology, 50*(3), 266–276. https://doi.org/10.1111/j.2044-8279.1980.tb00810.x

Yilmaz, R., & Yilmaz, F. G. K. (2020). Examination of the effectiveness of the task and group awareness support system used for computer-supported collaborative learning. *Educational Technology Research and Development, 68*(3), 1355–1380. https://doi.org/10.1007/s11423-020-09741-0

Zhao, R., & Orey, M. (1999). *The scaffolding process: Concepts, features, and empirical studies*. Unpublished manuscript, University of Georgia Press.

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education*, *47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

CHAPTER 10

Implementing a Successful Collaborative Active Learning Approach in Information Technology Discipline

Anuja Dharmaratne, Ting Fung Fung, and Golnoush Abaei

Introduction

Collaborative Active Learning (CAL) simply means stepping away from lecturing alone, and facilitating the sharing of knowledge and effectively solving much harder problems in teams. When CAL is effectively practiced, the classrooms turn into friendly, positive and welcoming shared learning spaces (Stover and Holland, 2018). The learner-centred and technology supported environment motivates learners to freely share their

A. Dharmaratne (✉) · T. Fung Fung · G. Abaei
School of IT, Monash University Malaysia, Subang Jaya, Malaysia
e-mail: anuja@monash.edu

T. Fung Fung
e-mail: ting.fung@monash.edu

G. Abaei
e-mail: golnoush.abaei@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_10

thinking and interact with others. Collaborative learning is based on the social constructivist learning theory where students work together to achieve common goals through interaction and collaboration (Krange & Ludvigsen, 2008). According to Arvaja et al. (2007) collaboration is defined as a shared knowledge construction where students jointly build on others' ideas and thoughts (Mercer, 2010) and not just accumulate them. In order to construct knowledge collaboratively, students have to activate their prior knowledge both at the individual and group levels because improved prior knowledge activation leads to improved knowledge integration (Erkens & Bodemer, 2019).

Compared to conventional teacher-centred learning style, CAL can address a number of learning needs. When CAL is practiced in a classroom, the teacher speaks less, and provides opportunities for students to discuss. Hence, when the scheduled work is distributed among the team members, even the most inactive students in the class can also participate in the activities (Le et al., 2017). When the teacher hands over the responsibilities of solving a problem to groups of students, the active students generally take the lead. Similarly, the inactive students will also share their ideas with their peers since they feel more comfortable in smaller groups. The inactive students may not be willing to talk that much in large groups due to low level of confidence and socialisation issues. According to Hood et al. (2021) academic self-efficacy and social anxiety together can influence students' perceptions of active learning and the degree of their engagement in the activities. Nevertheless, working in small groups helps students make gains in academic achievement, motivation and self-efficacy (Bandura, 2000; Hernandez et al., 2013). In line with the Social Interdependence Theory (Johnson & Johnson, 2013) in order to maximise the collaborative potential of groups, students have to acquire interpersonal and small group skills.

Less conducive learning spaces such as large lecture halls with fixed seating arrangements have also resulted in suboptimal results and often frustration among instructors and students alike (Talbert & Mor-Avi, 2019). Therefore, according to Kolb and Kolb (2005, 2017) conducive learning spaces have to be hospitable, that is, environments which are psychologically safe for lecturers to challenge and support students in their learning. In addition, for students to feel safe to explore new ideas without having to worry of being judged (Kolb & Kolb, 2017). There are five dimensions in the hospitable learning spaces, they are: institutional, physical, cultural, social, and psychological (Kolb & Kolb, 2017). Scager et al. (2017) found that student autonomy and self-regulatory behaviour, combined with a challenging, open, and complex group task that required the students to create something new and original contributed to effective collaboration.

In this chapter, we are presenting the Collaborative Active Learning (CAL) experiences for undergraduate and postgraduate students from a variety of nationalities, cultures and geographical locations. The subject we have chosen falls under Information Technology discipline. During these CAL sessions, students are required to participate and collaborate as teams. The tutor monitors each group's activities and intervenes when support is requested. The venues utilised are equipped with peripherals that support the tutor and the students to interact seamlessly and the flexible furniture in the venues also supports the group-based activities. Case studies were also utilized so that students can learn from real-life examples (Escartín et al., 2015). A frequent question students always raise is why they need to learn certain concepts and when they will use their knowledge on such concepts in practice, and case studies offer a way to create that sense of relevance. To this end, learning activities that students perceive as relevant to their daily assignments, meaningful and valuable are the ones they consider as significant to their learning and they are willing to take up the challenges of these activities to their thoughts and emotions (Pellegrino & Hilton, 2013). During the case-based learning process, assessment of student learning is focused on cognitive conflicts and reflections. Both successful and failed cases on selected topics have been presented to the students and they construct their opinion with references on those cases. Students are encouraged to share their opinions and contest other's opinions objectively. They experience cognitive conflicts and reflect on their common knowledge on the topics which lead them to assimilate new materials into pre-existing conceptions. It is through the reflection, assimilation and elaboration of different viewpoints, made possible by the cognitive conflicts that facilitates learning (Van den Bossche et al., 2006). Nevertheless, studies have shown that socio-cognitive conflicts encourage confidence (De Dreu & Weingart, 2003) and enhance group cohesion and group members' commitment (Jehn & Mannix, 2001). In our CAL sessions, these case studies have been successful in stimulating attentiveness and engagement among the groups and supported comprehending and synthesising solutions based on the real-world context.

Further, we tried to show students how to effectively learn, apply and continuously improve their critical and reflective thinking skills to solve case-based problems. The assessments were designed in such a way that allow students to demonstrate the learning outcomes and learn more through the assignment work and group collaboration. In order to achieve the stated objectives, the assessment followed the principles of making learning explicit, promoting learning autonomy and focusing on learning rather than performance (James et al., 2007). The principles are in line with assessment for learning process that helps students set clear goals, identify gaps and strategies to close the gaps (Hattie & Timperley, 2007). Resources for knowledge and skills development were provided to the students in such a way that it helped them to explore themselves and to achieve the learning outcomes by visual summaries, readings and guidelines and communicating interactively with others during the interactive sessions. Students were also provided with some pre-reading and pre-recorded learning materials that they need to go through before participating in the class activities, so that they would be able to participate in the live discussions effectively.

Another strategy used in our classes is problem-based learning (PBL), (Tee, Chapter 4 this volume). It encourages students to develop their problem-solving abilities, critical thinking skills and communication skills while providing them opportunities for working in groups, finding and evaluating research materials, and life-long learning (Duch et al., 2001). We used real-world problems over the entire semester as the assessment specification and we encouraged students to work in teams, exchange ideas and explore the applicability of the learned concepts instead of just listening to the lecturer. The students were trained to think deeper into the concepts learned and pitch their ideas individually and afterwards they analysed all the ideas and reasoned on the best one and defended it. Specifically, according to Dixson (2010) activities where students have to apply concepts to problem solving as in PBL and those that motivate them to interact with the content are considered engaging by the students. In the context of collaborative learning, engagement is crucial in shared knowledge construction that involves both the individual and social processes (Lazonder et al., 2003). The group themselves divided the work among the group members according to the level of complexity and prepared a plan for each member to involve in and work together to solve it. This work was in the form of a multistage project, where the problem was open-ended so that the students worked independently pitching various approaches to solve the problem by conceptualizing, designing, and presenting their innovative ideas to the teaching team.

The PBL activity we developed was based on the guidelines suggested by Duch et al. (2001):

- An effective problem must first create an interest among the students and motivate them to look for deeper understanding of the concepts required to solve the problem. The students must feel that they have a stake in solving the problem.
- The problem should make the students search for facts, evidence and theoretical foundations behind their reasoning on why they made certain decisions and they should be able to defend them.
- The problem should be complex enough for a group of students to work together and come to a solution where each student contributes evenly. In problem-based learning, the students should synthesize a solution based on the knowledge they gained in the class and the idea of a working solution where everybody contributes is the key objective.
- The initial problem should be open-ended and all the students should be able to project some ideas based on their prior knowledge. The environment should be comfortable for all the students to engage in discussions as a group. The formation of the group at this level is crucial as we expect them to collaborate effectively targeting a proper and acceptable solution for the given problem in the end.
- The content covered in the problem should align with the learning outcomes of the course. It should cover the students' prior learning as well as connect with the content covered in other courses.

The relaxed and enjoyable nature of these learning approaches motivates students to learn while engaging with tasks designed for learning, regardless of their cultural or socioeconomic background. Unlike traditional lecture halls, CAL spaces are designed to promote active learning, which increases student engagement (Romaniuk, 2021). Besides the physical space mentioned, other spaces like institutional, cultural, social and psychological are equally important to create and maintain the hospitable learning space for teaching and learning (Kolb & Kolb, 2005, 2017).

Preparation

We have chosen flipped classrooms as our main strategy of delivering an effective curriculum to the students. To strengthen the flipped classroom approach, we have incorporated pre- and in-class activities, cases and problems which are discussed in the later parts of the chapter. There are three main reasons for choosing the flipped classroom method instead of a traditional teaching method:

1. Engage students to take ownership of their learning
2. Build and test one's understanding in a supportive environment.
3. Develop critical thinking, communication and reflection skills.

In addition to the three reasons mentioned, according to Moffett and Mill (2014), students prefer flipped classrooms due to out-of-class instruction that comes with a large amount of flexibility. In this regard, Heijstra and Sigurðardóttir (2018) argue that there is flexibility in the learning time and pace, thus giving students more control over the learning process.

Figure 10.1 shows the workflow of the two main teaching styles, namely (a) traditional and (b) flipped classrooms. As in Fig. 10.1(a), according to the traditional teaching style, students first attend lectures and based on the lecture presentation (which is usually a one-way communication channel), they go through the learning material that could be sometimes difficult to understand. Later, based on the homework and final examination, they are assessed to see whether they have learned the contents or not. This approach neither actively engages students nor provides them with an opportunity to use their intellectual abilities for learning. However, as shown in Fig. 10.1(b), in flipped classroom approach, students should participate in several different learning activities each week such as self-paced reading of the textbook, watching a pre-recorded video prior to the weekly workshop, responding to case-based activities and completing the online quizzes. These readings, videos, case-based activities and related quizzes are the first stepping stone of the flipped classroom approach we practiced.

Our flipped classrooms are structured as follows:

- First, we start with pre-class activities such as assigned readings, case-based activities, pre-recorded materials followed by a quiz to

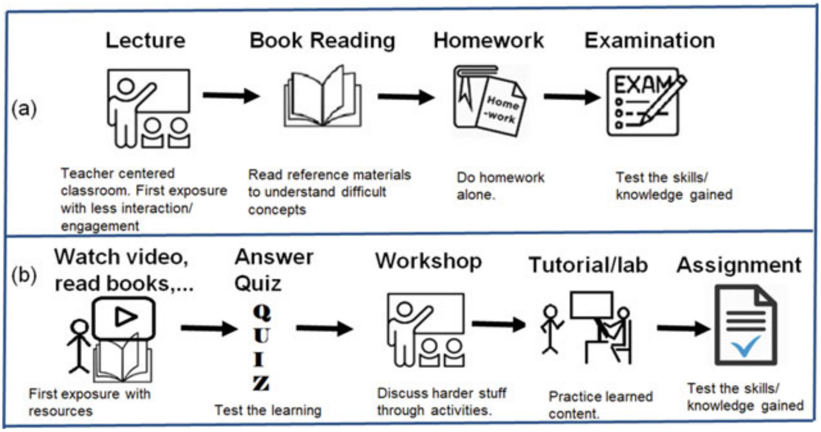


Fig. 10.1 Workflow of Traditional teaching method (a) and Flipped Classrooms (b)

test the students' understanding. These quizzes carry marks and they are focused on assessing the students' understanding of the theory content covered by the reading materials or the pre-recorded materials. Some examples which align with the theories learnt are provided for them to explore as case studies so that they can be discussed during the workshop. The pre-class activities should trigger reasoning, arguing or debating (Cohen, 1994) in order to enhance knowledge construction.

- The in-class workshop comes next according to the weekly class plan as shown in Table 10.1. The theories learnt during the previous workshops are revised, case studies are discussed and hands-on activities on the theoretical aspects are carried out during the in-class workshop. Lecturer walks around the class and provides feedback on the case study discussions that take place among each group. The feedback helps students to be involved in a wider discussion forum with their peers at a later stage. Lecturer facilitates students into deeper learning by providing ***constructive*** feedback for them to collaborate and discuss among their peers. A take-home task is assigned at the end of the workshop so that the students are able to reflect their learning and apply them in another task.

Table 10.1 Sample class schedule for a semester of 12 weeks

Pre-class activities: • Recommended reading material • Pre-recorded videos • Quizzes (with marks)—covering the concepts learned • Examples of case studies	
Week #	In-class (workshop) activities
1–12	• Unit synopsis, Introduction, Curriculum, Assignments, Weekly plan, Software & tools required, etc. • Introducing the case study as Assignment 1, explain the marking rubric, forming groups, explain how to conduct a literature review • Discussion on case study (Mode 1) • Discussion on case study (Mode 2) • Discussion on case study (In depth hybrid Mode 1 & 2) • Group presentation addressing how the case study can be solved, follow by feedback • Discussion on case study & identify the problem to tackle (PBL—Problem-based learning) • PBL—Discuss the identified problem, potential solutions and identify best approach • PBL—Target the best method to solve the problem and implementation • PBL—Review implementation and provide instructions on presenting it • Final presentation on the solutions, challenges faced, etc. • Final report to be submitted
Post-class activities: • Take-home task to be completed and submitted on Moodle coding/implementation, • Weekly log book (group-based), • In-semester assignment tasks, • Discussion forums, • Case study analysis	

- Finally, the post-class activity is focused on applying the theory learned in each workshop on the take-home task to stimulate practical understanding of the theory. This take-home task needs to be completed and submitted on Moodle and after assessing them, feedback is provided on Moodle on each attempt and sample solutions are also produced after the submission deadline. There are two types of the take-home tasks: (i) a programming task based on the theory learnt in the workshop—students learn how to apply theories in a practical situation, (ii) differentiating between two or more theories learnt along with an example of an application in a real-world situation—in this task, students recap the theories learned during the workshops and think back on how a certain theory can be correctly applied in a practical context. In order to reduce anxiety, post-class activities may provoke in a student. Freeman et al. (2017) and Cooper et al. (2018) suggest to make the activities low stakes or no stakes in terms of marks, provide ample time for activities completion and allow self-selection of working partners. These suggestions also make the post-class activities less intimidating (Figs. 10.2, 10.3).

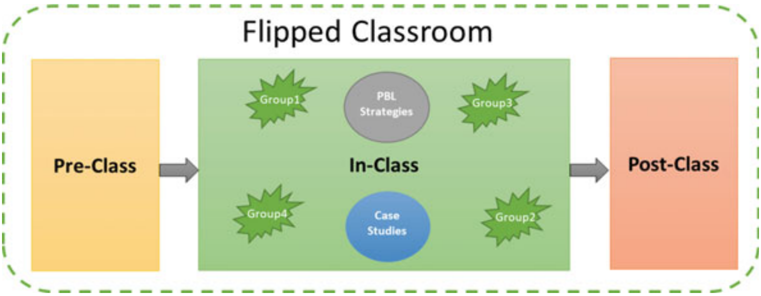


Fig. 10.2 Brief overview of our class plan

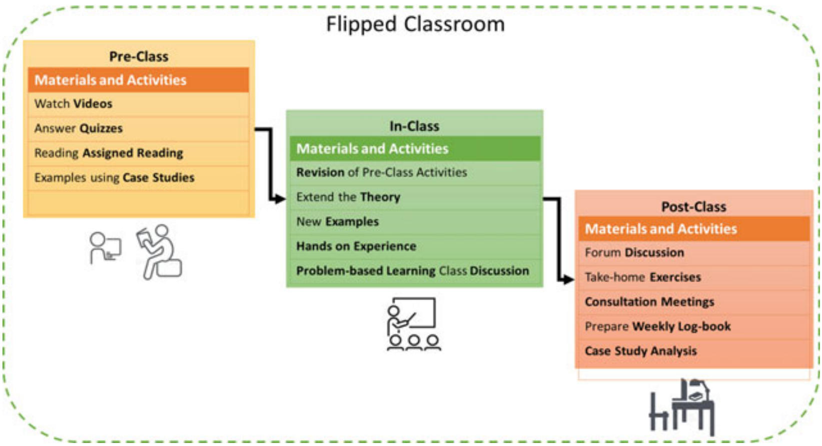


Fig. 10.3 Activities planned in pre-, in- and post-class sessions

It should be noted that in the flipped classrooms, pre-class activities (readings/pre-recorded content/quizzes) are crucial and a student's workshop experience depends on their preparation. In fact, completing the pre-class activities before attending the workshop discussion sessions are a key part of a student's learning in our plan. Students should be prepared before the workshop and discussion sessions thus the quiz is designed as a motivational activity with marks as "carrot" to induce participation and also to appreciate the students' efforts. There is no doubt, students must come prepared in the flipped classroom approach and Vaughan (2014) claims that due to accountability resulting from active learning, students are motivated to come prepared in class, thus enhancing their ability to learn. On the other hand, students who are accustomed to a teacher-centred approach may not come prepared as they expect their teachers to offer them the content (Owens et al., 2020).

Our class plan for the whole semester follows the schedule as shown in Table 10.1.

As the first step of our Collaborative Active Learning (CAL) session, a positive classroom culture is inculcated by greeting the students with a welcoming note and explaining the planned activities along with the learning outcomes to be achieved by the end of the session. This positive vibe among the students has been one of the key ingredients towards the success in our collaborative learning initiatives. According to Trowler and Cooper (2002), cultures play a significant role in the teaching and learning regimes that comprise local rules, assumptions and practices.

In our classes, we have noticed that the majority of students tend to reason their ideas inductively rather than deductively. In comparison to learning from logical development stemming from basic principles, they learn better from examples (Oxford University Press ELT, 2017). Thus, case studies are beneficial to students in the following aspects:

- thriving on a real and complex crisis requiring group members to draw from and share their experiences to help solve the problem (Pedler, 2012)
- involvement of developing problem-solving, teamwork and decision-making skills
- allowing participants to learn by doing/applying what they have learned to a real organisational issue can achieve multiple results simultaneously within a relatively short period (Serrat, 2008).

Student-centred approaches encourage students to participate in their own and others' education. When instructors want students to apply what they've learned in real-world situations, case studies are ideal. This is because a case study is an adapted narrative of reality that involves analysis of problems and decision-making by the students (Carvalho et al., 2021). For the learning process to be meaningful, the cases must relate to the knowledge previously acquired by the students (Peixoto, 2016). Case studies can take many forms, from a simple "What would you do in this situation?" to a detailed description of a situation with data to analyse. In our CAL sessions, students are asked to answer an open-ended question (simple case) that gradually develops into a complex problem with multiple possible solutions, that is, a PBL approach that requires a fully developed group action plan, proposal, or decision. Therefore, these tasks can range from one paragraph responses to fully developed group action plans, proposals, or decisions.

These are the common elements of our case studies:

- A decision-maker who is grappling with some question or problem that needs to be solved.
- A description of the problem's context.
- Supporting data, which can range from data tables to URL links.

To illustrate, the instructor is frequently the decision-maker regarding the flow of the case-based discussion who determines the scope of case studies, prepared questions, assessment methods and evaluations. Specifically, the tutor should determine who conducts the assessment—the tutor, an industry specialist, a panel, peer groups, or students self-evaluating? Additionally, they must decide whether to assign a class or group grade, to evaluate individual performance, or to have the product evaluated by peers.

Typically, case studies are paired with a reading assignment that introduces or clarifies a concept or analytical technique relevant to the case. Prior to the workshop session, students read the case, consider the instructor's preparation questions, conduct supplemental research on the case details and context, complete the case study task as envisioned by Cohen (1994), and finally have an appropriate discussion about their solutions and findings. Throughout the workshop session, the instructor facilitates discussion by utilising key questions, dialogue, debate, and conceptual frameworks to unearth the case-based lessons.

Throughout our CAL sessions, we practised two main case study formats, that is, Mode 1 and Mode 2 at abstract level. Based on the given examples on selected topics, such as Moral Machine, case studies with open-ended questions (Mode 1) are carried out to promote cognitive conflicts and reflections (Awad et al., 2020). The students are given time to form their opinions based on the cases. Following that, open discussions and debates are held, and students are encouraged to share their perspectives and objectively contest each other's opinions. As discussed earlier, cognitive conflicts encourage confidence (De Dreu & Weingart, 2003) and enhance group cohesion and group members' commitment (Jehn & Mannix, 2001). The instructor serves as the decision maker and mediator on the presented topic, ensuring that the flow of discussion and debate is well matched with the embedded lesson.

The role-playing format is the second format of the case studies (Mode 2). This format is appropriate for use in a small classroom of around 30 students, as it targets at a group-based activity (Peranginangin, Chapter 6 this volume). Role-playing is a simulated task of low fidelity and for it to be effective, it is important that the educational objectives and the content are clearly stated (Malheiros, 2012). The concept and topics change on a weekly basis, and students are assigned roles based on the types of users for their software application. The main task is accompanied by a plethora of subtasks to ensure that students participate in a progressive manner and learn to manage their time effectively. For example, if they need to design and test a software application, they must consider the perspectives of different types of potential users. The following are some examples of given roles for this task, as well as some potential areas to consider:

- As a senior citizen that uses this app occasionally:
  - I need this app to… because of…
- As a tech savvy end user that uses this app regularly:
  - this app should have…. because….
- As a developer:
  - I'll design it with… because…
- As the stakeholder:

  - I'm expecting.... in this app because....
- As the expert evaluator:
  - I'm looking at .... features... because....

Students receive immediate feedback at the end of the class, as well as some personalised feedback via email that is intended to guide them based on the embedded learning topics. According to Zheng et al. (2022), personalised feedback may significantly improve the students' collaborative knowledge-building level. Nevertheless, Winstone et al. (2017) and Timms et al. (2016) stressed that students must engage with the feedback by decoding its meaning, and act on it. In this manner, they can recognise its value and significance in supporting their learning. After thoroughly analysing the assigned case study, students are required to present their findings and pitch their ideas for resolving the problem identified in the case study. This provides them with a problem-solving learning opportunity. In this manner, the case study approach gradually incorporates the problem-based learning method but still within our main CAL strategy of flipped classrooms.

During our active learning sessions, we discovered several advantages of problem-based learning that is rooted with case studies (refer to 'Feedback from Students' section for their responses):

- Initiatives for self-learning: We discovered that the students take initiatives and ownership of their own learning. They conduct background research as homework and use their research abilities and creativity to solve problems. As a result, they develop self-confidence as well as creativity to enhance skills that benefit them greatly in the long run. The student-centred approach encourages students to reflect on their own work and according to Zhang and Zheng (2018) indirect feedback from the lecturers is effective to develop an awareness of self-learning.
- Active participation: Students are the drivers of their own educational vehicle. Rather than simply taking notes or listening to a teacher, students take the lead in various aspects as needed to solve the problem at hand. They brainstorm ideas, discuss the benefits and drawbacks of each item, conduct risk analysis, use critical thinking skills, and think outside the box to arrive at a consensus on a collective plan to solve the problem. According to Bolden et al. (2019),

active engagement is the key to student success, therefore, lecturers should find ways to engage students and subsequently increase the quality of learning in line with the principle of constructive alignment (Biggs & Tang, 2011).

- Develop transferable skills: By participating in group discussions, they learn from others and broaden their abilities to solve similar problems in the future. They learn to apply the same concept in different contexts, which enable them to propose working solutions with appropriate customization to other problems. The advantage of working in a group is that it helps to build transferable skills like leadership, communication skills and mutual engagement (Curseu et al., 2012).
- Create a strong team dynamic: In most problem-based learning activities, a number of students collaborate to find solutions to a problem. This opportunity allows them to learn negotiation skills, how to appreciate and compromise ideas, effective communication, punctuality, listening to others, and working in a collaborative environment. In addition, the relational approach enhances the team dynamics and thus constitutes effective group work strategies leading to active participation from the members (Fung et al., 2018).
- Sharing the joy of rewards: rather than completing some work alone, the satisfaction level is higher when the joy is shared among peers than when individual success is achieved. In a group problem-solving activity, the lessons learned would be massive, the depth of the problem solved would be greater, and as a result, the satisfaction of solving a larger-scale problem in an innovative way would be a better reward than simply passing a hurdle. In order to enhance their chances to obtain the joint reward and to achieve the common goals, students realise that working together is the best option in accordance with the Social Interdependence Theory (Johnson & Johnson, 2013).

The following steps were implemented in designing the problem-based learning activity after the students gained a clear understanding of the problem to be solved through the case study:

(a) Describe the outcomes of the activities.
(b) Give a synopsis of the problem they are trying to solve.

(c) Ground rules for grouping students—it would be best if a personality test could be used to identify the different types of students in the class and distribute them across groups so that each type is represented.
(d) Allow students to decide on different responsibilities for each group member.
(e) Explain the marking rubric and other assessment criteria, such as peer evaluation, individual contribution, and so on.

According to Stevens and Levi (2005), by providing rubrics to students, it helps to convey the task expectations to them, help them focus their efforts on the task requirements, and improve the effectiveness of feedback which is given based on the rubrics.

During the case study and PBL workshop sessions, the tutor reviews the theoretical concepts learned in the pre-class activities (e.g., an algorithm used in solving a problem that requires coding/programming) and assists the students on how to apply the theory they learned. Students who work collaboratively on certain tasks as teams are thought to improve their soft skills needed on group dynamics, negotiation skills, and working with people from different cultures, educational backgrounds, and attitudes. During the programming sessions, students learn from one another, correct one another's mistakes, and seek assistance from tutors when necessary. They are given immediate feedback on the tasks they have completed. When each student proposes a different solution, the most effective solution was chosen from among the many proposed by everyone in the class. Students can boost their self-esteem and are motivated to be active rather than passive during these activities. They recognise that coming up with a holistic solution as a team is more respected than individual solutions (Romaniuk, 2021).

Implementation

Planned Activities

Week 1 to Week 6

In Week 1, ice-breaking activities should be held to build trust between the instructor and students. As a result, students tend to feel more confident and eager to learn. In a climate of trust, the team members can positively and constructively react to feedback and critique from the other members (Fransen et al., 2011). Teamwork is essential for group-based learning, but they struggle to form groups with strangers. Find-a-friend is a 5-min event where participants are assigned students at random.

The open discussion on the given topics in Week 2 case study (Mode 1) can promote cognitive conflicts and reflections. Students are expected to conduct their own research using the prepared literature and supporting statements.

One of the examples is as follows:

> **Objective**: To discuss the ethics of artificial intelligence.
> **Background**: If forced to choose, who should a self-driving car save in an unavoidable crash?
> Should the passengers in the vehicle be sacrificed to save a pedestrian? Or should a pedestrian be sacrificed to save a family of four in the vehicle?
> **Process**: Weighing up whom a self-driving car should save is a modern twist on an old ethical dilemma known as the trolley problem. The Moral Machine (Awad et al., 2020) presented several variations of this dilemma involving a self-driving car.

Who should a self-driving car save? Please consider the following situations:

- a successful business person?
- a known criminal?
- a group of elderly people?
- a herd of cows?
- pedestrians who were crossing the road when they were told to wait?

Following that, students are encouraged to share their perspectives and objectively contest each other's opinions in an open discussion and debate. The instructor serves as the decision maker and mediator on the presented topic, ensuring that the flow of discussion and debate is well aligned with the embedded lesson set during preparation.

Week 3 case study (Mode 2) is on role-playing. Students take on various roles in the context of simulated scenarios, may assume the profile of a character or personality, and interact and participate in a variety of and complex learning settings.

To create specific goals and objectives, instructors use the SMART (Specific, Measurable, Achievable, Relevant, and Timely) template (Cothran & Wysocki, 2019). The appropriate scenario simulation and role playing assist in answering the following questions in accordance with SMART.

Specific

- What do you want the student to achieve?
- Who needs involvement to accomplish the goal?
- When do you want to have the goal finished?
- Why exactly should the students achieve this goal?

Measurable

- How can instructors measure progress and know if students have successfully met the goal?
- Are students capable of achieving the goal?
- Do they have the required skills?
- Can these goals be achieved through simulation?

Relevant

- Why should they achieve this goal?
- What is the impact of this practice?

Timely

- What is the due date of this goal?
- Can the goal be achieved by a specified date?
- Can the learning objectives be met in the time allotted for the scenario?

Week 4 exploration via Mode 1 and Mode 2 case studies provides students with the experience and knowledge gained through conflict and reflection following discussion that eventually enhance group cohesion and group members' commitment (Jehn & Mannix, 2001). This week, students must progress beyond their current learning level and engage in thematic analysis. Students need to think outside the box with factual information and engage in constructive conflict with the other teams. However, when students are challenged out of their comfort zone, it may lead to socio-emotional conflicts that involve personality clashes and it may negatively impact group cohesion (De Dreu & Weingart, 2003; Jehn & Mannix, 2001). Therefore, students have to learn how to regulate socio-emotional conflicts.

Momentum generated by weeks of discussion, debate, data collection, and thematic analysis result in the formulation of a solution to the given case study. In Week 5, they use an elevator pitch, which is a brief two- or three-sentence description of their idea to present their solution and the instructor and peers provide feedback. The presenter also share a brief reflection. The team receives formal feedback with grades via the grade system to inform them on their performance and potential improvements, that is, the main focus of the feedback is not on marks but on learning.

The problem-based learning starts in Week 6. The students write a proposal based on the pitched idea in the previous week and improve their solution based on instructor's feedback. They need to form the objectives and propose a design for their solution towards the assigned case study. Group-based assessments are conducted by the instructor to evaluate the proposed solution in terms of validity, adequacy and achievability using the SMART template. A useful strategy to enhance group-based assessment involves interim reports of work in progress—it helps to reduce procrastination, encourages student accountability, discourages free riding and provides early feedback (Carless, 2017).

Week 7 to Week 12

By Week 7, students have already prepared their proposal which basically covers the theoretical parts of their assignments. From this week onwards, they are supposed to work on the actual implementation and more in-depth discussions take place to help the students to work on their final assignment. Examples of topics discussed are:

(a) How to improve the performance, threads to validities, GUI[1] and other aspects that are required to have a package-wise outcome to a real-world problem.
(b) How to design a COVID-19 mobile application to provide the most up-to-date and relevant information to the general public.

[1] Graphical User Interface.

After providing feedback based on the proposal submission in Week 6, each group needs to have an extra group consultation session during which all the assignment-1 (proposal) related feedback is reviewed to help the groups clarify their doubts and understand the contents that are not accurate and need improvements. In other words, based on the set goals, the students with some assistance from the tutors identify gaps and strategies to close the gaps (Hattie & Timperley, 2007).

Week 9 is all about solving problems not in separate group discussions but involving all the students present in the class. This provides and opportunity to discuss different issues they have come across as well as the different solutions that may have been identified so far, sharing them with their teachers and other classmates, helping them to think beyond the box and engaging in this type of live activities more deeply. The involvement of teachers in the group discussions helps to break any stalemate and also encourages students to consider other alternatives when they encounter a dilemma (Fung et al., 2018). Consequently, knowledge gained from the discussions involved within this week and the research done recently could be integrated with practice, and the solutions that each team has in its mind are updated (Savery, 2006).

Week 10 activity provides opportunities for students to collaborate and practice their communication and social skills which are aligned with the PBL strategies (Hmelo-Silver, 2004). In order to provide ideas to students on how issues with real world applications have been addressed by the professionals, a series of short seminars have been conducted using industry speakers to share the solutions of real-world problems.

Week 11 is all about polishing the deliverables and final report and finalizing everything before submission. The concept of verification and validation are also discussed and reviewed this week which is very important in developing any deliverable.

Finally, in Week 12, all the learning contents are reviewed along with a discussion on the learning objectives that have been planned to achieve from the first week onwards and how we fulfilled them during these 12 weeks.

Students' Academic Performance

As per the performance of the students, we noticed an increase in their average marks due to a higher weightage towards the distinctions with a positive skewed bell-curve in the final marks' distribution. Obviously, every student is different and the academically weaker students showed a comparatively lower performance than the high achievers. According to Honicke and Broadbent (2016), academic self-efficacy is positively associated with the self-perception of academic performance. To this end, social anxiety tends to correlate negatively to academic self-efficacy and academic performance (Hood et al., 2021). In this respect, Hood et al. (2021) proposed to reduce social anxiety by decreasing competitive climate, increasing minority groups' representation, and increasing the lecturers' transparency in using CAL as well as approachability. In a similar vein, according to Yildiz Durak (2022), group studies and group dynamics may contribute positively to the development of academic self-efficacy during learning activities with the support of the group members.

The end of the year results of one of the subjects shows that the performance has clearly improved in 2021 with 62% of the students achieving Distinctions (D) and High Distinctions (HD) compared to the previous year's total of 11%. To be more specific, in 2021, 12% of the students received HDs and 50% received Ds compared to the 0% HDs and 11% Ds in 2020. According to these results, it is evident that our approach has a tremendous effect on the academic performance of the students. In another study conducted by Yildiz Durak (2022) in computing courses, the results show significant and positive academic success, particularly in the peer-assisted learning model of the flipped classroom approach.

Some students' feedback that may have contributed to a better academic performance: "It makes the classes even more enjoyable when the lecturer explains the real-world applications of the topics we are currently learning", "It's a nice unit – fun to explore by myself", "The unit is well organised, the classes are all well-structured and the assignments instructions are clear".

Maintaining Log Books

During the whole semester of this course, the students have maintained log books. Maintaining a log book brings many benefits to one's learning journey. It allows the students to plan their work better and be more efficient in achieving goals with proper time management. Students need to write down each week's deliverables, pre-planned targets that are not achieved and the reason hindering the achievements of targets in their log book. A log book makes them feel accountable for their success. It further persuades students to be focused without being side-tracked or distracted. The commitment level increases when a student observes a successful plan ahead. The students are motivated once they look back and witness how far they have come. Moreover, writing about the reflections along the journey is relatively straightforward when a log book is maintained. Some criteria for evaluating the log book would be the level of punctuality, responsibility, integrity, approachability, flexibility on rescheduling availability of meetings. Therefore, our students are advised to maintain a weekly log book to furnish at the end of the semester to submit along with the final report. According to Kim et al. (2019), through active learning students construct personal understanding of concepts and subsequently, reflection helps them to integrate new knowledge with the existing one.

Peer Assessments

Peer assessments help to maintain the credibility of the grading plan of an assessed task. In most contexts, the students are assessed by their peers. It provides a chance for them to enhance an important skill they should develop: appreciating others' work. Anson and Goodman (2014) says that group work experiences can "help them learn from others' observations of their behaviour". Additionally, peer assessment provides opportunities for students to understand the assessment criteria, internalises the characteristics of quality work and improves their learning experience (Race, 2001). Peer assessments of student work can solve many group-based problems. It can solve or help to solve one of the key issues in group-based assessments—free-riders. Since the students know that they would be assessed by the peers at the end, they try to avoid being low ranked according to the peers' evaluations and engage more in the work to be accomplished. Hence, it helps to improve the performance of the group members. Peers can provide very valuable constructive feedback as they work on the same project, and they know the problem context better.

In our plan, we involved the students in two types of peer assessments. First, the students (within the same group) are instructed to review the contribution of their group members in solving the problem they are assigned to. This includes factors such as punctuality, responsiveness, meeting deadlines, etc. Secondly, each group was provided with a different rubric to assess the piece of work produced by the other teams and assess the solution based on a systematic criterion including functionality of the proposed solution, design, aesthetic properties, clarity of the idea, etc.

Challenges

Group-based activities are challenging during the initial weeks as students are reluctant to work with others due to different personality types, cultural differences and shyness. Various ice breaking activities and constant encouragement from the instructor and peers helped to overcome this issue and the shared responsibility falls on the instructor and peers in building a trusted and encouraging open discussion environment. The following problems arose during the case study sessions.

- Scenario simulation assessments can cause so much anxiety in students who struggle with public speaking or group participation that it affects their performance or participation. Find-a-friend activity from Week 1 helped greatly in establishing the social interaction and team-based encouragement to overcome this challenge
- In a simulated environment, it is impossible to truly recreate authenticity. The instructor's only option is to use various aspects of simulation to meet the students' assessment needs.
- Throughout a simulation, students must be guided, and learning must be scaffolded.
- It is best to notify their colleagues about the timing of simulations, as preparing for a simulation can prevent students from completing other learning and assessment tasks.
- Facilitators must sometimes spend a significant amount of time learning the tools needed to create a simulation, track and structure activity, and monitor and communicate with students during simulations. This investment can only benefit their teaching, but expect time-pressed teachers to be hesitant at first.

Another issue that frequently arises in group-based activities and assignments is when the amount of work that each student in the group does is not distributed evenly. In this situation, there is essentially no difference between the student who has done more and the student who has not been as involved as the other members. It is the responsibility of the teaching team to find a solution and ensure that each member of the group receives the appropriate amount of credit. In Strong and Anderson's (1990) study, according to the students the option to "divorce" a team member or the option to leave a team has a strong effect in reducing free riding.

In addition to the issues mentioned above, there is another issue that arises in this method of teaching. As shown in Table 10.1 and Fig. 10.4, this method has a kind of flow in which weekly materials are related to some part of the assignments, and if the student misses any of the teaching or tutorial sessions, he/she may struggle to connect everything together to complete the assessment task. Of course, these students can compensate for their absence through pre-class activities and consultation sessions.

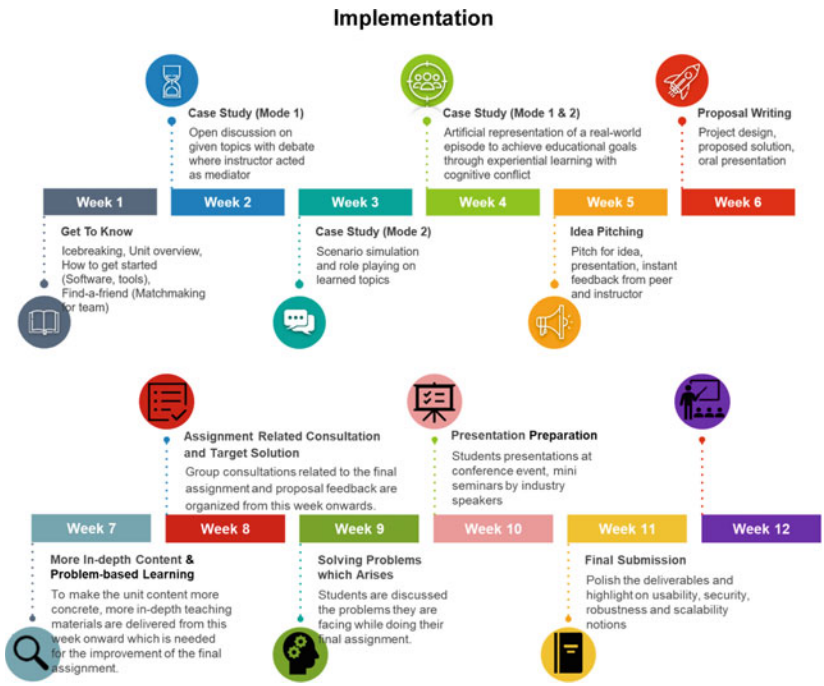


Fig. 10.4 Road map of the scheduled 12-week content

Feedback from Students

With Collaborative Active Learning (CAL), students acquire many skills: negotiation, communication, critical thinking and professionalism. When asked what are the best aspects they experienced with respect to the goals and purposes of CAL as practised in this chapter, particularly on engaging students to take ownership of their learning, the students responded:

> "Collaborating with a team to deliver a project",
> "We have a lot of freedom when working on the project",
> "I think it's a good opportunity for students to explore things outside of concepts learned in normal lectures in other units." and
> "Teamwork."

Subsequently, on the next goal of improved understanding in a supportive environment, the student's reflected as follows:

> "How the things we learnt in the previous week connects with the later weeks to allow us to optimize our solution.",
> "The unit was structured in a way that week by week we get to slowly build our product",
> "The different topics that were taught each week was what I found to be most effective, as I could see that how these topics and its assessments were related.",
> "Applying design principles/patterns during the workshops is well done. It provides good hands–on experience for students to help them translate what they've learnt over to the assignments.",
> "The pre–recorded videos embedded with quizzes are the most effective in my opinion. This is because it allows me to understand the short videos effectively and understand the learning outcomes of the week, providing a better understanding about the materials."

Incorporated into the feedback of the two goals as stated above, students also acquired and improved on their communication and reflection skills and to a certain extent critical thinking too.

On the negative aspect, the students find the number of submissions is too extensive: "Reduce the number of reports to be produced so we can have more time to improve the product". "I will suggest reducing the workload of the assessments".

This needs to be looked in carefully and amendments are planned for the next offering of the same content.

Conclusion

Collaborative active learning (CAL) has become a popular instructional method though it has not been practiced that much in higher educational environments due to various reasons. In our study, we have attempted to design a class plan for a semester at a higher education institute consisting of enriched collaborative activities in a flipped classroom with case studies and problem-based learning activities. A detailed lesson plan was prepared for each week and according to the students, it has improved the effectiveness of collaboration among them. The students tend to appreciate their learning process, collaborate with the team mates, sense their achievements and the problems they have contributed to solve. This is because the flipped classroom approach gives students more flexibility over learning time and pace and thus better control over the learning process (Heijstra & Sigurðardóttir, 2018) and the tasks that relate to knowledge previously learned make the learning process more meaningful (Peixoto, 2016). It emphasizes that CAL in higher education should be planned carefully with challenging and appropriate tasks which help the students to apply their intellectual ability to solve real-world problems.

The students experienced team dynamics, mutually supported peers, interacted effectively and motivated since they sense the responsibility of their own work. Our study demonstrated a positive correlation between CAL and the students' achievement. This has been witnessed from their performance in assignments and the course evaluations at the end of the semester.

As a final note, higher education institutes can creatively plan offering harder subjects to achieve the learning outcomes easily via various interactive tools available for quizzes, online polls, discussion forums, video editing tools, etc. It's worth investing in CAL initiatives as it establishes a constructive atmosphere for students which enhances their confidence, interactions, self-esteem, retention and responsibility as adults ready to go to the industry which is a crucial part of the vision statement of most institutes. To this end, students who adopt the unreflective approach to learning can be supported in transforming their learning into deeper and reflective methods through constructively aligned teaching (Hailikari et al., 2021) like CAL.

References

Anson, R., & Goodman, J. A. (2014). A peer assessment system to improve student team experiences. *Journal of Education for Business, 89*(1), 27–34. https://doi.org/10.1080/08832323.2012.754735

Arvaja, M., Salovaara, H., Häkkinen, P., & Järvelä, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning and Instruction, 17*(4), 448–459. https://doi.org/10.1016/j.learninstruc.2007.04.003

Awad, E., Dsouza, S., Shariff, A., Rahwan, I., & Bonnefon, J. F. (2020). Universals and variations in moral decisions made in 42 countries by 70,000 participants. *Proceedings of the National Academy of Sciences, 117*(5), 2332–2337. https://doi.org/10.1073/pnas.1911517117

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science, 9*(3), 75–78. https://doi.org/10.1111/1467-8721.00064

Bolden, E. C., III., Oestreich, T. M., Kenny, M. J., et al. (2019). Location, location, location: A comparison of student experience in a lecture hall to a small classroom using similar techniques. *Active Learning in Higher Education, 20*(2), 139–152. https://doi.org/10.1177/1469787417742018

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). Open University Press.

Carless, D. (2017). Students' experiences of assessment for learning. In D. Carless, S. M. Bridges, C. K. Y. Chan, & R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 113–126). Springer Nature.

Carvalho, A., Teixeira, S.J., Olim, L., de Campanella, S., & Costa, T. (2021). Pedagogical innovation in higher education and active learning methodologies – A case study. *Education + Training, 63*(2), 195–213. https://doi.org/10.1108/ET-05-2020-0141

Cohen, E. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*(1), 1–35. https://doi.org/10.3102/00346543064001001

Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *International Journal of STEM Education, 5*(1), Article 23. https://doi.org/10.1186/s40594-018-0123-6

Cothran, H. M., & Wysocki, A. F. (2019). Developing SMART goals for your organization. *EDIS*, *2005*(14). https://doi.org/10.32473/edis-fe577-2005

Curseu, P. L., Janssen, S. E., & Raab, J. (2012). Connecting the dots: Social network structure, conflict, and group cognitive complexity. *High Education, 63*(5), 621–629. https://doi.org/10.1007/s10734-011-9462-7

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology, 88*(4), 741–749. https://doi.org/10.1037/0021-9010.88.4.741

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning, 10*(2), 1–13. https://files.eric.ed.gov/fulltext/EJ890707.pdf

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The power of problem-based learning* (1st ed.). Stylus Publishing.

Erkens, M., & Bodemer, D. (2019). Improving collaborative learning: Guiding knowledge exchange through the provision of information about learning partners and learning contents. *Computers & Education, 128*(January), 452–472. https://doi.org/10.1016/j.compedu.2018.10.009

Escartín, J., Saldaña, O., Martín-Peña, J., Varela-Rey, A., Jiménez, Y., Vidal, T., & Rodríguez-Carballeira, L. (2015). The impact of writing case studies: Benefits for students' success and well-being. *Procedia – Social and Behavioral Sciences, 196*, 47–51. https://doi.org/10.1016/j.sbspro.2015.07.009

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(2011), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Freeman, S., Theobald, R., Crowe, A. J., & Wenderoth, M. P. (2017). Likes attract: Students self-sort in a classroom by gender, demography, and academic characteristics. *Active Learning in Higher Education, 18*(2), 115–126. https://doi.org/10.1177/1469787417707614

Fung, D., Hung, V., & Lui, W.-M. (2018). Enhancing science learning through the introduction of effective group work in Hong Kong secondary classrooms. *International Journal of Science and Mathematics Education, 16*(2018), 1291–1314. https://doi.org/10.1007/s10763-017-9839-x

Hailikari, T., Virtanen, V., Vesalainen, M., & Postareff, L. (2021). Student perspectives on how different elements of constructive alignment support active learning. *Active Learning in Higher Education* (online). https://doi.org/10.1177/1469787421989160

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112. https://doi.org/10.3102/003465430298487

Heijstra, T. M., & Sigurðardóttir, M. S. (2018). The flipped classroom: Does viewing the recordings matter? *Active Learning in Higher Education, 19*(3), 211–223. https://doi.org/10.1177/1469787417723217

Hernandez, P. R., Schultz, P. W., Estrada, M., Woodcock, A., & Chance, R. C. (2013). Sustaining optimal motivation: A longitudinal analysis of interventions to broaden participation of underrepresented students in STEM. *Journal of Educational Psychology, 105*(1), 89–107. https://doi.org/10.1037/A0029691

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research Review, 17*(2), 63–84. https://doi.org/10.1016/j.edurev.2015.11.002

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., Gerrits, R., Lawford, H., Ott, B., Ross, K., Paige, O., Stowe, S., Jensen, M., & Hull, K. (2021). "I like and prefer to work alone": Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), ar12. https://doi.org/10.1187/cbe.19-12-0271.

James, M., Black, P., Carmichael, P., Drummond, M. J., Fox, A., MacBeath, J., & McCormick, R. (2007). *Improving learning how to learn: Classrooms, schools and networks*. Routled.

Jehn, K. A., & Mannix, E. A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. *Academy of Management Journal, 44*(2), 238–251. https://doi.org/10.5465/3069453

Johnson, D. W., & Johnson, F. P. (2013). *Joining together: Group theory and group skills* (11th ed.). Allyn and Bacon.

Kim, A. M., Speed, C. J., & Macaulay, J. O. (2019). Barriers and strategies: Implementing active learning in biomedical science lectures. *Biochemistry and Molecular Biology Education, 47*(1), 29–40. https://doi.org/10.1002/bmb.21190

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*(2), 193–212. https://doi.org/10.5465/amle.2005.17268566

Kolb, A. Y., & Kolb, D. A. (2017). *The experiential educator: Principles and practices of experiential learning*. Experience Based Learning systems.

Krange, I., & Ludvigsen, S. (2008). What does it mean? Students' procedural and conceptual problem solving in a CSCL environment designed within the field of science education. *International Journal of Computer-Supported Collaborative Learning, 3*(1), 25–51. https://doi.org/10.1007/s11412-007-9030-4

Lazonder, A. W., Wilhelm, P., & Ootes, S. A. W. (2003). Using sentence openers to foster student interaction in computer-mediated learning environments.

Computers & Education, 41(3), 291–308. https://doi.org/10.1016/S0360-1315(03)00050-2

Le, H., Janssen, J., & Wubbels, T. (2017). Collaborative learning practices: Teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education, 48*(1), 103–122. https://doi.org/10.1080/0305764x.2016.1259389

Malheiros, B.T. (2012). *General didactics*, LTC, Rio de Janeiro, Freire, R. A. A Didactics in Higher Education. Cengage.

Mercer, N. (2010). The analysis of classroom talk: Methods and methodologies. *The British Journal of Educational Psychology, 80*(1), 1–14. https://doi.org/10.1348/000709909X479853

Moffett, J., & Mill, A. (2014). Evaluation of the flipped classroom approach in a veterinary professional skills course. *Advances in Medical Education and Practice, 4*(5), 415–425. https://doi.org/10.2147/AMEP.S70160

Owens, D. C., Sadler, T. D., Barlow, A. T., & Smith-Walters, C. (2020). Student motivation from and resistance to active learning rooted in essential science practices. *Research in Science Education, 50*, 253–277. https://doi.org/10.1007/s11165-017-9688-1

Oxford University Press ELT. (2017, August 8). *Inductive and deductive grammar teaching: what is it, and does it work?* Oxford University Press. https://oupeltglobalblog.com/2015/04/24/inductive-and-deductive-grammar-teaching/

Pedler, M. (2012). *Action learning in practice* (4th ed.). Routledge.

Peixoto, A. G. (2016). The use of active methodologies in high school: Evaluation of the use of practical classes as a tool to aid learning in biology. *Periodico Cientıfico Outras Palavras, 12*(2), 35–50.

Pellegrino, J. W., & Hilton, M. L. (Eds.). (2013). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. National Academies Press.

Race, P. (2001). *A briefing on self, peer and group assessment* (Assessment Series guide 9). Generic LTSN.

Romaniuk, S. N. (2021). *Collaborative and active learning in higher education classrooms*. https://elearningindustry.com/collaborative-and-active-learning-higher-education-classrooms

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning, 1*(1), Article 3. http://docs.lib.purdue.edu/ijpbl/vol1/iss1/3/

Scager, K., Boonstra, J., Peeters, T., Vulperhorst, J., & Wiegant, F. (2017). Collaborative learning in higher education: Evoking positive interdependence. *CBE Life Sciences Education, 15*(4), Article 69. https://doi.org/10.1187/cbe.16-07-0219

Serrat, O. (2008). *Action learning*. https://www.adb.org/publications/action-learning

Stevens, D. D., & Levi, A. J. (2005). *Introductions to rubrics: An assessment tool to save grading time, convey effective feedback and promote student learning*. Stylus Publishing.

Stover, S., & Holland, C. (2018). Student Resistance to Collaborative Learning. *International Journal for the Scholarship of Teaching and Learning*, *12*(2). https://doi.org/10.20429/ijsotl.2018.120208

Strong, J. T., & Anderson, R. E. (1990). Free-riding in group projects: Control mechanisms and preliminary data. *Journal of Marketing Education, 12*(2), 61–67. https://doi.org/10.1177/027347539001200208

Talbert, R., & Mor-Avi, A. (2019). A space for learning: An analysis of research on active learning spaces. *Heliyon*, *5*(12). Article e02967. https://doi.org/10.1016/j.heliyon.2019.e02967

Timms, M., DeVelle, S., & Lay, D. (2016). Towards a model of how learners process feedback: A deeper look at learning. *Australian Journal of Education, 60*(2), 128–145. https://doi.org/10.1177/0004944116652912

Trowler, P., & Cooper, A. (2002). Teaching and learning regimes: Implicit theories and recurrent practices in the enhancement of teaching and learning through educational development programmes. *Higher Education Research & Development, 21*(3), 221–240. https://doi.org/10.1080/0729436022000020742

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Vaughan, M. (2014). Flipping the learning: An investigation into the use of the flipped classroom model in an introductory teaching course. *Education Research and Perspectives (online), 41*(1), 25–41.

Winstone, N. E., Nash, R. A., Parker, N., & Rowntree, J. (2017). Supporting learners' agentic engagement with feedback: A systematic review and a taxonomy of recipience processes. *Educational Psychologist, 52*(1), 17–37. https://doi.org/10.1080/00461520.2016.1207538

Yildiz Durak, H. (2022). Flipped classroom model applications in computing courses: Peer-assisted groups, collaborative group and individual learning. *Computer Applications in Engineering Education*. Advance online publication. https://doi.org/10.1002/cae.22487

Zhang, L., & Zheng, Y. (2018). Feedback as an assessment for learning tool: How useful can it be? *Assessment & Evaluation in Higher Education, 43*(7), 1120–1132. https://doi.org/10.1080/02602938.2018.1434481

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education*, *47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

CHAPTER 11

Using Team-Based Scenario Learning (TBSL) Approach to Teach Audit Risk

Shyamala Dhoraisingam Samuel and Ravichandran Subramaniam

Introduction

The World Economic Forum report, 'Future of Jobs Report' (2016), identified the top three skills needed in 2020: complex problem solving, critical thinking, and creativity. Previously, when the report was published in 2015, the top three skills were complex problem solving, coordinating with others, and people management. This shift in the competencies from 2015 to 2020 was mainly due to the emergence of the Fourth Industrial Revolution, affecting the audit and assurance engagements. Therefore, in light of the expectations of future workplace employers, accounting educators have to be proactive in their pedagogy to teach the Audit and

S. D. Samuel (✉) · R. Subramaniam
Monash University Malaysia, Subang Jaya, Malaysia
e-mail: shymala.dhoraisingam@monash.edu

R. Subramaniam
e-mail: ravichandran.subramaniam@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_11

Assurance unit offered at an undergraduate level. The Audit and Assurance unit is a third-year compulsory unit for those students who intend to pursue their professional accountancy examinations after graduation.

Application of core audit concepts encompasses three main areas. Firstly, it is the application of different concepts and techniques to the audit model such as documentation of the internal control environment of the client, to highlight potential areas of weaknesses, and the identification of potential red flags in the risk assessment stage of the audit. Second, how the audit model is used to design the audit methodologies to be used such as using the auditor's judgement on planning materiality and the quality of audit evidence to be obtained to achieve the confidence on the client's financial statements. This is important in order for the auditor to issue the auditor's report on the financial statements as to whether it shows a true and fair view. Lastly, the emphasis on the importance of changing the teaching pedagogical approach to ensure that students are exposed to real world simulated scenarios (Buckless et al., 2014).

Furthermore, auditors are assigned as teams on their audit assignments to their client's locations in practice. Therefore, team-based scenario learning (TBSL) is introduced together with peer learning to promote team interactions. Peer learning is central in this approach as there would be two-way feedback between students and/or two-way dialogue between lecturers and students (Keppell & Riddle, 2012). Importantly, in today's learning the main focus is on how to learn and not what to learn and students learn through project-based group work and peer learning. To this end, Boud (2001) concurs that peer learning should be mutually beneficial involving the sharing of ideas, knowledge and experiences among participants. The adoption of TBSL learning prepares students to analyse, synthesise, manage their time, and communicate their possible solutions from scenario-based auditing situations. The advantage of the TBSL learning approach is that it enables students to improve their academic performance and will be able to apply their skills at their workplace after graduation. This is because peer learning skills acquired through TBSL are well suited for professional development as it promotes sharing of partners' experiences through action and reflection (Eisen, 2001; Pedder et al., 2008).

Team-Based Scenario Learning (TBSL)

Team-based scenario learning utilises hypothetical real-world situations encountered by auditors to facilitate learning. Working as a team also creates opportunities for students to learn from one another, as students communicate, discuss, argue, and elaborate as they respond to the scenarios. Appendix 1 exhibits a scenario designed as an open-ended question that allows for alternative responses and applying their previously learned knowledge. The collaborative learning begins when students gather additional information on media releases, besides materials such as due diligence sample reports or general risk factors found in the lecture notes, to achieve their learning outcomes of Appendix 1 question. These are, first, to evaluate the client's audit risk factors and second, to justify any potential material misstatements in the client's financial statements. According to Beattie et al. (2012), scenarios in teaching auditing are better than the traditional-lecture type approach to improve student's learning outcomes. The use of scenarios takes precedence over the lecture style of teaching, which tends to focus on imparting knowledge from the lecturer to the student. Adopting scenarios allow a student to bridge the gap between theory and practice. It also allows lecturers to scaffold the development of skills aligned to the learning outcomes and to offer students more complex scenarios that test their capabilities at higher levels (Crisp, 2012). Therefore, the real world-like scenarios aid students in applying auditing concepts such to the audit risk assessment model, which entails assessing and responding to risks of material misstatements, assessing the internal controls over financial reporting cycle, communication of the findings of the audit tests, and finally, the auditor report. The example in Appendix 1 aids students in their risk assessment phase of an audit, where judgment and reasoning are needed to evaluate the areas that require audit attention. Incidentally, the assessment of scenario-based learning should centre on rewarding the development of skills and capabilities that are valued (in Appendix 1—judgment and reasoning) and not just quantitative measurement (Crisp, 2012).

Furthermore, the TBSL learning approach attempts to develop the students' practical skills in planning risk-based audits. The scenarios allow students to use their knowledge of the audit procedures learned from their study materials to assess audit risks, design an audit strategy, and audit team composition. This approach promotes collaborative learning to obtain group responses/consensus when students undertake group tasks designed to support collaboration amongst group members. The student discussions on the tasks allocated to each group member encourage peer interaction and group inter-dependence to achieve the learning outcomes as stated in Appendix 1 (Ravenscroft et al., 1999). Studies have shown that task interdependence—interconnection among tasks—leads to more communication, helping and information sharing (Johnson, 1973). In addition, according to the Social Interdependence Theory (Johnson & Johnson, 2009) the positive interdependence and individual accountability elements of the theory are necessary to maximise the collaborative potential of groups. From the students' perspective, TBSL learning encourages students to have a safe learning space to face the consequences of their decisions and choices. To implement the safe learning environment, the lecturer and tutors create an environment by informing the students that each group member has equal status, encouraging intergroup engagement, individual accountability, and friendship to reduce group conflicts (Cabrera et al., 2002). In this regard, the lecturer has created a team psychological safety so that the team members feel safe for interpersonal risk-taking (Edmondson, 1999), feel comfortable to express their experiences, and share equitably the group attention (Edmondson & Lei, 2014) and subsequently through mutual respect and trust students develop confidence to speak up. Relating the real-life case study of audit interactions, (Beattie et al., 2012), emphasise the importance of helping students acquire the necessary skills to deal with problems effectively via the use of scenarios based on real situations. Furthermore, the current focus on learning outcomes is on "what graduates can do and not just about what they know" (Long & Ehrmann, 2005, p. 54), therefore, the learning activities should focus on authentic learning interactions which are relevant to the student's future career.

Drawing again on the work of Beattie et al. (2012), the authors highlight those real-life issues in accounting and auditing are usually complex and messy. Auditing is problematic as there are grey areas to be considered by the auditor. Examples of such grey areas are exercising an appropriate level of professional scepticism, gathering audit evidence about how much is sufficient and proper, assessing materiality, and interpreting accounting standards when the client's financial reports are organised to exercise professional judgment. Besides grey areas, another issue is critical thinking. Based on Scriven and Paul's (1987) work, critical thinking is defined as actively and skillfully conceptualising, applying, analysing, synthesising, and evaluating information gathered from or generated by observation, experience, reflection, and reasoning or communication. Using Scriven and Paul's (1987) concept to TBSL aids in developing a student's critical thinking skills from their learning activities to self-reflect on their individual learning needs, participate in team discussions and learn from their peers. The model introduced by Scriven and Paul (1987) considers three aspects of thinking. First, the development of good reasoning skills by students to solve the problems addressed in the given scenarios. The gathering of information, as mentioned earlier, aids students in developing their reasoning skills to solve the problems identified in the scenarios. This is achieved by students applying the audit theories and concepts to the simulated real life audit situations. Second, the information gathered from various sources such as media etc., are applied to the relevant auditing standards to reduce the risk of giving the incorrect audit opinion, as the auditor needs to exercise their professional skepticism and audit judgments. Finally, students' intellectual traits or thinking dispositions are achieved by introducing reflective writing as a teaching pedagogy. Reflecting on their learning process aids in improving their learning as well as in developing their critical thinking skills. TBSL enables students to peer learn within the group to learn and unlearn an audit topic to achieve their learning outcomes.

In summary, the development of critical thinking and soft skills will prepare the students to be work-ready. Hence, they are expected to demonstrate their capability to apply core concepts, and principles learned in auditing how auditors' concerns in real-life situations are evaluated, analysed, and synthesised. In the context of auditing, the diverse arguments put forward from students in their discussions of the scenario-based problems will aid the students to think and socially interact with the group members critically. Furthermore, having team diversity creates an environment that promotes diverse views from students from different backgrounds, enabling them to discuss and work together to arrive at a group consensus with regard to the complex, messy grey areas. Of note, diversity of points of view together with minority dissent contribute to the cognitive differentiation (Curseu et al., 2018) which may trigger constructive conflict among the group members resulting in a productive negotiation process (Decuyper et al., 2010). According to Van den Bossche et al. (2006) constructive conflict is defined as negotiation through arguments and clarifications team members' differences in interpretation.

Preparation of Team-Based Learning Scenario

Student Group Formation

Auditors are expected to be analytical and critical in interpreting their client's data, for example, when they use automated tools and techniques in their audit. The audit process requires auditors to work as a team and to interact with the members of the audit team and their clients (Okike, 1999). Therefore, at the start of a semester, the Facilitator will carry out an ice-breaking session with the students. The ice-breaking session helps students know each other by names and also some personal attributes of their peers. During the ice-breaking session, students are briefed on the dos and don'ts of group formation. Additionally, the benefits and skills acquired on using projects for learning and collaboration are reiterated and emphasised. However, the Facilitators' main challenge is not just about encouraging the students to work together but also making it a practical learning experience. Therefore, we strive to maintain a balance by ensuring that groups do not hinder the progress of other students or encourage favouritism and idleness among the groups which may be captured during the peer evaluations that are conducted at the end of the group assignment submissions. In addition, grouping may influence the enhancement of group-based learning because the cognitive load theory entails the importance of an incomplete knowledge base to create an optimum condition for collaborative learning (Kirschner et al., 2009; Retnowati et al., 2018; Sweller et al., 2011). To illustrate, in a homogenous grouping it may be difficult to close the knowledge gap because the group members share a similar knowledge base (Lou et al., 1996; Zhang et al., 2016), thus collaboration may be redundant.

After which, the students form groups/teams of a maximum of four in each group. The 'buddy system' for group collaboration is introduced to promote common understanding, social cohesion, and intercultural competencies between students at a private international university (Marginson & Sawir, 2011). Following this system, students, particularly the lower performing students, may take social responsibility on group learning seriously and accept that interdependence works both ways, that is, accepting their peers' ideas and defending their own contributions (Chang-Tik & Dhaliwal, 2022). The buddy system begins with a student choosing one friend to be in the same group. To complete the balance of the number of team members, students will complete a Google-shared sheet to make up the remaining group members. As the

Google-shared sheet is accessible online to all students, they can form groups with different cohorts by updating their names simultaneously in the system. In summary, the buddy system is a method to select and form groups that the members can work together with.

At the same time, workshop sessions are organised to show how to conduct peer evaluation of their group members on the rating scale (see Appendix 3). Peer evaluation is necessary as it provides a structured learning process for students to critique and give feedback on a platform available in Moodle. Students are encouraged to be critical and provide feedback wherever possible among their team members and to other groups as and when necessary. However, the points stressed to the students are that critical feedback is encouraged but should be positive, constructive, and uplifting towards achieving the group's objective which is to provide a possible solution to the problem(s). The input should not be personal or detrimental to the group's progress. Additionally, there are workshop sessions to provide feedback individually and collectively as a group in analysing clients' data.

Another salient reason is that peer evaluation equips them with skills to reassess their work and benchmark them to improve their performances. The students are encouraged to positively take feedback and reassess their work based on the peer evaluation and comments during their discussions. These skills are essential to be mastered, as it is also what employers seek when the students commence their career in any field. Benchmarking is an excellent way to know if the students are at the mark or have a long way to go. Students are encouraged to focus on the areas where they feel they need to improve. However, this does not mean competing with colleagues or having a 'mind-set' of a rat race attitude merely outperforming their team members.

Furthermore, when assigning the groups, students who had an internship experience are spread among the teams to help support those who did not have such an experience, especially with work paper preparation. As auditing and assurance are practical undertakings, students require a mixture of technical knowledge and the foundation of their critical thinking and soft skills as a professional accountant. Working in groups or teams helps students develop their soft skills in collaborative active learning. Nguyen et al. (2020) mentioned four soft skills: communication skills, active listening skills, professional skills, and teamwork skills. Wellman (2010) and Reid and Anderson (2012) examine employee problem-solving skills, which require judging, analysing, and synthesising, relating to intelligence. The students are informed that in collaboration they have to build on one another's ideas and thoughts (Arvaja et al., 2007) and not cumulatively shared knowledge (Mercer, 1996). They have to ask questions for elaborations, seek mutual explanations and be involved in analytic reasoning that may end in cognitive conflicts which is advocated as essential for cognitive growth of students (Buchs et al., 2004). It is important to note that high-level collaboration requires students' willingness and effort towards collaboration as well as personal responsibilities. However, according to Hamalainen and Hakkinen (2010) the main problem for collaboration is unequal participation in the group work—asymmetric collaboration—that may become an obstacle for group cohesiveness (Capdeferro & Romero, 2012).

Nevertheless, workshop sessions are also made available to students on analysing and being critical in analysing their assignment client's data and collaborating in a group. Before analysing or evaluating clients' data, students need to read extensively on the subject area via articles, magazines, text, or media coverage. Upon acquiring substantial knowledge of the subject matter background, students can discuss and provide reasonable critics of the subject matter. Furthermore, with a sufficient amount of preliminary reading and understanding of the subject, they could provide valuable inputs and constructive ideas into the discussion. During the workshop session, the Facilitator will feedforward on their responses, which is carried out in an informal manner in order to give students a feeling of a safe learning environment. It is crucial as it encourages students to openly communicate and participate in the discussions. In this regard, the team collaboration improves students' communication skills and provides them the confidence to undertake a self-reflection on their learning process.

Scenario 1: Analysis of Audit Risk Factors

Open-ended questions will be created for Scenario 1 (see Appendix 1) to obtain multiple responses from the students. Possible grey areas such as non-routine transactions, the complexity of the organisation, and assumptions made on audit risk factors will require students to communicate their thinking processes to their team members to discuss and arrive at a consensus. The open-ended questions aid students in relating the lecture materials to a real-world situation. The grey areas are built into the open-ended questions creating task interdependence requiring students to share information and practise positive interdependence, an element in the Social Interdependence Theory (Johnson & Johnson, 2009), in order to maximise collaboration among group members, particularly in peer learning.

Scenario 1 relates to evaluating a client's audit risk, which requires students to analyse, gather information, and discuss their multiple responses to the issues raised in the scenario. For these collaborative discussions to occur, students will form a group of four to carry out their conversations of the open-ended questions. Before students can have their group discussions, they must attend a training session on collaborative learning, peer feedback, and issues of group dynamics. To this end, according to Yildiz Durak (2022) group studies and group dynamics contribute positively to the development of academic self-efficacy of students during learning activities with the support of the group members. For a start, students conduct pre-discussion to deliberate on the initial segregation of their assignment load and the responsibilities to be undertaken by the group as a whole. The students are reminded of the cognitive load theory that emphasises the significance of the incomplete knowledge base condition for collaborative learning (Kirschner et al., 2009; Retnowati et al., 2018; Sweller et al., 2011) as well as the weaknesses of homogeneous grouping. After that, the students must select a team leader to lead the team. The main challenge here is the appointment of a team leader, as there is a tendency for a division to occur among the group. But these are resolved via peer feedback, where students express their dissatisfaction and provide suggestions on how not to repeat past misjudgements. Nevertheless, collaborative active learning usually practises shared leadership which is more beneficial in terms of peer learning than individual leadership (Johnson et al., 2002; Kayes, 2004). The students' learning outcomes are reinforced by providing them with online learning activities and workshops. For instance, reinforcements are made available when Facilitators listen to students' multiple responses and provide suggestions for further deliberations. Once the pre-discussion is over, the students attend a face-to-face group discussion. During this session, the Facilitator will probe students with questions in order to provide direction and feedback on their discussions.

These probing questions provide more clarity to the subject of discussion via active learning and ultimately enhance the students' thinking process. Interestingly, intergroup reactions occur when groups compare their responses or miss-interpretations the Facilitators response. Under such circumstances, Facilitators provide feedback in the form of practical examples to clarify the discourse at hand. Accordingly, the intergroup reactions are positive indications of cognitive differentiation which eventually may trigger constructive conflict among the groups resulting in a productive deliberation process (Decuyper et al., 2010).

Finally, scenario-based knowledge helps students increase their learning experience (Mio et al., 2019). Students can better understand their learning materials by applying their cognitive thinking to specific scenarios rather than knowledge-based learning in the form of quizzes. To illustrate, the techniques provided in this chapter require students to evaluate a company's audit risk, which will develop a student's skill in exercising their judgment on materiality and planning. Furthermore, working as a team develops students' soft skills such as communication of ideas, and leadership skills. The learning activities in scenarios 1 to 3 are designed to have no "right" or "wrong" responses. The scenarios help to achieve the learning outcomes, develop the students' critical thinking as well as their communication skills. The workshops, excluding the ice-breaking session, are utilised to share amongst the group members their prior knowledge, collaboration in peer learning that leads to more understanding, and finally, discussion to arrive at a consensus response to the problem. In practice, based on the construction of the audit team, the leader will lead the team to ensure that the task progresses and provide solutions to emerging audit issues that will be discussed with the engagement partner to ensure the audit quality of the client engagement. Hence, the soft skills required by the profession are sought after by the accounting firms.

Scenario 2: Material Misstatements

The majority of the students enrolled in the course do not have any practical or working experience as auditors. For that reason, the traditional lecturing approach is not suitable for the competencies identified in the 'Future of Jobs Report' (2016) as the audit textbooks, lecture handouts, and notes only provide subject matter knowledge. Hence, Scenario 2 supports a real-life scenario that will give students the 'working experience.' It is important as it gives students an authentic environment which is in line with constructivism and experiential learning, generally referred to as situated learning (Stahl et al., 2006). The authenticity of the scenario helps to establish a learning climate that enhances students' comfort and willingness to participate (Thomas & Thorpe, 2019) and subsequently increases the level of collaboration. A discussion forum encourages students through social interaction to learn by actively discussing and listening to their peers. The classroom and the Moodle system provide a physically safe learning environment for students.

Furthermore, it is crucial to understand that students need to engage with confidence, equal status, individual accountability, and friendship to reduce group emotional conflicts. The Facilitator must ensure that classroom expectations and rules are made known to the students. In addition, students are encouraged to communicate freely in the classroom and have discussions that provide a friendly atmosphere in order to promote cognitive conflicts through the collaborative activities and to avoid free riders as a result of asymmetric collaboration. According to Abernethy and Lett (2005), free riders may cause frustration among students about the grades obtained in group work. Importantly, if the problem is not mitigated it may drive other students to be free riders too (El Massah, 2018).

A Facilitator will be able to provide feedback in two ways. The first approach is during consultation hours, where students will come in their respective groups to have open discussions with the Facilitator. There will be a consultative process where the Facilitator and the group will have open-ended questions to discuss and brainstorm. The Facilitator's main objective is to encourage out-of-box discussions and instill an analytical mind-set in the students. In addition, through the consultative process the Facilitator receives feedback on the students' performance and subsequently adjusts the scaffolding to meet the diverse needs of the student learning process (Arvaja et al., 2010). The second approach is where groups can communicate via the specific forum link shared with each group. In this instance, only the particular groups will see the comments discussed with the Facilitator. Confidentiality is to be observed by the respective groups. The positive aspect of this part is that communication is maintained at any point in time. However, there will be a grace period when the Facilitator will be actively involved in the discussions.

On the other hand, peer feedback is also established among the groups to ensure that each group member understands, respects, and adheres to the expectations of each group member. Constant communication via meetings and correspondence among the group members will minimise any conflicts that may occur. Students acquire the collaborative and peer learning skills through TBSL approach where they attempt to fill the knowledge gap by listening to others recall information (Blumen & Rajaram, 2008), relearn information, if necessary (Rajaram & Pereira-Pasari, 2010), and avoid recall errors by receiving feedback from group members (Barber et al., 2010).

Upon forming the groupings, the students must discuss Scenario task 2 in the discussion forum, encouraging student engagement and inter-group discussions. The benefit of this mode of discussion forum is that students are prohibited from seeing other students' comments on learning task 2 until they have posted on Moodle. Each student in the group is encouraged to contribute to the Moodle forum. To get students to collaborate, a different group must pick any two group responses and comment with reasons they agree or disagree with the comments posted in Moodle. There is no word limit for postings by the group; however, students are encouraged not to be very brief. The Facilitator's role is to initiate discussions amongst the students and provide constructive feedback to students' postings. The Moodle platform allows students to learn through social interaction, based on the principles of social constructivism (Palincsar, 1998). According to Szabo (2015) peer facilitation in online forum discussions positively impacted student participation. However, to bring the discussion to a higher level of deliberations and to include more discussion of the prescribed readings, lecturers' inputs may be needed to guide it to the required outcomes.

Collaborative learning is made possible by the Facilitator's constructive comments and students individually reading their lecture materials and commenting on other students' posts as a form of peer learning, particularly having two-way feedback among peers and dialogue between lecturers and students (Keppell & Riddle, 2012). As Facilitators, our responsibility is to encourage students to comment without fear of being criticised. Students should be at ease to provide constructive feedback and agree to disagree positively. It is salient for the students to understand that feedback should be relevant and valuable for the other person, i.e., focus on the discussion. There should always be respect for another person's opinion and consider the position we give and receive our feedback. It is also essential that students reflect on the importance of describing the issues at hand rather than interpreting them. Thus, with this core understanding of constructive comments, the groups are expected to allocate time for the preparatory work of Scenario 2.

The Facilitator's primary interest in achieving the TBSL objective is how students work as a team and reach a group consensus. Each group member must submit a self-reflection of their experience at agreeing to each group meeting. Self-reflection refers to a critical component of emotional intelligence and developing a better understanding of others. Hence, this reflective practice can help students develop creative thinking skills and encourage active participation in the class environment. Additionally, self-reflection is one of the phases in Zimmerman and Schunk's (2008) model of self-regulated learning, which is an essential component of any form of collaborative active learning that is based on theories that consider learning as a constructivist, self-regulated, and collaborative process (Niemi & Nevgi, 2014). Students are also motivated to attend the group meetings to provide more ideas and feedback and feel countered as contributing to the team's success. For instance, the more committed students tend to provide constructive feedback on team members who are not contributing towards the overall group performance. Scenario 2 was opened for a week, after which the students were to complete a peer evaluation form (see Appendix 3). Students are invigorated to complete a peer evaluation form to ensure that the team members know the standards required to complete the assignment and share and communicate their expectations to their team members. Peer assessments help to reward those who contribute more. Only the individual members from each group will be able to assess their peers in terms of individual contributions or efforts made by each member. Hence, this will spur students to reach a group consensus and work as a team. It also means to discourage the uneven distribution of workloads within the group members. Furthermore, the regular feedback that they gather within the group helps them to gauge their progress both as a group and individually.

Scenario 3: Audit and Non-Audit Services

Students are required to watch a video on the provision of audit and non-audit services. Videos are used as a TBSL audio-visual learning tool as they provide students an opportunity to see auditing in practice. Using videos as an interactive learning tool encourages group social interaction and learning. However, according to the cognitive load theory (Van Merrienboer & Sweller, 2005) and the cognitive theory of multimedia learning (Mayer, 2005), video as a presentation format can influence students' working memory and their invested cognitive load. Therefore, care is taken to avoid working memory overload due to animation, and redundant information visually and verbally. Consequently, annotations or video transcript documents are used to improve students' comprehension of the video content (Joksimovic et al., 2019). The peer learning process involved regulating emotional conflicts and embracing cognitive conflicts in understanding concepts and knowledge of the topic and connecting what they have learned in the lecture materials to new information. The collaborative peer learning within the group is reinforced by students questioning and explaining to each other.

The interactive videos encourage student engagement, develop students' reasoning skills when open-ended questions are inserted relating to audit and non-audit services. First, students are required to select the latest video on the provision of audit and non-audit services either in the context of Malaysia or internationally. Once the group has selected a video, each group is to submit their chosen video to the Facilitator. The Learning Management System (LMS) platform used is Moodle. Using the interactive HTML5 Package (H5P) tool in Moodle, the Facilitator will insert open-ended questions at various discussion points to each submitted video to elicit multi-responses from the students. For example, the students need to have a critical mind-set to answer the following question: Why do you think this is a global issue to be addressed by the accounting profession? The task was intended to prompt responses from group members about why this is a current issue and any possible solutions for an audit firm that provides audit and non-audit services. Another learning activity is to embed quizzes and puzzles into the interactive videos. These interactive activities are both summative and formative assessments. This enables the Facilitator to assess whether the learning outcomes have been achieved.

As Facilitators of the auditing course, the aim is to develop students' thinking, reasoning and communication processes by prompting higher-order thinking responses to scenario-based questions rather than having them cite learned responses from their study materials. Students will respond to situational questions that reveal a lot about their skills, abilities, character, and personality. Students will also be able to delve into their strengths and weaknesses to gauge how they can respond to a hypothetical situation in the current and future problems. This form of scenario-based assessment focuses on rewarding students on the development of essential skills and capabilities needed in auditing (Crisp, 2012). Likewise, with this type of support and guidance from the Facilitators, students will also be able to provide peer feedback more realistically and simultaneously have the ability to interpret the input constructively obtained from their peers.

Hence, promoting higher-order thinking responses to scenario-based questions with effective peer feedback will make the learning experience more resourceful and wholesome. The authentic learning interactions acquired in this scenario together with assessment and feedback that are designed to support learning will be useful for the students' future career. For instance, we noticed that students who performed peer feedback and higher order thinking responses tend to obtain relatively higher scores. In addition, due to the simulation experience, the Facilitator can ask additional higher-order critical thinking questions on the assessments, such as requiring students to assemble multiple audit procedures to solve a real-life scenario. Students are expected to have countermeasures to respond to the gaps in the strategy and to access the parts of plans based on the significant impact on the highest probability and highest severity and work their way down.

As this is a scenario-based question, the Facilitator expects extensive reading and research before attempting the question. Students need to brainstorm in a group as only through group discussions, creative and insightful ideas and thoughts emerge. Peer feedback will also provide an overall check and balance on the deliberations made by the group. Peer feedback will also filter issues that are not sensible, idealistic, and narrow through discussions. The outcome of the peer feedback will result in ideas that will be more realistic, objective, and acceptable by the group members. In other words, students are expected to practise individual accountability by reading and researching extensively before meeting up with their peers for group deliberations. During the group discussion every member is expected to contribute, argue, and elaborate in the spirit that they are together in achieving a common goal (positive interdependence). On the other hand, if students were to merely read lecture notes without additional research or minimum brainstorming sessions, providing a slip short peer review report and to have hardly any deliberations among the group, then the overall outcome will be dismal. Hence, Facilitators have to constantly emphasise on the positive aspects of outcome-based approach of scenario-based questions.

Assessment and Feedback

The implementation of Scenario 1 is via open-ended questions, and it begins in a particular way. Open-ended questions start with words such as why, how, what, describe, tell me about, or what do you think about.

They are conducted to encourage students to reason, think, reflect, and arrive at a complete answer rather than a simple response such as a 'yes' or 'No.' Open-ended questions are used as follow-ups for other questions. Students are to provide responses related to the specific scenario provided in the question. 'Facilitator's feedback is based on a structured rubric that considers factors such as identification of relevant problem areas, relevant recommendations, critical review of the problem areas, and the rationale in concluding.

Implementation of Scenario 2 is via discussion forums using scenario-based questions in their discussions. This practical online learning model provides flexibility and connectivity in the virtual or online classroom. The design and implementation of these forums significantly affect the students' learning experience and outcomes. Discussion forums use the online Moodle software as the communication channel. Students are briefed on the usage of the Moodle software, and technical issues faced by the students will be brought to the attention of the Moodle administrator to address them. Facilitators are expected to provide feedback on their expectations towards the student's work quality, respond promptly, point out the strengths and weaknesses of the arguments, present sufficient evidence and examples where necessary, and draft the answer before posting.

Scenario 3 uses video presentations as a mode to gauge students' learning experience. Here, the Facilitator provides a range of recommended visual recordings for students to view and understand. Students are encouraged to read extensively on materials related to the subject matter that is to be deliberated. Students are evaluated on how they can respond to the scenario based on the rubric criteria before the class. The expectation has been set in advance, and the necessary scope of coverage is also made known in the rubric. The feedback provided to the student will be more on how far or how close the answers are as per the rubric criteria, and on their strengths and the areas of improvement. The use of rubric helps students to focus their efforts and at the same time it assists lecturers to convey clear expectations of the scenario to the students thus ensuring them that the activities are within each student's range of competence (Owens et al., 2020). In doing so, it helps to reduce student resistance while enhancing motivation (Allen & Tanner, 2006).

Conclusions

TBSL as a pedagogical tool ensures that students are encouraged and facilitated through their collaborative group learning activities to meet face-to-face, share their diverse responses, and work as a team to arrive at a group census. This simulated audit and assurance setting in Scenario 1 requires students to analyse the audit risk factors, brainstorm ideas to identify and process the knowledge from their learning materials and apply it to a scenario. In Scenario 2, students were expected to reflect on their audit and assurance lecture materials and their prior financial reporting knowledge. The Facilitator is expected to encourage the development of higher-order thinking skills and deep learning that enables students to synthesise their prior learning from other units to auditing. The belief is that students can analyse and communicate the potential audit issues found in the discussion forum in the Moodle platform. The discussion forum acts as a channel to improve student communications. As auditors, their audit findings need to be reported to their clients and within the audit team. In Scenario 3, the students must carry out their group research that links to their learning activity. The learning activity will entail students attempting to align the learning outcomes of Scenario 3 to the selection of a suitable video to discuss the question. This learning activity would require team collaboration and dynamics in selecting an appropriate video. The group submission of the self-reflection journal plays a role in showing how the group dynamics have been resolved., The use of interactive videos gives relevancy to the audit and assurance unit and engages students. Furthermore, viewing interactive videos may enhance students' learning outcomes as they are involved in group learning and relearning their prior knowledge and apply it to a learning activity in the video.

Based on the Facilitator's perspective, the main challenge is designing the learning activities for the three scenarios. The questions had to be open-ended to encourage multiple responses from the students. Another challenge to the Facilitator was in the group formation stage where a student did not have a 'buddy.' Coaxing a student to be randomly placed in a group may demotivate a student.

In summary, the design of real-life scenery, videos, and forum discussions via Moodle allow students to achieve their learning outcomes through group collaboration and peer learning. The combination of the various learning activities encourages students to put forward their discussions, leading to critical thinking and social interaction with the group members in accordance with the positive interdependence and individual accountability elements of the Social Interdependence Theory (Johnson & Johnson, 2009). The presence of a Facilitator further enhances the students' learning process. The main objectives of the learning activities in Scenarios 1, 2 and 3 were to engage students actively to reinforce their learning outcomes by giving immediate feedback on their multiple responses. The sources of feedback were from their peers as well as the Facilitator.

Appendix 1: Analysis of Audit Risk Factors

This scenario is intended to allow audit students to evaluate the audit risks to their clients.

You are the Engagement partner in charge of a new client, Stay Alive, whose year-end is Dec. 31, 2020. On Jan. 3, 2021, there was a news media release regarding Stay Alive as follows:

Stay Alive is making its long-awaited stock market debut. The home-sharing company priced its shares at $100 per share on Wednesday, Dec. 9, 2020, giving it an overall value of $75 billion. The shares of Stay Alive will trade in the Bursa Malaysia under the symbol "STAL."

Required

1. Put yourself as the engagement partner in charge of the audit of Stay Alive. Discuss with the audit team whether any additional due diligence needs to be considered due to the listing in Bursa Malaysia (Malaysian Stock Exchange)?
2. Evaluate the potential risk factors your client may face as an audit team for the current year's audit.

You are required to discuss as a group of four (4) members how you as an auditor will evaluate and justify your concerns of any three (3) factors that may influence the audit risk of your client. The planning of the financial audit is for the year ended Dec. 31, 2020.

Note to students: Students must extensively read their lecture notes, articles, and magazines before this assignment. Again, they are expected to use their analytical skills to evaluate and justify the factors that may influence the audit risk as per the scenario provided. Students are required to collaborate in a group of four.

Appendix 2: Material Misstatements

Your client, ABC Group Incorporated, manufactures goods for resale. The following information is extracted from the schedule of non-current assets, and notes to the financial statements for the year ended Dec. 31, 2020, is shown below:

The schedule of non-current assets at Jan. 1, 2020, excluding any additions to the non-current assets, are shown as follows:

Existing assets	*Cost basis*	*Accumulated depreciation*	*Economic expected life*
Land	$3,500,000		
Factory buildings	$20,000,000	$52,100,500	20
Equipment	$500,000	$300,000	5
Furniture and fittings	$8,250,000	$8,250,000	4

Additional information.

1. The accounting policy of ABC Group Incorporated regarding its non-current assets is that depreciation is based on the straight-line method and charged when the non-current asset is available for use.
2. The total costs of acquiring new non-current assets acquired on 1st May 2020 are $2.5 million for land; $90,000,000 for buildings; $8,900,000 for equipment; and $2,200,000 for furniture and fittings.
3. The total depreciation expenses shown in the financial statements were $3,900,000. ABC charges depreciation on a time basis.

Required

The information provided assessed the risk of material misstatements identified in ABC Group Incorporated for the year ended Dec. 31, 2020. Using analytical procedures, students need to apply the four-module learning outcomes:

1. Select and apply data-appropriate accounting techniques to critically analyse financial data in a variety of business decision-making.
2. Make informed financial judgments based on the outcome of such accounting analyses.

3. Critically appraise the techniques used and the information to which they have been applied.
4. Demonstrate a critical understanding of the internal, external, and legal environments the judgments have been made.

Appendix 3: Peer Evaluation Form for Group Members

Your name ____Student ID _____________.

Part A

Write the name of each of your group members in a separate column. For each person, indicate the extent to which you agree with the statement on the left, using a scale of 1–4 (1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree). Total the numbers in each column.

Assessment citeria	*Group member*	*Group member*	*Group member*	*Group member*
Frequently attend meetings and promptly				
Contribute productively to group discussions				
Covers the areas allocated to each member				
Work is prepared conscientiously				
Exhibits a cooperative and supportive attitude				
Provide inputs considerably to the success of the project				
Total marks				

Part B

Feedback on team dynamics:

1. How resourcefully did you work towards the success of the group?
2. Indicate any specific behaviours that were particularly valuable or detrimental to the team?
3. What did you learn about teamwork, and what will you carry into your next group experience?

References

Abernethy, A., & Lett, W. (2005). You are fired! A method to control and sanction free riding in group assignments. *Marketing Education Review, 15*(1), 47–54. https://doi.org/10.1080/10528008.2005.11488891

Allen, D., & Tanner, K. (2006). Rubrics: Tools for making learning goals and evaluation criteria explicit for both teachers and learners. *CBE Life Sciences Education*, *5*(3), 197–203. https://doi.org/10.1187/cbe.06-06-0168

Arvaja, M., Hämäläinen, R., & Rasku-Puttonen, H. (2010). Challenges for the teacher's role in promoting productive knowledge construction in computer-supported collaborative learning contexts. In S. Simon, K. Fernstrom, T. Wubbels, and B. Hudson (Eds.), *Online learning communities and teacher professional development: Methods for improved educational Delivery* (pp. 263–280). IGI Global.

Arvaja, M., Salovaara, H., Hakkinen, P., & Jarvela, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning and Instruction, 17*(4), 448–459. https://doi.org/10.1016/j.learninstruc.2007.04.003

Barber, S. J., Rajaram, S., & Aron, A. (2010). When two is too many: Collaborative encoding impairs memory. *Memory & Cognition, 38*(3), 255–264.

Beattie, V., Fearnley, S., & Hines, T. (2012). A real-life case study of audit interactions resolving messy, complex problems. *Accounting Education, 21*(2), 111–129.

Blumen, H. M., & Rajaram, S. (2008). Influence of re-exposure and retrieval disruption during group collaboration on later individual recall. *Memory, 16*(3), 231–244.

Boud, D. (2001). *Peer learning in higher education: Learning from and with each other*. Kogan Page.

Buchs, C., Butera, F., Mugny, G., & Darnon, C. (2004). Conflict elaboration and cognitive outcomes. *Theory into Practice, 43*(1), 23–30. https://doi.org/10.1207/s15430421tip4301_4

Buckless, F. A., Krawczyk, K., & Showalter, D. S. (2014). Using virtual worlds to simulate real-world audit procedures. *Issues in Accounting Education, 29*(3), 389. https://doi.org/10.2308/iace-50785

Cabrera, A. F., Crissman, J. L., Bernal, E. M., Nora, A., Terenzini, P. T., & Pascarella, E. T. (2002). Collaborative learning: Its impact on college students' development and diversity. *Journal of College Student Development*, *43*(1), 20–34. http://www.hci.sg/admin/uwa/MEd7_8633/Causal_comparative2.pdf

Capdeferro, N., & Romero, M. (2012). Are online learners frustrated with collaborative learning experiences? *The International Review of Research in Open and Distributed Learning, 12*(2), 26–44. https://doi.org/10.19173/irrodl.v13i2.1127

Chang-Tik, C., & Dhaliwal, J. (2022). Collaborative learning approach to teach computer coding in informal spaces. *Learning: Research and Practice, 8*(1), 5–24. https://doi.org/10.1080/23735082.2021.1953571

Crisp, G. (2012). Assessment in Virtual Learning Spaces. In M. Keppell, K. Souter, and M. Riddle (Eds.), *Physical and virtual learning spaces in higher education*: *Concepts for the modern learning environment* (pp. 199–218). IGI Global.

Curseu, P. L., Chappin, M. M. H., Jansen, Rob J. G., Dynamics of Innovation Systems, & Innovation Studies. (2018). Gender diversity and motivation in collaborative learning groups: The mediating role of group discussion quality. *Social Psychology of Education*, *21*(2), 289–302. https://doi.org/10.1007/s11218-017-9419-5

Decuyper, S., Dochy, F., & Van den Bossche, P. (2010). Grasping the dynamic complexity of team learning: An integrative model for effective team learning in organisations. *Educational Research Review, 5*(2), 111–133. https://doi.org/10.1016/j.edurev.2010.02.002

Edmondson, A. C. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly, 44*(2), 350–383. https://doi.org/10.2307/2666999

Edmondson, A. C., & Lei, Z. (2014). Psychological safety: The history, renaissance, and future of an interpersonal construct. *Annual Review of Organizational Psychology and Organizational Behavior, 1*(1), 23–43. https://doi.org/10.1146/annurev-orgpsych-031413-091305

Eisen, M. J. (2001). Peer-based professional development viewed through the lens of transformation. *Holistic Nursing Practice, 16*(1), 30–42. https://doi.org/10.1097/00004650-200110000-00008

El Massah, S. S. (2018). Addressing free riders in collaborative group work: The use of mobile application in higher education. *International Journal of Educational Management, 32*(7), 1223–1244. https://doi.org/10.1108/IJEM-01-2017-0012

Hamalainen, R., & Hakkinen, P. (2010). Teacher's instructional planning for computer-supported collaborative learning: Macro-scripts as a pedagogical method to facilitate collaborative learning. *Teaching and Teacher Education, 26*(4), 871–877. https://doi.org/10.1016/j.tate.2009.10.025

Johnson, D. W. (1973). Communication in conflict situations: A critical review of the research. *International Journal of Group Tensions, 3*, 46–67.

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher, 38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Johnson, S., Suriya, C., Won Yoon, S., Berrett, J., & La Fleur, J. (2002). Team development and group processes of virtual learning teams. *Computers & Education, 39*(4), 379–393. https://doi.org/10.1016/S0360-1315(02)00074-X

Joksimovic, S., Dowell, N., Gasevic, D., Mirriahi, N., Dawson, S., & Grasser, A. C. (2019). Linguistic characteristics of reflective states in video annotations under different instructional conditions. *Computers in Human Behavior, 96*, 211–222. https://doi.org/10.1016/j.chb.2018.03.003

Kayes, D. (2004). The 1996 Mount Everest climbing disaster: The breakdown of learning in teams. *Human Relations, 57*(10), 1263–1284. https://doi.org/10.1177/0018726704048355

Keppell, M., & Riddle, M. (2012). Distributed learning spaces: Physical, blended and virtual learning spaces in higher education. In M. Keppell, K. Souter, & M. Riddle (Eds.), *Physical and virtual learning spaces in higher education*: *Concepts for the modern learning environment* (pp. 1–20). Hershey, PA: IGI Global.

Kirschner, F., Paas, F., & Kirschner, P. A. (2009). A cognitive load approach to collaborative learning: United brains for complex tasks. *Educational Psychology Review, 21*(1), 31–42. https://doi.org/10.1007/s10648-008-9095-2

Long, P. D., & Ehrmann, S. C. (2005). The future of the learning space: Breaking out of the box. *EDUCAUSE Review, 40*(4), 42–58. https://bit.ly/3DOdUNz

Lou, Y., Abrami, P. C., Spence, J. C., Poulsen, C., Chambers, B., & d'Apollonia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research, 66*(4), 423–458. https://doi.org/10.3102/00346543066004423

Marginson, S., & Sawir, E. (2011). International and Intercultural education. In S. Marginson & E. Sawir (Eds.), *Ideas for Intercultural Education* (pp. 1–19). Springer.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 31–48). Cambridge University Press.

Mercer, N. (1996). The quality of talk in children's collaborative activity in classroom. *Learning and Instruction, 6*(4), 359–377. https://doi.org/10.1016/S0959-4752(96)00021-7

Mio, C., & Ventura-Medina., E., & João, E. (2019). Scenario-based eLearning to promote active learning in large cohorts Students' perspective. *Computer Applications in Engineering Education, 27*(4), 894–909. https://doi.org/10.1002/cae.22123

Nguyen, T. H. D., Le, V. L., Hau, N. V., Do, D. T., & Thao, N. T. T. (2020). Evaluation of auditors' professional skills in local auditing firms in Hanoi. *Journal of Asian Finance, Economics, and Business, 7*(9), 583–591. https://doi.org/10.13106/jafeb.2020

Niemi, H., & Nevgi, A. (2014). Research studies and active learning promoting professional competences in Finnish teacher education. *Teaching and Teacher Education, 43*, 131–142. https://doi.org/10.1016/j.tate.2014.07.006

Okike, E. (1999). The Coopers & Lybrand excellence in audit education programme a note. *Accounting Education: An International Journal, 8*(1), 57–65. https://doi.org/10.1080/096392899331044

Owens, D. C., Sadler, T. D., & Barlow, A. T. (2020). Student motivation from and resistance to active learning rooted in essential science practices. *Research in Science Education, 50*, 253–277. https://doi.org/10.1007/s11165-017-9688-1

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*, 345–375. https://doi.org/10.1146/annurev.psych.49.1.345

Pedder, D., Storey, A., & Opfer, V. D. (2008). *Schools and continuing professional development (CPD) in England—State of the nation research project* (A report commissioned by the Training and Development Agency for Schools). Cambridge University and the Open University.

Rajaram, S., & Pereira-Pasari, L. P. (2010). Collaborative memory: Cognitive research and theory. *Perspectives on Psychological Science, 5*(6), 649–663. https://doi.org/10.1177/1745691610388763

Ravenscroft, S. P., Buckless, F. A., & Hassall, T. (1999). Cooperative learning: A literature guide. *Accounting Education, 8*(2), 163–176. https://doi.org/10.1080/096392899330991

Reid, J. R., & Anderson, P. R. (2012). Critical thinking in the business classroom. *Journal of Education for Business, 87*(1), 52–59. https://doi.org/10.1080/08832323.2011.557103

Retnowati, E., Ayres, P., & Sweller, J. (2018). Collaborative learning effects when students have complete or incomplete knowledge. *Applied Cognitive Psychology, 32*(6), 681–692. https://doi.org/10.1002/acp.3444

Scriven, M., & Paul, R. (1987). Critical thinking. In *Proceedings from the 8th annual international conference on critical thinking and education reform*. Summer.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 409–426). Cambridge University Press.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer.

Szabo, Z. (2015). Better together: Teams and discourse in asynchronous online discussion forums. *Journal of Psychological and Educational Research, 23*(1), 73–88.

Thomas, G., & Thorpe, S. (2019). Enhancing the facilitation of online groups in higher education: A review of the literature on face-to-face and online group-facilitation. *Interactive Learning Environments, 27*(1), 62–71. https://doi.org/10.1080/10494820.2018.1451897

Van den Bossche, P., Gijselaers, W. H., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Van Merrienboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147–177. https://doi.org/10.1007/s10648-005-3951-0

Wellman, N. (2010). The employability attributes required of new marketing graduates. *Marketing Intelligence & Planning*, *28*(7), 908–930. doi.https://doi.org/10.1108/02634501011086490

Yildiz Durak, H. (2022). Flipped classroom model applications in computing courses: Peer- assisted groups, collaborative group and individual learning. *Computer Applications in Engineering Education*.https://doi.org/10.1002/cae.22487.

Zhang, L., Kalyuga, S., Lee, C., & Lei, C. (2016). Effectiveness of collaborative learning of computer programming under different learning group formations according to students' prior knowledge: A cognitive load perspective. *Journal of Interactive Learning Research, 27*(2), 171–192. https://doi.org/10.1016/j.chb.2010.03.038

Zimmerman, B. J., & Schunk, D. H. (2008). Motivation, an essential dimension of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation & self-regulated learning: Theory, research & applications* (pp. 1–30). Erlbaum.

CHAPTER 12

Peer-Led Case Study Methodology in the Learning of Statistics

Shiney John and Revathi Sagadavan

The best thing about being a statistician is that you get to play in everyone else's backyard.

John Tukey (1977)

Introduction

Students in today's classroom are not confined just to four walls (Bonk & Graham, 2012) and they are not willing to learn from just one subject expert. To illustrate this point, according to Roberts and Weaver (2006, p. 97) learning is now "leaving the classroom" and Johnson and Lomas (2005) concur that digital devices are turning any spaces outside the classroom into informal learning spaces. Learning today happens through

S. John (✉) · R. Sagadavan
INTI International University, Nilai, Negeri Sembilan, Malaysia
e-mail: shiney.john@newinti.edu.my

R. Sagadavan
e-mail: revathi.sagadavan@newinti.edu.my

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_12

collaboration, cooperation, and mutual sharing of knowledge. Technologies and many web-based tools have aided this new method of learning. Transformations that have happened in teaching and learning scenarios have linked students, instructors, resources and activities into a collaborative learning environment, which redefines the teacher's position and enables students to transform the learning process according to their individual needs (Chiriac & Granström, 2012; McClellan, 2015; Mejias, 2006). Few studies have shown that collaborative active learning (CAL) increases engagement, alters learning attitudes, enhances self-efficacy and promotes collaboration (Baepler & Walker, 2014; Ge et al., 2013; Park & Choi, 2014; Salter et al., 2013). Another study on active learning in science, engineering and mathematics shows a six-percentage average increase in student assessment results and a substantial reduction in the number of students failing (Freeman et al., 2014). The above studies suggest that CAL positively influences student learning. In a collaborative learning environment, knowledge is shared or transmitted among learners as they work towards common learning goals, for example, a shared understanding of the subject in hand or providing a solution to a problem. To this end, Arvaja et al. (2007) added that it is not enough to cumulatively share knowledge, students have to construct and build on one another's ideas and thoughts (Mercer, 1996) through collaborative activities like a mutual explanation, elaborative questioning and analytic reasoning. These changes enable a student-centred learning environment, which creates classrooms with minimal support from instructors, where they only facilitate and foster peer discussions. Nevertheless, according to Panadero and Järvelä (2015), collaboration alone does not always lead to effective group work. It has to be supported by a regulatory mechanism to increase students' attention to the given tasks and group awareness. The mechanism also allows students to consolidate their learning awareness by providing them a platform to set learning goals and monitor their learning processes (Lai, 2021).

Introductory Statistics is an integral part of the undergraduate business course syllabus as students need to make inferences about a population parameter when faced with real-world business situations and challenges. The statistical concepts they learn together with the tools used in data analysis prepare students to deal with real-life situations as they become more skilled in teamwork, collaboration and communication. Hence, statistics instructors have to be more innovative in their teaching strategies. Implementing active learning strategies using real-life situations helps encourage discovery learning and develop statistical reasoning and thinking skills. We allowed students to collect and analyse authentic data which meant that the learning tasks required students to reflect on real-life consequences of the outcomes of the tasks given. In this chapter, we discuss specific collaborative active learning strategy used to teach hypothesis testing, which can be implemented at the tertiary level to encourage active learning and collaboration among students.

The CAL strategy discussed here is a combination of peer-led team learning and case study methodology which is addressed as peer-led case study methodology. This CAL strategy, that we deployed in our introductory statistics class, enabled the engagement of the whole class rather than a small group of students who actively participated by responding to the lecturer's questions. This strategy is more than allocating tasks across the group and individual learning spaces as it encourages students to think independently (Tullis & Goldstone, 2020). Felder and Brent (2016) found that CAL strategies expect learners to perform meaningful learning activities and reflect upon how they solve statistical problems. Learning statistics using this strategy can be considered a major transformation from the traditional approach. Cousin (2010) and Reagan (2018) are of the view that students find hypothesis testing a troublesome and unpleasant concept where they have identified the difficulties students face when learning hypothesis testing.

Over the years of teaching statistical hypothesis testing, we have observed that Introductory Statistics students struggle to develop a robust and connected understanding of the real meaning of statistical hypothesis testing. Though they can perform the procedures, students do not have a strong understanding of the concepts, the logic and uses of the methodology. This is especially noticeable when tests and assignments are conducted relating to hypothesis testing concepts. We observed that students face difficulties when they state the null and alternative hypotheses, make a hypothesis decision, compute the test statistic value and write the decision and conclusion statement. We successfully implemented peer-led case study methodology in our classroom practices to make the teaching and learning process more effective. Similarly, Carlson et al. (2016) have successfully conducted peer-led learning in a STEM discipline. Studies have shown that students have benefited from peer instruction (Trout et al., 2014) across many fields, including Physics (Pollock et al., 2010), Biology (Knight et al., 2013), Chemistry (Brooks & Koretsky, 2011), Calculus (Lucas, 2009), Computer Science

(Porter et al., 2013), Entomology (Jones et al., 2012) and even Philosophy (Butchart et al., 2009). This pedagogical approach shifts the focus from teacher-centered instruction to peer instruction which improves learners' conceptual understanding, reduces student attrition in difficult courses (Lasry et al., 2008), decreases failure rates (Porter et al., 2013), improves students' attendance (Deslauriers et al., 2011), and bolsters student engagement and attitudes to their respective course (Lucas, 2009). Nevertheless, according to Mazur (1997) peer instruction—as used in our methodology—is a pragmatic transition from a teacher-centered approach to an engaging active learning pedagogy. Specifically, during peer instruction students are in complete control of the learning process and they self-regulate the discussion (Arico & Lancaster, 2018). As such, they must negotiate meanings and be empowered to "talkback" in order to reconstruct understanding in accordance with their own terms (Green, 2019) as well as to afford them space to critique the institutional conventions and underlying practices (Lillis, 2006). Our goal was to improve our students' understanding of the concept of hypothesis testing by the end of a semester.

The statistics course is a four-credit hour course which is conducted three times a week over a period of fourteen weeks. It is a supporting course required for Business major students at the university. Students usually take this course during their first or second year of study. Hypothesis testing is a topic that is usually taught after teaching sampling distribution and estimation of confidence intervals. As such, students have the basic knowledge of inferential statistics. In our study, online self-check exercises were administered to gauge the students' level of understanding with regards to estimation and confidence intervals. A medium-class size of 50 to 100 students were taught the topic of hypothesis testing, delivered in a blended mode for four weeks. Students had access to the notes and videos that showed the practical applications of hypothesis testing in Blackboard, the learning management system currently used at the university. The students were expected to read the notes and watch the videos before attending the class the next day. For a CAL approach to be effective, students must have a strong sense of commitment and responsibility towards the group's preparation which is essential for the learning process (Perumal, 2008).

Peer-Led Case Study Methodology

The class session commenced with an instructor-led briefing where the students gathered together for a detailed discussion regarding the information sent on the learning management system and summarized what was expected to be completed by the end of four weeks. Since part of the course requirement was to complete a case-based group project, the instructors required the students to work as a group on a case that demands a high level of collaboration among peers. This is because learning together with peers in collaborative learning enables students to build a supportive community that can raise the performance of each student (Nokes-Malach et al., 2015). Peer instruction benefits not just the specific questions posed during the discussion but also improves accuracy in relation to similar problems encountered later (Smith et al., 2009). The peer-led case study methodology is a pedagogical student-centred approach that provides small group instruction led by peers. Each team member takes equal responsibility in guiding and mentoring group members to develop their understanding of the concepts. Students need to remember and recognize certain concepts in hypothesis testing before they can understand and apply them in an analysis to arrive at relevant conclusions. In the context of peer instruction, it is pertinent to acknowledge the significance of self-assessment which according to Arico and Lancaster (2018) enables students to appraise their levels of knowledge and skills before engaging in peer instruction. In this regard, students learn more when they teach others. This is because when they reflect on observation of any inconsistencies, it may lead to improved learning (Kolb, 2015).

The worksheets were used to prepare students for a case study adequately. The students were asked to form groups of 4-5 members before they attended the day's class where they had to work as a group on the statistical topic designated for the day's worksheet. They were allowed to choose their group members as they were aware of each other's mastery of the subject and readiness. Therefore, they were able to work better together. By knowing the group capabilities, it enabled the instructors in providing the necessary guidance, support and ideas for the group in guiding them to the successful completion of their case study. Nevertheless, according to Zhang et al. (2016) homogeneous grouping where all members of a group have a similar knowledge base may hinder sharing of information because it is difficult to obtain "superior" knowledge from another member. Similarly, to enhance group-based learning through collaborative learning the cognitive load theory dictates the need to have an incomplete knowledge base so that students can interact to fill the knowledge gap (Retnowati et al., 2018; Sangin et al., 2011).

Within our classes were students of mixed abilities. For this particular research, the learning style of the students in the class was established by using a well-known instrument originally formulated by Felder and Silverman (1988). Knowing students' learning styles was extremely beneficial as we were able to adjust our instructions leading to better classroom management. It is noteworthy that for statistics, it is beneficial to design and implement student-centred approaches like blended learning, computer-aided instruction and role-play because these approaches are favoured by students of the Visual learning style which is positively correlated to the Teaching Presence of the Community of Inquiry framework (Chang-Tik, 2018). Even though the students had different styles of learning, once the group was formed peer teaching encourage independent learning. It strengthened their relationship with each other. They communicated well about their reasoning and also explained, described and reflected upon their knowledge. We noticed that students could do much more when they were in a group rather than on their own. They had benefited remarkably from peer instruction explanations, comments and discussions from their teammates (Chang-Tik, Chapter 3 this volume). The conversations, interactions and explanations in group settings support intelligent collaborative learning activities that enhance group learning and provide essential support whenever necessary. If the students are in an environment where they can communicate freely, exchange ideas and contribute to the outcome, they will feel comfortable, and hence collaborative active learning may occur. After all, according to Hood et al. (2021), an environment that supports academic self-efficacy and social anxiety may significantly affect students' engagement in an active learning situation (Cooper et al., 2017). Students were advised that the groups should also meet outside the classroom regularly to develop more understanding of the concepts and help build their problem-solving skills.

Curran et al. (2013) used peer-led team learning as a collaborative learning technique that engaged students in problem-solving and found that students acquired significantly greater content mastery in statistics compared to non-participating peers. In that study, students were advised not to focus on finding the correct answers to the task but on the problem-solving process itself, including conceptual understanding, communication skills, and teamwork. In the study, no specific roles were assigned to the group members. Berli (2018) concurred that this type of collaborative activity learning process offered a positive learning environment that helped build self-confidence and increased individual participation. In Roth et al. (2001) peer-led team learning model, team leaders were students who previously performed well in the course. We did not want a team leader to lead the activity as we wanted everybody in the team to be given equal importance and to participate without any sense of prejudice. We wanted our students to be responsible for their learning, to discuss and explain to the team members without any fear of their conceptual understanding and facilitate an active collaborative learning environment. This is in line with Fransen et al. (2011) findings that shared leadership is more beneficial to group learning than directive leadership which tends to limit discussion due to strong leadership. By implementing the peer-led case study model in learning the concepts of hypothesis testing, we noticed that students learned through experience, interacted with each other by facilitating discussions, and developed meaningful learning experiences. In a traditional classroom, higher-order thinking skills will not be achieved purely through a lecture delivered. This is because learning is not achieved by the transfer of knowledge but by achieving understanding through the integration of new concepts into prior knowledge, preferably through active participation both by students and instructors.

Students in the group worked together as they gained knowledge and social skills by merging teamwork and individual accountability. It was noticed that even though the group members were individuals with various aptitudes, talents, and skills, they worked together to achieve an expected outcome. Each team member was responsible for learning the material and also for helping the other members of the team to learn. A sense of ownership of the activity's outcome was developed among the students. The students' actions are in line with the Social Interdependence Theory developed by Johnson and Johnson (2013), particularly, the elements of positive interdependence and individual accountability which are used to maximise the collaborative potential of the groups. In terms of the cognitive demands of the team in solving problems, the team members have to accommodate construction, co-construction and constructive conflicts among themselves in order to achieve mutually shared cognition (Van den Bossche et al., 2006). The instructor could notice that each group member ensured that everyone in the team understood and successfully completed the given task. This whole process gave the students a deeper understanding and better retention of the hypothesis concept. Forming groups allows students to develop trust, communicate opinions and views and in turn helps to reduce fear, anxiety, and nervousness (Gregersen, 2017). We believe that students who learn effectively in groups will encourage each other to ask questions, explain and justify their opinions, communicate well about their reasoning, describe and reflect upon their knowledge. In subsequent sections, we discuss how the peer-led case study methodology was implemented in four weeks linking worksheet activities with the case study.

First Week—Worksheet Activities

We were well aware that the basic elements of active learning are student activities and engagements in the learning process. Keeping this in mind, the topic of hypothesis testing was divided into many subtopics and the worksheet was designed accordingly. To successfully complete a case to be presented to the students from Week 2 onwards, the worksheet activities were designed to provide them specific skills needed to draw a conclusion after formulating and testing a hypothesis. Emphasis was given on applying theoretical knowledge gained to real-life situations so that their decision-making and problem-solving skills would be developed. Learning to use statistical inference concepts that emphasize estimation and hypothesis testing of means and proportions was part of the learning outcomes to be achieved by this course. Students need to know certain specific procedures to arrive at the correct conclusion when solving a hypothesis testing question. Questions in the worksheets guided them on the appropriate methods. A typical worksheet contained mostly real-life application questions related to each procedure. To ensure the procedures were correctly done, null and alternative hypotheses should be stated correctly. A few questions were assigned to emphasize the importance of this step. An example is given below:

> Question: The average room rate in hotels in Malaysia is $200 per night. A tour operator believes that the average room rate in hotels near Kuala Lumpur International Airport is higher or different.

The students discussed and peer instructed one another in groups to propose the null and alternative hypotheses. The instructors had experience dealing with students' misconceptions regarding the null and alternative hypotheses through the assessments given. To correct this misconception, a few questions of the same format were given in the worksheets. They were guided with the help of examples to distinguish between the sample mean and population mean and the symbols used to differentiate the null and alternative hypotheses. After discussing and working together through peer instruction on these questions, students became well-versed in writing null and alternative hypotheses suitable for the situation. Nevertheless, they were encouraged to refer to the instructors for guidance but not answers when they were doubtful. Once the worksheet was done, another worksheet was distributed, allowing them to master the next step collaboratively where they argued and defended their responses. Importantly, they were empowered to "talk back" in order to reconstruct understanding in their own terms (Green, 2019) particularly where their responses differed from the group consensus. The peer instruction practiced here allowed students to have complete control of the learning process and they both co- and self-regulate the discussion (Arico & Lancaster, 2018). The alternative hypothesis stated in this worksheet required the students to decide the tails of the test. Appropriate activities through peer instruction and discussions allowed them to gain a better understanding of the step. The critical value approach and p-value approach followed as the knowledge of this concept is essential to arrive at the correct decision of whether to reject or not reject the null hypothesis. This was followed by a conclusion that allowed the students to make an inference about the population. The worksheets that were provided helped in mastering all these procedures.

All the processes mentioned above were repeated until the students mastered all the hypothesis testing procedures. The peer-led discussion was encouraged with minimal intervention from the instructors. The instructors offered encouragement, feedback and positive reinforcement, but they did not directly teach, tutor, or confirm the answers provided by the students. Instead, they asked scaffolding questions to assess students' learning and help to guide students toward solving the problems on their own. For example, the questions assisted in clarifying any misconceptions and also in ensuring students progressed towards an understanding of the subsequent concepts. In addition, the scaffolding questions also provide opportunities for students to think of the relevancy of the responses and to check whether they are aligned with the hypothesis testing concepts (Ortega & Jambaya, Chapter 9 this volume). If the students were unsure of any procedures, the instructors encouraged more discussions, allowing learning opportunities through sharing of ideas, arguments and elaborative questioning from more capable team members. Students had to understand the situation clearly and with proper discussion, came to a commonly agreed co-shared solution whereby everyone was equally responsible for the outcome attained. Students were constantly reminded that the focus was on their responses and not correct answers. This approach was to encourage more participation and to take away any fears of not knowing the correct answers and to avoid students staying silent and being non- participative. Based on the above actions, the instructors just led them to the right path with minimal intervention.

There was a structure for the students to work on and encouragement was provided while they made progress. The design of the worksheets allowed the student to build knowledge through incremental steps starting from the basics of stating the correct null and alternative hypotheses to finally drawing a correct conclusion. In this manner, the new knowledge that the students attained from the worksheets was based on the previous knowledge they acquired, which helped them to make connections. Thus, the student's interest and motivation to learn the topic increased. Open discussion among peers allowed students to guide the ongoing conversation without fear. The open communication among the team members that we observed in the class supported a healthy class environment which heightened student engagement and reduced social anxiety. The students had authority and individual accountability and felt relaxed to continue with their work as they did not face any barrier or obstruction from the instructors. This is possible because, through peer instruction, they control the learning process and co- and self-regulate the discussion (Arico & Lancaster, 2018). Another interesting aspect noticed during these peer-led teaching sessions is that some team members became 'experts' on a particular topic and that members started teaching other members in line with the view that this approach embraces Vygotsky's Zone of Proximal Development where the development level of individual may be higher depending on peer support (Yildiz Durak, 2022). In addition, according to Van den Bossche et al. (2006), task cohesion, interdependence, psychological safety and group potency are crucial interpersonal contexts needed for engagement in team learning which may lead to higher perceived team effectiveness. The discussion on the worksheets among the peers promoted learning which saw many meaningful information rich discussions led by team members in line with the positive interdependence element of the Social Interdependence Theory (Johnson & Johnson, 2013). The mutual respect given to each other's opinions was noteworthy and students realised that by working together on an activity made the job easier in the true spirit of shared leadership. This was evident in the last activity which combined all the procedures needed to solve a hypothesis test question. Let us have a look at one of the examples given.

> Question: It was reported that the average starting salary of all graduates with a master's degree two years ago was $4,300. The sample mean and sample standard deviation of the starting salaries of a random sample of 50 graduates with a master's degree last year was $4,100 with a sample standard deviation of $400. Test at 1% level of significance whether there is sufficient evidence to show that the mean starting salary of all graduates with master's degree last year is less than the mean of all graduates with master's degree two years ago?

By the time this worksheet was given to the students, most group members were well versed with the necessary procedures needed to solve the activity offered. The instructors noted that the majority of the group members had a firm grasp of the concepts at hand, they learned together and when needed, they assisted a few group members in clarifying some misconceptions. Practice time given in the class helped the students to reinforce the concepts through group-based learning where they were collectively accountable for the outcome of the activity.

The students were ready to work with the case study now as they understood the use and necessity of hypothesis testing procedures which allowed them to test claims regarding a characteristic of a population based on sample evidence and probability. The worksheet activities had prepared them to read and identify the details necessary to answer the questions required by the given circumstances. They were trained to check and draw out information needed to complete the analysis of real-life situations. They were actively involved in the group discussions inside and outside the classroom where they shared their opinions, ideas and knowledge. In the weeks that followed, they worked with the sample data they collected and used the statistical tools learned to analyse it.

Second Week—Case Study Preparation

Students were expected to develop an idea to work on a particular case where they could relate or carry out the analysis based on the hypothesis testing concept. They were advised to look for something around them so that data could be collected easily. Real-life scenarios and case studies that used hypothesis testing concepts had already been given to the students using notes and videos in the first week. Students were expected to use Wiki in the Blackboard (Learning Management System (LMS) used by the university) to discuss and agree on the case they would like to carry out. Wikis promote active learning where students can actively participate in educational activities. Wiki helps to support collaborative learning activity among group members by making it possible for them to contribute towards a jointly assessed outcome, which supports inquiry-based learning and the co-construction of knowledge (Yukawa, 2006) as well as the internalisation and externalisation of knowledge (Cress & Kimmerle, 2008).

Additionally, Wiki supported the collaborative learning environment, which nurtured online and offline collaboration, making it possible to work on the case outside the classroom, developing collaborative networks among peers which facilitated and assessed peer feedback and most importantly managed team performance (Ben-Zvi, 2007). Students took into consideration their peers' responses and appropriate changes were made. Team members used the "discussion page" to facilitate and promote discussions and to explore possibilities, thus forming a community of collaboration. In this community, students internalise the information available in Wiki and subsequently integrate it to develop new knowledge (Cress & Kimmerle, 2008). The features in Wiki allowed the group members to rewrite or reorganize the content. The instructors were in touch through the LMS emailing system to guide students' queries and to provide socio-constructivist feedback. This process helped students to think out of the box and to collaboratively react to the feedback to arrive at a shared consensus. Sample videos on the application of hypothesis testing such as salary comparison based on gender, the horsepower of different brand cars, etc., were given to students in the Week 1 content posted on Blackboard. These videos allowed the students to understand and use the p-value approach in analyzing the data. The decision and conclusion of the case needed to be clearly stated based on the requirements of the test.

Third Week—Case Study Brainstorming

Each group had a personal discussion with the instructors. During the meeting, students had a brainstorming session regarding the case study with the instructors in an atmosphere of staff-student partnership. Specifically, in the first week, the students had already discussed and collectively agreed upon the case they were planning to conduct through group-based self-assessment as to why the case was a simple one with an easy data collection process. Consequently, in the partnership together with the instructors, they co-assessed the suitability and the scope of the case study. If it had a wide scope, then the instructors narrowed it down so that the case study could be completed within the time frame given. This partnership strengthened the students' self-regulating process and enabled them to become more active in their learning (Deeley & Brown, 2014). The students had to submit the finalized case in a week. There were some cases where the study was not suitable to be conducted. For example, a group came up with an idea to conduct a study on food preference by university students. This study was not appropriate as they dealt with categorical variables, whereas for hypothesis testing we needed numerical variables. There were cases where students were too ambitious on the sample size. Lack of experience and exposure on data collection could have led them to choose a big sample. The instructors wanted them to collect data easily so that they wouldn't lose motivation and lament that they would not finish the work within the time allocated. So, during the brainstorming session, the instructors guided them in the correct direction and instructions. If the case was rejected appropriate guidance was given, for example on the type of variables to be considered.

Once they got the approval from the instructors, they prepared a simple questionnaire which helped them to start with the data collection. The students were expected to collect their data within a week. At the same time, they worked on a short report on the preparation of the case study they were conducting, which was graded. Continuous discussion among the group members on data collection, data analysis and report writing took place in Wiki. Therefore, even though the report was graded, the collaboration in Wiki aided student learning. This platform was very useful to conduct this case study as it made the quantity and quality of each group member's contributions more transparent and hence encouraged participation. The team members could add comments, share ideas, commence discussions and post their feedback on the Wiki page. The students considered the responses of their peers and it was found that it enhanced learning when they challenged one another's ideas and debated on other alternatives. This process allowed the instructors to monitor the students' work from time to time and helped identify the group's sleeping partners who were not contributing to the group effort. It also gave an idea to see whether the team members were on the right track, whether they were doing their designated job and the data collection done by individual members. The instructors could also use Wiki's "My Contribution" page to evaluate each student's contributions to the activities and discussions. The main aim of this evaluation process was to mitigate the free rider's problem which according to Abernethy and Lett (2005) and Kayes et al. (2005) may cause students to feel frustrated over the grades received for group work. From time to time, the instructors provide appropriate feedback, which allows an increased understanding of the topic. It helped us ensure that everybody was in line with the objective and this in turn helped make the case study a success. To this end, Zheng et al. (2022) added that personalized feedback may significantly improve the students' collaborative knowledge-building level and better co-regulate the behavioural patterns of the group members.

Fourth Week—Case Study Findings

Students as a group submitted a report and also presented their findings by using Microsoft PowerPoint. Presentation skills shown by the group members were taken into consideration in the marking criteria. The instructors and other group members were encouraged to give constructive comments on their peers' presentations. The evaluation rubric focused on the structure of the final report, data collection method, data analysis, and recommendations and conclusions. To this end, the instructors set clear learning outcomes and performance criteria (rubric) in the activities. The criteria in the rubric and the expectations of the learning outcomes were explained to the students to enable them to self-regulate their learning. Furthermore, each group was also given a different rubric or marking sheet to evaluate their group members' contributions. This rubric checked whether the team members attended meetings regularly, contributed meaningfully to discussions, completed the designated job on time and contributed cooperatively to the successful completion of the project. This encouraged students to be engaged throughout the sessions and gave a better idea of the topics of discussion. As explained earlier, it was not about the right answers, but about the understanding of the concept and the decision-making process.

During the activity, group members maintained a learning atmosphere. To illustrate, when some group members asked questions to seek further clarifications of the findings, the more capable members were seen explaining the concepts and helping others who had difficulty understanding in line with the peer instruction practices. This activity mirrors the role of instructors acting as a guide and emphasizes the importance of selecting relevant learning materials to support active student participation. We noticed that after this activity, the students performed better in other topics and developed an enthusiasm for learning statistics. These batch of students performed better specifically in the topic of hypothesis testing compared with the previous semester students who learned it in a traditional setting. We found that the students had better confidence in approaching this particular topic in statistics and this in turn had motivated us to design the consequent topics using collaborative active learning strategies. We believe this approach can be implemented in any other courses and hence, it can increase students' confidence, effectively support the students' ability to solve problems, generate new knowledge through discussion between peers and improve students' understanding.

Conclusion

We have explained and described the positive impact of implementing collaborative active learning (CAL) using peer-led case study methodology in an Introductory Statistics class and it has shown that CAL strategy has improved students' performance in the subject, increased learner engagement and enhanced learning outcomes in Statistics. This strategy is time-consuming yet it gives a very positive improvement in students' understanding of the application of hypothesis testing theory in the decision-making process. The planning started a semester ago, approximately three months, choosing appropriate materials and methodology. The worksheet materials need to be challenging, relevant to the topic, directly related to the notes posted on LMS, and suitable for working in a small group. This is because when the learning materials are designed with proper interaction, they may influence the quality of information exchange leading to a higher level of cognitive processing by the students (Wang et al., 2018). More than that, students become more confident and comfortable with their peers and the instructors.

As instructors, we felt that the students had an excellent opportunity to work together with instructors and classmates and obtained a positive, unforgettable experience by playing an essential role in assisting their peers through a seemingly difficult course. We observed that the students became more engaged. They interacted by using real data, incorporated active learning, emphasized conceptual understanding rather than memorization, enhanced their written and oral communication skills, learned to work as part of a team and provide constant feedback. Furthermore, the feedback provided by the instructor, which followed the peer discussion, guided the students and helped improve their performance and also corrected their misconceptions which benefited their learning. This CAL strategy has allowed an opportunity to form a staff-student partnership which enabled students to become more active and self-regulated learners (Deeley & Brown, 2014). Consequently, through this partnership, students can respond and reflect upon information together with their instructors and peers leading to more enriched learning and significant constructive feedback.

To increase the use of active learning, instructors must be allowed to choose and implement appropriate instructional strategies for their class size, instructional goals and teaching preferences in a constructive way. The CAL strategy, such as peer-led case study methodology where students have meaningful discussions facilitated by their peers, has helped students learn the content in a more meaningful and more profound way. Additionally, as a collaborative active learning strategy, peer-led case study methodology assists in students learning together and also changes the role of the teacher from knowledge giver to a facilitator of learning. It creates and provides a more interactive and active learning environment that promotes communication and collaborative learning among the students throughout the semester.

References

Abernethy, A., & Lett, W. (2005). You are fired! A method to control and sanction free riding in group assignments. *Marketing Education Review, 15*(1), 47–54. https://doi.org/10.1080/10528008.2005.11488891

Arico, F. R., & Lancaster, S. J. (2018). Facilitating active learning and enhancing student self-assessment skills. *International Review of Economics Education, 29*(2018), 6–13. https://doi.org/10.1016/j.iree.2018.06.002

Arvaja, M., Salovaara, H., Hakkinen, P., & Jarvela, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning and Instruction, 17*(4), 448–459. https://doi.org/10.1016/j.learninstruc.2007.04.003

Baepler, P., & Walker, J. D. (2014). Active learning classrooms and educational alliances: Changing relationships to improve learning. *New Directions for Teaching and Learning, 2014*(137), 27–40. https://doi.org/10.1002/tl.20083

Ben-Zvi, D. (2007). Using Wiki to promote collaborative learning in statistics education. *Technology Innovations in Statistics Education*, *1*(1). https://doi.org/10.5070/T511000029

Berli, A. (2018). Multiple studies: The influence of collaborative learning approach on Indonesian secondary high school students' English-speaking skills. *English Language Teaching Educational Journal, 1*(3), 149–160. https://doi.org/10.12928/eltej.v1i3.143

Bonk, C. J., & Graham, C. R. (2012). *The handbook of blended learning: Global perspectives, local designs*. John Wiley & Sons.

Brooks, B. J., & Koretsky, M. D. (2011). The influence of group discussion on students' response and confidence during peer instruction. *Journal of Chemistry Education, 88*(11), 1477–1484. https://doi.org/10.1021/ed101066x

Butchart, S., Handfield, T., & Restall, G. (2009). Using peer instruction to teach philosophy, logic and critical thinking. *Teaching Philosophy, 32*(1), 1–40. https://doi.org/10.5840/teachphil20093212

Carlson, K., Celotta, D. T., Curran, E., Marcus, M., & Loe, M. (2016). Assessing the impact of a multi-disciplinary peer led-team learning program on undergraduate STEM education. *Journal of University Teaching & Learning Practice, 13*(1), 5. https://files.eric.ed.gov/fulltext/EJ1097251.pdf

Chang-Tik, C. (2018). Impact of learning styles on the community of inquiry presences in multi-disciplinary blended learning environments. *Interactive Learning Environments, 26*(6), 827–838. https://doi.org/10.1080/10494820.2017.1419495

Chiriac, E. H., & Granström, K. (2012). Teachers' leadership and students' experience of group work. *Teachers and Teaching, 18*(3), 345–363. https://doi.org/10.1080/13540602.2012.629842

Cooper, K. M., Ashley, M., & Brownell, S. E. (2017). Using expectancy value theory as a framework to reduce student resistance to active learning: A proof of concept. *Journal of Microbiology & Biology Education, 18*(2), e18.2.32. https://doi.org/10.1128/jmbe.v18i2.1289

Cousin, G. (2010). Neither teacher-centered not student-centered: threshold concepts and research partnerships. *Journal of Learning Development in*

Higher Education, 2. https://journal.aldinhe.ac.uk/index.php/jldhe/article/view/64/41

Cress, U., & Kimmerle, J. (2008). A systemic and cognitive view on collaborative knowledge building with wikis. *Computer-Supported Collaborative Learning, 3*(2), 105–122. https://doi.org/10.1007/s11412-007-9035-z

Curran, E. M., Carlson, K., & Celotta, D. L. T. (2013). Changing attitudes and facilitating understanding in the undergraduate statistics classroom: A collaborative learning approach. *Journal of the Scholarship of Teaching and Learning, 13*(2), 49–71. https://files.eric.ed.gov/fulltext/EJ1011702.pdf

Deeley, S. J., & Brown, R. A. (2014). Learning through partnership in assessment. *Teaching and Learning Together in Higher Education, 1*(13). https://repository.brynmawr.edu/cgi/viewcontent.cgi?article=1107&context=tlthe

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large: Enrollment physics class. *Science, 332*(1), 862–864. https://doi.org/10.1126/science.1201783

Felder, R., & Brent, R. (2016). *Teaching and learning STEM: A practical guide*. Jossey-Bass.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education, 78*(7), 674–681.

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(2011), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Freeman, S., Eddy, S., McDonough, M., Smith, M., Okoroafor, N., Jordt, H., & Wenderoth, M. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Science, 111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Ge, X., Yang, Y. J., Liao, L., & Wolfe, E. G. (2013). Perceived affordances of a technology-enhanced active learning classroom in promoting collaborative problem solving. In Paper presented at *IADIS international conference on cognition and exploratory learning in digital age* (CELDA 2013) (pp. 359–362). Fort Worth, TX.

Green, S. (2019). What students don't make of feedback in higher education: An illustrative study. *Journal of English for Academic Purposes, 38*(2019), 83–94. https://doi.org/10.1016/j.jeap.2019.01.010

Gregersen, T. (2017). Improving the interaction of communicatively anxious students using cooperative learning. *Lenguas Modernas, 26–27*, 119–133. https://revistas.uchile.cl/index.php/LM/article/viewFile/45488/47555.

Hood, S., Barrickman, N., Djerdjian, N., Farr, M., Magner, S., Roychowdhury, H., Gerrits, R., Lawford, H., Ott, B., Ross, K., Paige, O., Stowe, S., Jensen, M., & Hull, K. (2021). I like and prefer to work alone: Social anxiety, academic self-efficacy, and students' perceptions of active learning. *CBE Life Sciences Education, 20*(1), 12. https://doi.org/10.1187/cbe.19-12-0271

Johnson, C., & Lomas, C. P. (2005). Design of the learning space: learning and design principles. *EDUCAUSE Review, 40*(4), 16–28. https://bit.ly/3k0Akn6

Johnson, D. W., & Johnson, F. P. (2013). *Joining together: Group theory and group skills* (11th ed.). Allyn and Bacon.

Jones, M. E., Antonenko, P, D., & Greenwood, C. M. (2012). The impact of collaborative and individualized student response system strategies on learner motivation, metacognition and knowledge transfer. *Journal of Computer Assisted Learning, 28*(5), 477–487. https://doi.org/10.1111/j.1365-2729.2011.00470.x

Kayes, A., Kayes, C., & Kolb, D. (2005). Experiential learning in teams. *Simulation and Gaming, 36*(3), 330–354. https://doi.org/10.1177/1046878105279012

Knight, J. K., Wise, S. B., & Southard, K. M. (2013). Understanding clicker discussions: Student reasoning and the impact of instructional cues. *CBE-Life Sciences Education, 12*, 645–654. https://doi.org/10.1187/cbe.13-05-0090

Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Pearson Education.

Lai, C.-L. (2021). Effects of the group-regulation promotion approach on students' individual and collaborative learning performance, perceptions of regulation and regulation behaviours in project-based tasks. *British Journal of Educational Technology, 52*(6), 2278–2298. https://doi.org/10.1111/bjet.13138

Lasry, N., Mazur, E., & Watkins, J. (2008). Peer Instruction: From Harvard to the two-year college. *American Journal of Physics, 76*(11), 1066–1069. https://doi.org/10.1119/1.2978182

Lillis, T. (2006). Moving towards an 'academic literacies' pedagogy: Dialogues of participation. In L. Ganobscik -Williams (Ed.), *Teaching academic writing in UK higher education* (pp 30–45). Palgrave Macmillan.

Lucas, A. (2009). Using peer instruction and i-clickers to enhance student participation in calculus. *Primus, 19*(3), 219–231. https://doi.org/10.1080/10511970701643970

Mazur, E. (1997). *Peer instruction: A user's manual*. Prentice Hall.

McClellan, C. (2015). Teamwork, collaboration, and cooperation as a student learning outcome for undergraduates. *Assessment Update, 28*(1), 5–15. https://doi.org/10.1002/au.30045

Mejias, U.A. (2006). Teaching social software with social software. *Innovate: Journal of Online Education, 2*(5), 2. http://www.innovateonline.info/index.php?view=article&id=260.

Mercer, N. (1996). The quality of talk in children's collaborative activity in classroom. *Learning and Instruction, 6*(4), 359e377. https://doi.org/10.1016/S0959-4752(96)00021-7

Nokes-Malach, T. J., Richey, J. E., & Gadgil, S. (2015). When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review, 27*(4), 645–656. https://doi.org/10.1007/s10648-015-9312-8

Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist, 20*(3), 190–203. https://doi.org/10.1027/1016-9040/a000226

Park, E. L., & Choi, B. K. (2014). Transformation of classroom spaces: Traditional versus active learning classroom in colleges. *Higher Education, 68*(5), 749–771. https://doi.org/10.1007/s10734-014-9742-0

Perumal, J. (2008). Student resistance and teacher authority: The demands and dynamics of collaborative learning. *Journal of Curriculum Studies, 40*(3), 381–398. https://doi.org/10.1080/00220270701724570

Pollock, S.J., Chasteen, S.V., Dubson, M., & Perkins, K, K. (2010). The use of concept tests and peer instruction in upper division physics. In M. Sabella, C. Singh, and S. Rebello (Eds.), *AIP conference proceedings* (Vol. 1289). AIP Press.

Porter, L., Bailey-Lee, C., & Simon, B. (2013). Halving fail rates using peer instruction: A study of four computer science courses. In *SIGCSE'13: Proceedings of the 44th, ACM technical symposium on computer science education* (pp. 177–182). ACM Press.

Reagan, A. R. (2018). Teaching undergraduate social statistics online: A classroom assessment of instructional interventions to reduce statistics anxiety and facilitate student success. *Journal of Education and Social Policy, 5*(4), 186–196. https://doi.org/10.30845/jesp.v5n4p22

Retnowati, E., Ayres, P., & Sweller, J. (2018). Collaborative learning effects when students have complete or incomplete knowledge. *Applied Cognitive Psychology, 32*(6), 681–692. https://doi.org/10.1002/acp.3444

Roberts, S., & Weaver, M. (2006). Spaces for learners and learning: Evaluating the impact of technology-rich learning spaces. *New Review of Academic Librarianship, 12*(2), 95–107. https://doi.org/10.1080/13614530701330380

Roth, V., Goldstein, E., & Marcus, G. (2001). *Peer-led team learning: A handbook for leaders*. Prentice Hall.

Salter, D., Thomson, D. L., Fox, B., & Lam, J. (2013). Use and evaluation of a technology-rich experimental collaborative classroom. *Higher Education Research & Development, 32*(5), 805–819. https://doi.org/10.1080/07294360.2013.777033

Sangin, M., Molinari, G., Nüssli, M.-A., & Dillenbourg, P. (2011). Facilitating peer knowledge modeling: Effects of a knowledge awareness tool on collaborative learning outcomes and processes. *Computers in Human Behavior, 27*(3), 1059–1067. https://doi.org/10.1016/j.chb.2010.05.032

Smith, M. K., Wood, W, B., Krauter, K., & Knight, J. K. (2011). Combining peer discussion with instructor explanation increases student learning from in-class concept questions. *CBE-Life Sciences Education, 10*(1), 55–63.

Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves on in-class concept questions. *Science, 323*(5910), 122–124. https://doi.org/10.1126/science.1165919

Trout, M. J., Borges, N., & Koles, P. (2014). Modified peer instruction improves examination scores in pharmacology. *Medical Education, 48*(11), 1112–1113. https://doi.org/10.1111/medu.12590

Tullis, J. G., & Goldstone, R. L. (2020). Why does peer instruction benefit student learning? *Cognitive Research, 5*, 15. https://doi.org/10.1186/S41235-020-00218-5

Van Boxtel, C., Van Der Linden, J., & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction, 10*(4), 311–330. https://doi.org/10.1016/S0959-4752(00)00002-5

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Wang, C., Fang, T., & Miao, R. (2018). Learning performance and cognitive load in mobile learning: Impact of interaction complexity. *Journal of Computer Assisted Learning, 34*(6), 917–927. https://doi.org/10.1111/jcal.12300

Yildiz Durak, H. (2022). Flipped classroom model applications in computing courses: Peer- assisted groups, collaborative group and individual learning. *Computer Applications in Engineering Education*. https://doi.org/10.1002/cae.22487

Yukawa, J. (2006). Co-reflection in online learning: Collaborative critical thinking as narrative. *International Journal of Computer-Supported Collaborative Learning, 1*(2), 203–228. https://doi.org/10.1007/s11412-006-8994-9

Zhang, L., Kalyuga, S., Lee, C., & Lei, C. (2016). Effectiveness of collaborative learning of computer programming under different learning group formations according to students' prior knowledge: A cognitive load perspective. *Journal of Interactive Learning Research, 27*(2), 171–192. https://doi.org/10.1016/j.chb.2010.03.038

Zheng, L., Zhong, L., & Niu, J. (2022). Effects of personalised feedback approach on knowledge building, emotions, co-regulated behavioural patterns and cognitive load in online collaborative learning. *Assessment & Evaluation in Higher Education*, *47*(1), 109–125. https://doi.org/10.1080/02602938.2021.1883549

PART III

Conceptual Framework and Pedagogical Perspectives

CHAPTER 13

Optimisation of Collaborative Active Learning in Different Settings and Disciplines in the Tertiary Setting

Gillian Kidman and Deya Chakraborty

Introduction

In the 1980s, tertiary institutions were urging faculty to actively involve and engage students in the process of learning. "Despite the urgency of these calls, research consistently has shown that traditional lecture methods, in which professors talk and students listen, dominate" our tertiary classrooms (Bonwell & Eison, 1991). The Bonwell and Eison report provided an excellent summary of active learning in Higher Education. They outline how it could be incorporated into the classroom through modified lectures, the inclusion of questioning and discussions,

G. Kidman (✉) · D. Chakraborty
School of Curriculum, Teaching and Inclusive Education, Faculty of Education, Monash University, Clayton VIC, Australia
e-mail: gillian.kidman@monash.edu

D. Chakraborty
e-mail: Deya.Chakraborty@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_13

and the barriers to change. Bonwell and Eison's comprehensive overview of strategies that promote active learning, listed below, is similar to many of the strategies featured in Section B of this book:

- Visual-Based Instruction
- Writing in Class
- Problem Solving
- Computer-Based Instruction
- Cooperative Learning
- Debates
- Drama
- Role Playing, Simulations, and Games
- Peer Teaching.

The nine chapters in this book present tertiary classroom research from a new educational era—an era that has seen the advancement of computer-based instruction. Bonwell and Eison described computer-based instruction as high cost, drill and practice, data management, word processing, and learning to program. There is little need to outline the changes in computer-based instruction over the past three decades since the Bonwell and Eison report. It is sufficient to say that the tertiary classrooms of today and those of 30 or more years ago are vastly different mainly due to the inclusion of education technologies—as they are now called.

The discussion in this chapter aims to draw together the nature of collaborative active learning (CAL) as presented by the nine chapters in Section B of this book. Section B gave practical activity-based approaches drawn from several different disciplines. This book can be considered a case study of a selection of tertiary institutions in Kuala Lumpur, Malaysia, and their implementation of collaborative active learning from various Faculties. Not all faculties, departments, schools and centres could be included. Still, what has been described can, we feel, be considered representative of the Universities involved and the collaborative active learning approach for this particular geographical location at this specific point in time—a time of educational change due to global pandemics and greater autonomous student learning.

We do not intend to describe or critique each of the nine chapters individually. Instead, we have focused on the corpora of ideas (the data) across and within the nine chapters collectively. We have conducted a quantitative frequency analysis of this corpus in the form of a word cloud so that visualisation of collaborative active learning was possible. We then undertook a qualitative analysis of the nine chapters to reveal a shared understanding of the process of active learning in our context. Thus, we present this chapter in two parts. Initially, we offer the word cloud analysis to provide a visual overview of text in the nine chapters of Section B. Word clouds do not illuminate linguistic knowledge or the semantic context of phrasing. Thus, we then present a qualitative thematic in the second part of the chapter. A conceptual framework was derived from the analysis of the nine chapters. Each of the authors in Section B of this book has grounded their work in this framework. Their ideas, tools and insights contribute to a common lens that supports our collective understanding of active learning in university settings in Kuala Lumpur, Malaysia.

A Visual Overview of Collaborative Active Learning

We used word cloud software (WordArt, 2022) to undertake a statistical analysis of the research presented in Section B of this book and then to deliver this analysis in a visual form. Word clouds are used to give a visual overview of a text by depicting the words that occur most often within the text. We used the nine chapters presented in Section B of this book as our text corpora for this chapter. We thus converted a large amount of one-dimensional text data (58,141 words) into a two-dimensional data configurational form in space (Ma et al., 2022). Typically, word cloud software prepares a statistical overview by positively correlating the font size of the words from the text with the word frequency utilising a spatial layout. The more often a word appears within the text corpora, the larger the word appears in the image generated. The font size indicates how often the word occurs in the text corpora, normally after having 'stop words' removed. Stop words are a form of a negative dictionary (Rajaraman & Ullman, 2011) where words are filtered out (stopped) before or after processing text data. Stop words are the most common words that search engines avoid processing to save space and time. The most common stop words are short function words, such as *the, is, at, which*, and *on*.

The advantage of creating a word cloud is the subsequent ease of identifying the most commonly occurring words and their relative frequency compared to others. However, it isn't easy to make accurate numerical estimates of those frequencies. We found the generation of the word cloud to help analyse and interpret our vast corpora of data (58,141 words) and provide the text's focus and the key concepts previously inaccessible at first glance.

The methodology was as follows:

1. Combined the full text of all nine chapters into a single word file
2. Removed all chapter titles, authors' names and institution names
3. Removed all abstracts and keywords
4. Removed all section headings and subheadings
5. Removed all references
6. Copied remaining text (n = 58,141 words) into the free online *WordArt* word cloud generator
7. Visualised the word cloud to include the 50 most frequently used terms
8. Cleaned the resultant word cloud for erroneous stop words not automatically filtered (n = 4 (CI; onto; hunt; not)
9. Edited the text colour of the representative keywords to 'black' to remove auto-randomised text colour (removal of distractor non-variable)
10. Saved the resultant word cloud (see Fig. 13.1).

Figure 13.1 is the resultant word cloud depicting the 50 most representative keywords from the nine chapters. As Fig. 13.1 exhibits, the key representative term is 'student'. The 49 most frequently used words in the text corpora, after student, are randomly placed around the central location of the key representative term. The visualisation is reassuring as we expect the student to be at the centre of collaborative active learning. This indicates that the academic community that wrote the chapters is firmly focused on their students. The nine chapters' key content and thematic information are being active with learning. Peers, groups or teams, time, skills, practices, discussions, feedback and so on are all important.

All word clouds are static visualisations, providing no interaction capabilities. As a result, they have limitations in providing a purely statistical summary of isolated words without taking linguistic knowledge about the words and their relations into account. Thus, the semantic context of phrasing is lost. We have overcome this limitation by conducting a

Fig. 13.1 Representative keywords characterising the research around collaborative active learning

thematic analysis of the authors' ideas and understandings. We present this as a conceptual framework in the following section.

A Conceptual Framework of Collaborative Active Learning

Braun and Clarke (2013) outline a thematic analysis as a "distinctive method with a clearly outlined set of procedures" (p. 178). Thus, a thematic analysis is a data analysis method that identifies themes and patterns of meanings across a dataset. As identified at the beginning of this chapter, our data set are the nine chapters that constitute Section B of this book. We adapted the seven analytical steps of Braun and Clarke:

1. Reading and familiarisation—each chapter was read several times to gain an understanding of the CAL research
2. Coding—the identification of phrases that captured the essence of the CAL research
3. Searching for themes—the frequency of codes illuminated themes
4. Reviewing themes—the themes and codes were scrutinised to reveal themes and subthemes

5. Defining and naming themes—terms derived from the language used by the authors of the chapters
6. Finalizing the analysis—the themes and subthemes were considered in light of the literature cited within the chapters
7. Presentation of the thematic analysis as new knowledge—new theoretical relationships combining cited and new research was visualised into a process (a conceptual framework) to explain CAL. This process is our contribution to existing CAL knowledge.

As depicted in Fig. 13.2, our thematic analysis indicates CAL is a process of optimisation. We introduce the conceptual framework *Optimising Collaborative Active Learning in Tertiary Settings* (OCALiTS). OCALiTS indicates three phases are involved in the process of optimising CAL.

Phase 1 is concerned with opportunity—the opportunity to think critically. Central to the provision of this critical thinking is the role of the facilitators and the students' actions. The authors of the nine chapters were employed across various disciplines (Psychology, Statistics, Engineering, Anatomy, Gender Studies, Information Technology, Accounting, and Finance), yet the similarities are striking. Faculty need to understand they have the responsibility of going beyond the traditional lecture teacher-centred approach to teaching. Tasks need to change, ICTs need

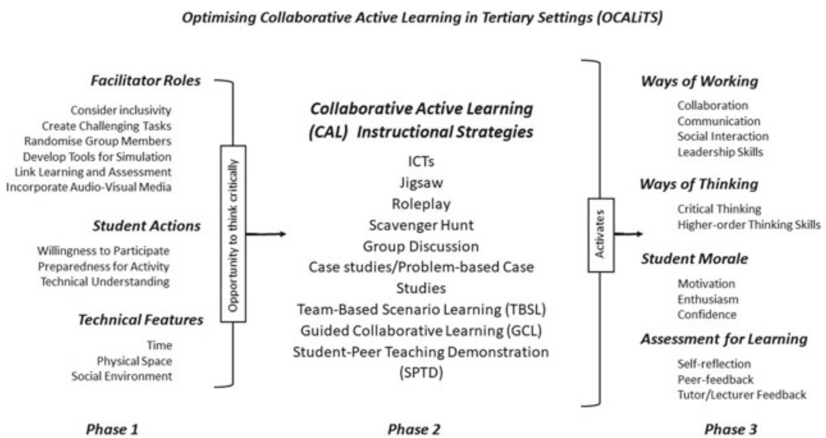


Fig. 13.2 The Optimising Collaborative Active Learning in Tertiary Settings (OCALiTS) conceptual framework

to be developed, and student experience needs consideration. However, this needs to co-occur as the student becomes aware that they need to be a participant in the process. The students need to be willing to think deeply, get out of their seats and comfort zones, and construct their knowledge instead of absorbing and repeating already known knowledge. Thus, CAL is a pathway for deep learning—shifting away from surface and rote learning.

CAL strategies aim to engage students in the classroom and ensure their active participation and, hence, learning. However, students may themselves pose challenges for the tutors or facilitators to implement such strategies effectively in the classroom. Ortega and Jambaya (2022) found that students were resistant and unwilling to participate in the CAL classroom. Students' reluctance to work with one another results from the differences in their personality types, cultural variations, and shyness (Dharmaratne et al., 2022). Students were not always adequately prepared for the CAL class and did not take ownership and responsibility for their learning (Ortega & Jambaya, 2022). The lack of understanding of technical concepts is another challenge for successfully implementing CAL strategies (Peranginangin, 2022).

To complement the human side of CAL, technical features also need to be considered. The acknowledgement that CAL takes time is essential. Time for both the faculty and the students to develop CAL teaching and learning skills and time to collaborate is critical. Then provision also needs to be made to create a physical space for the CAL to occur and develop the social environment. CAL strategies can be time-consuming (John & Sagadavan, 2022) and require a socially conducive environment for learning (Goh, 2022). Goh suggested that students find it highly challenging to enhance their critical thinking, personal confidence, mutual respect, and mutual learning in and beyond the CAL classroom due to a lack of safe space.

Facilitators need an adequate amount of time to learn the online learning tools and preparation needed to plan and implement these collaborative active learning strategies (Ortega & Jambaya, 2022; Von & Gopalai, 2022), and this can cause facilitators to be resistant to using such strategies (Dharmaratne et al., 2022). Problems may arise as the facilitators engage in the design of the tasks. The task must be challenging and relevant for students (John & Sagadavan, 2022) and open-ended to encourage multiple responses from the students. The tasks need to be designed to challenge students such that answers cannot be found on smart devices (Von & Gopalai, 2022). Furthermore, facilitators must ensure the linking between learning activities and assessment tasks to ensure the commitment of students and the inclusion of different types of audio-visual media (Goh, 2022). The inherent nature of the CAL strategies involves group/teamwork. Therefore, issues such as equal distribution of workload (Dharmaratne et al., 2022), free riders, social loafers and inactive members (Peranginangin, 2022) need to be considered. Randomising group members can assist in this area (Dhoraisingam & Subramaniam, 2022; Von & Gopalai, 2022).

Phase 2 of the OCALiTS Framework relates to the instructional strategies employed to implement CAL. This phase is central to the framework. Although the terminologies have changed, we can see familiar strategies to those listed in the Bonwell and Eison (1991) report. To replace computer-based instruction, we now have Information Communication Technologies (ICTs). Although the CAL instructional strategies may appear somewhat conventional to contemporary teaching, the distinction is made that it promotes students' achievement when utilised through a CAL approach.

Student motivation and engagement become an important consideration (note willingness to participate from Phase 1) as participation cannot be assumed. The empowerment of student attitudes is also a consideration (leading into Phase 3). Faculty need to consider the strengths and weaknesses of their strategies and activities to present CAL as a useful blended whole. For example, in 1991, Borwell and Eison described computer-based instruction as a separate activity, devoid of integration into daily teaching and learning. Today, our authors describe ICT usage through a fully integrated approach. Although we have identified ICTs as a separate CAL instructional strategy in the OCALiTS Framework, we could also have incorporated it into each of the other listed strategies as the different strategies incorporated the ICTs into their delivery and the experience.

The CAL strategies employed several Web 2.0 technologies (Moodle, Padlet Wall, Wikis, Google Docs, Google Slides, Google Share, Videos, Discussion Forums, Simulated Scenarios, Asynchronous Video lectures, assessment tools) rarely used in isolation. Instead, the authors integrate the strategies depending upon the goals of the lessons or the larger unit of work. The nature of the CAL strategies itself was also limiting in some respect for the students. For example, a scenario simulation assessment could create stressful situations for students affecting their performance or participation (Dharmaratne et al., 2022), while a scavenger hunt involving the physical activity of various degrees could be restricting for students with disabilities (Von & Gopalai, 2022). Moreover, a scavenger hunt is an effective CAL strategy; however, students often prioritise speed over accuracy due to its *race-type* format (Von & Gopalai, 2022).

Phase 3 is the outcome of the CAL process—the student learning that occurred during the CAL process. Above, we mentioned that CAL instructional strategy selection, in Phase 2, explicitly considers student achievement as a differentiating factor from contemporary instructional strategies. Student achievement is the desired outcome of CAL. However, not all authors emphasised or ensured student achievement, in the same way, indicating a possible disciplinary emphasis might exist. Ways of Working and Ways of Thinking were identified as mainly related to the much researched 21st Century skills so valued by employers. Student achievement was often housed in these two themes. Student morale was also recognised as benefiting from CAL activities. A number of our authors noted their assessment practices in relation to CAL.

Conclusion

This chapter has presented a dual analysis of the nine chapters in Section B of this book. Through the statistical analysis of the text, visualised via a word cloud, we determined the student to be at the centre of the research. The nine chapters tended to focus on the student's learning in relation to CAL. This leaves room in the future for further research to focus on the faculty as participants in CAL. We imagine such research could explore faculty identity as a teacher of CAL. We also conducted a thematic analysis of the nine chapters. We created a conceptual framework that describes the shared understandings of the CAL process in the unique context of the higher education setting in Kuala Lumpur, Malaysia. The authors within Section B of this book, who ground their work in this OCALiTS Framework, did so by sharing their ideas, tools and insights across the three phases of the optimisation process for CAL. The mode of instruction was shown to be important. The timing of this book is coincidental to the current COVID-19 pandemic. However, this timing has been beneficial as we have been given the privilege of seeing CAL implemented along a continuum from face-to-face learning (Sen & Selvaratnam, 2022) and blended learning (Dharmaratne et al., 2022; Dhoraisingam & Subramaniam, 2022; Goh, 2022; John & Sagadavan, 2022; Peranginangin, 2022; Von & Gopalai, 2022) to fully online learning (Ortega & Jambaya, 2022).

The research presented in the nine chapters describes teaching in university settings that promote the use of strategies to advance students' knowledge (John & Sagadavan, 2022; Von & Gopalai, 2022), higher-order thinking skills (Dharmaratne et al., 2022; Peranginangin, 2022; Von & Gopalai, 2022) and values and attitudes (Dharmaratne et al., 2022; Goh, 2022; John & Sagadavan, 2022; Von & Gopalai, 2022). The teaching appears to be relevant to specific disciplines and offers feedback opportunities to the peers (Dharmaratne et al., 2022; Dhoraisingam & Subramaniam, 2022; Goh, 2022; John & Sagadavan, 2022; Ortega & Jambaya, 2022; Von & Gopalai, 2022), facilitators (Dharmaratne et al., 2022; Dhoraisingam & Subramaniam, 2022; Goh, 2022; John & Sagadavan, 2022; Ortega & Jambaya, 2022; Sen & Selvaratnam, 2022; Tee, 2022; Von & Gopalai, 2022) and self (Dhoraisingam & Subramaniam, 2022; Ortega & Jambaya, 2022).

References

Bonwell, C., & Eison, J. (1991). *Active learning; creating excitement in the classroom* (ASHE-ERIC Higher Education Report No. 1). The George Washington University, School of Education and Human Development.

Braun, V., & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE.

Dharmaratne, A., Fung, T. F., & Abaei, G. (2022). Implementing a successful collaborative active learning approach in information technology discipline. In C. Chang-Tik. G. Kidman, and M-Y. Tee (Eds.), *Collaborative active learning: Practical activity-based approaches to learning, assessment and feedback* (Chapter 10). Springer Nature.

Dhoraisingam, S. S., & Subramaniam, R. (2022). Using Team-based scenario learning (TBSL) approach to teach audit risk. In C. Chang-Tik. G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning—Practical activity-based approaches to learning, assessment and feedback* (Chapter 11). Springer Nature.

Goh, J. N. (2022). Collaborative learning in informal spaces: Formulating a pedagogical project of student-centred active learning in gender studies. In C. Chang-Tik. G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning—Practical activity-based approaches to learning, assessment and feedback* (Chapter 5). Springer Nature.

John, S., & Sagadavan, R. (2022). Peer-led case study methodology in the learning of statistics. In C. Chang-Tik, G. Kidman, and M-Y. Tee (Eds.), *Collaborative active learning—practical activity-based approaches to learning, assessment and feedback* (Chapter 12). Springer Nature.

Ma, Y., Xie, Z., Li, G., Ma, K., Huang, Z., Qiu, Q., & Liu, H. (2022). Text visualization for geological hazard documents via text mining and natural language processing. *Earth Science Informatics, 15*, 439–454. https://doi.org/10.1007/s12145-021-00732-0

Ortega, A., & Jambaya, R. (2022). Online collaborative active learning in psychology. In C. Chang-Tik, G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning—Practical activity-based approaches to learning, assessment and feedback* (Chapter 9). Springer Nature.

Peranginangin, Y. (2022). Collaborative active learning (CAL) approach in finance: A case of business strategy pitch presentation. In C. Chang-Tik, G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning—Practical activity-based approaches to learning, assessment and feedback* (Chapter 6). Springer Nature.

Rajaraman, A., & Ullman, J. D. (2011). *Data mining (PDF: Mining of massive datasets* (pp. 1–17). https://doi.org/10.1017/CBO9781139058452.002

Sen, A., & Selvaratnam, L. (2022). Future-proofing healthcare skills education: Technology-enhanced collaborative learning and peer teaching strategies for large student cohorts in anatomy practicals. In C. Chang-Tik, G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning: Practical activity-based approaches to learning, assessment and feedback* (Chapter 8). Springer Nature.

Tee, M.-Y. (2022). Learning to teach with technology with real-world problem-based learning. In C. Chang-Tik, G. Kidman, and M-Y. Tee (Eds.), *Collaborative active learning: Practical activity-based approaches to learning, assessment and feedback* (Chapter 4). Springer Nature.

Von, L. E., & Gopalai, A. A. (2022). Scavenger hunt activity to reinforce engineering fundamentals. In C. Chang-Tik, G. Kidman, and M.-Y. Tee (Eds.), *Collaborative active learning: Practical activity-based approaches to learning, assessment and feedback* (Chapter 7). Springer Nature.

WordArt. (2022). *Word cloud generator*. https://wordart.com/

CHAPTER 14

Technologies and Learning Spaces for Collaborative Active Learning

Chan Chang-Tik

Technology itself may play a role in fostering a student's motivation to engage in the material, but it may also hinder it depending upon individual differences.

Nicol et al. (2017)

Introduction

It is important to take a look at especially theoretical arguments for the significance of hospitable learning spaces (HLS), and technology-enabled active learning classrooms in collaborative active learning (CAL) environments. For instance, Kolb and Kolb (2017) claim that HLS is student-centred and it empowers students to facilitate a partnership in the learning process, therefore, care must be taken to intentionally create the five dimensions of HLS for students: institutional, physical, cultural,

C. Chang-Tik (✉)
Monash University Malaysia, Subang Jaya, Malaysia
e-mail: chan.chang.tik@monash.edu

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6_14

social, and psychological (Kolb & Kolb, 2017). This is because according to Kolb's experiential learning theory (2015) students drive the learning process through synergistic connections with the learning environments. Additionally, according to Trinh et al. (2021) HLS can provide conditions for experiential learning to develop even in large classes (about 90 students) aided by the Appreciative Inquiry (AI) methodology. Likewise, Donkin and Kynn (2021) argue that learning space does matter when it involves small group, task-focused active learning in a technology-enabled active learning classroom that encourages group facilitation. This purpose-built collaborative environment can improve student explicit learning outcomes like assessment grades. Interestingly, it also helps to develop student implicit outcomes such as engagement, communication, and motivation (Donkin & Kynn, 2021). Furthermore, digital technologies and assets of social media use in educational contexts have the potential to promote students' work visibility, facilitate interaction and new forms of social learning as well as provide collaborative learning opportunities (Carvalho & Santos, 2022).

Consequently, according to Brooks (2012) the types of classrooms (traditional versus technology-enabled active learning) are causally linked to the observed differences in the lecturer behaviour. Whilst, the physical environments may have influence on student learning, the effect on facilitating or inhibiting lecturer teaching is more pronounced (van Merrienboer et al., 2017). To illustrate, lecturers in large traditional classes are more likely to focus on factual knowledge and less so on active learning approaches and they have low expectations of students' shared responsibility in learning (Benton & Pallett, 2013). To this end, students do not expect to be involved with active learning activities as the physical environment does not support it. Therefore, the effect on the lecturer behaviour and the student and lecturer expectations may eventually impact the social learning space in large traditional classes to such an extent that it may impede CAL approaches.

Focusing on the two elements of learning spaces and technologies, this chapter attempts to use pedagogy to integrate these elements into CAL strategies for both formal and informal environments. Therefore, any attempt to remove and/or add any elements into or from the CAL strategies would reflect on whether the revisions would bring positive contributions that go beyond the current practical approaches.

Synergy Between Pedagogy and Technology

Educational technologies or, by and large, technologies are useful tools for lecturers who are equipped with pedagogical knowledge to deploy and implement the learning activities. To illustrate, as pre-class activities with bitesize videos are commonly used for students to view and interact before attending in-class workshops. However, students need more than videos because theoretically speaking, socio-constructivism purports that learning is a social phenomenon that requires discussing with, sharing with and teaching to others (Shieh, 2012). Therefore, it is crucial that lecturers set up a community of four to six students for them to interact and discuss the video content. This is because by interacting with their peers and lecturers and discussing ideas will generate a feeling of belonging to a community (Kwon et al., 2014) and eventually encourages students to be active in their learning (Hamalainen & Vahasantanen, 2011).

Next, in terms of the development of bitesize videos, design one video for each major concept presented in the lecture. Importantly, do not produce lecture-videos even if they are incorporated with interactive HTML5 Package (H5P), but try to stimulate students' thinking, provoke and excite them into wanting to know more. To achieve these results, relate the concepts to applications and real-life uses of the disciplines in the local situations (if possible). Additionally, lecturers can share with the students their personal experiences, research or project as well as problems related to the concepts and challenge them to find responses. Consequently, provide them reading materials with probing questions to satisfy their desire to seek information. By allowing students to express themselves easily and by creating a conducive learning environment, it is reasonable to assume that they can accept a shift in their role to work independently and to put effort towards group learning and taking responsibility for personal roles (Hamalainen & Hakkinen, 2010). To this end, the synergy between videos that stimulate thinking and discussion in a community may be more effective than videos that lecture students and not in sync with pedagogy. This is because meaningful learning can only be achieved through the synergy between innovative pedagogic infrastructure and a broad spectrum of pedagogic methods (Avidov-Ungar et al., 2018).

Consequently, in order to increase the effectiveness of students interacting in a community, lecturers have to teach them collaborative skills, which incidentally are assumed even though they are not self-evident (Kirschner et al., 2006). Consequently, before students are comfortable to openly share and discuss in a group, they have to feel safe to make mistakes and less wary of being laughed at. Therefore, the first step in developing collaborative skills is to acquire mutual trust. According to Janssen et al. (2007), mutual trust allows information to be exchanged within the group members and to critique as well as to constructively react to feedback from one another. According to Nicol and Macfarlane (2006) to be constructive students have to be actively involved in constructing their own meaning from the feedback received and use it to improve their work. Additionally, to promote social interaction, getting to know one another and to build friendship, lecturers can introduce to students' popular social media like Facebook, YouTube, Instagram, Messenger, WhatsApp, WeChat, and Discord. In an online environment students may feel disconnected and distant from one another therefore, lecturers should make themselves approachable by visiting each Zoom Breakout Room in turn, to set a tone that helps them be more comfortable with asking questions and the possibility of being wrong. Initially, the sharing of thoughts is between lecturers and students, but over time a comfort zone and mutual trust are developed for students to openly discuss any ideas with their peers. Of note, mutual trust is vital for students to feel safe to admit their problems, thus maximising the chance their peers and lecturers can assist them through effective and constructive feedback. In a similar vein, mutual trust implies the shared perception that every member of a group protects the interests and rights of one another and performs tasks deemed significant to the group interest (Fransen et al., 2011).

Further, to facilitate peer interactions the second step in developing collaborative skills is to embrace socio-cognitive conflicts. It is believed that challenges and even conflicts are unavoidable in human interactions and thus the main collaborative activities such as negotiation of shared meanings, elaboration, mutual explaining, and reasoning may lead to socio-cognitive conflicts which are advocated as essential for the cognitive growth of individuals (Buchs et al., 2004). To serve the purpose of cognitive conflicts, students can work as a group in either a face-to-face environment or an online platform. In this regard, each member of a group shares his/her self-constructed meaning from the pre-class activity in Padlet, Google Jamboard or other collaborative devices. This is because the social constructivist theory states that learning is a social phenomenon that requires sharing with and teaching to others (Powell & Kalina, 2009). Consequently, in the in-class workshop students are provided a new set of activities but somewhat related to the pre-class activity and they have to discuss and select five ideas from Padlet that they think are relevant to respond to the new activities. In this context, Padlet serves as a platform for students to share their pre-class responses and at the same time the pedagogical approach serves to facilitate student collaboration and co-construction of meaning when they interact with the in-class activities either in a face-to-face environment or an online platform like the Zoom Breakout Rooms. The cognitive conflict discussed earlier will function as a vehicle to enhance the construction and co-construction of meaning and the outcome is a mutually shared cognition, leading to higher group effectiveness (Van den Bossche et al., 2006).

In terms of increasing the effectiveness of CAL the third step in developing collaborative skills is social presence which can serve the purpose quite well. According to Fu et al. (2009, p. 553), social presence refers to "sense of awareness of an interaction partner". Specifically, it implies how affectively members of a group are connected to one another, or how they present themselves and perceive others in the social interaction. There remains, however, how do lecturers promote social presence to build up student collaborative skills. In this regard, lecturers must develop learning activities that require group input to complete successfully, and are complex enough to make students realise that it is to their advantage to work together in achieving their common goals and joint rewards. In this manner, they will develop a sense of community that motivates them in collaboration with their peers (Smith & Flaherty, 2013) and increase their emotional engagement (e.g., fun, enjoyment, interest) with the learning activities (Kwon et al., 2014). Once the social cohesion is strong it will lead to high outcome interdependence and hence students are more inclined to search for solutions and compromises (Johnson & Johnson, 1989). Furthermore, besides students, social presence of lecturers is a necessary component to effective online instructions (Shea et al., 2006) because students need to feel connected to their lecturers and peers (Lewis & Abdul-Hamid, 2006) as well as to the content being studied. It is noteworthy that Moodle H5P Interactive Content is an effective collaborative platform to support social presence and to strengthen social cohesion. This is because in this platform, students are provided different sets of information depending on their responses to the questions asked. The students' reactions to the information provided will lead them to another situation that requires them to collaborate and decide how to move their learning forward. In addition to the collaborative H5P platform, discussion forum and web pages may help to develop students' social presence (Dixson, 2010). Therefore, the pedagogical design of the learning activities as described above is underscored by the interactive nature of the platform, discussion forum and web pages.

Finally, in mediating group effectiveness in the context of CAL, the group shared mental models become the fourth step in developing collaborative skills. According to Van den Bossche et al. (2011), shared mental models are conditional for setting group goals, deciding on group strategies, allocating subtasks to group members, adequate monitoring of group processes, and effective communication. To this end, the team-related and the task-related mental models are crucial for effective implementations of the collaborative task as a group (Van den Bossche et al., 2011). Specifically, the team-related mental models focus on the team functioning and the expected behaviours of both the team as a whole and the individual members in relation to one another. Additionally, the task-related mental models focus on the strategies needed to successfully carry out the task using the information gathered. In order to achieve effectiveness in collaboration, these mental models should be negotiated within the group and continuously updated during the collaboration process (Fransen et al., 2011). Pedagogically, lecturers arrange for students to communicate face-to-face and online as well as through Moodle. All the information students obtained and provided by the lecturers are stored and shared with the group members in Google Drive and they also use the Drive to exchange work-in-progress. Likewise, Wiki as a social media has the potential for collaborative learning as it supports inquiry-based learning and the co-construction of knowledge (Yukawa, 2006) as well as the internalisation and externalisation of knowledge from work with Wiki (Cress & Kimmerle, 2008). Importantly, students have to acquire workable shared mental models in order to enhance their positive interdependence and commitment towards the group. In this regard, students—lower performing students—need to understand that interdependence implies both accepting their peers' views and defending their own contributions where they accept challenges as feedback in order to promote participation in group work (Chang-Tik & Dhaliwal, 2022). Upon completion of the group tasks, they are uploaded to Moodle Workshop for intergroup peer feedback. Even though this device is designed for peer assessment, it can be adapted for feedback. Given all the insights as discussed in this section, it is plausible to conclude that when technologies are in sync with pedagogies, student learning in the CAL environments both formal and informal would be fun, meaningful and interactive.

Technologies to Support Both Assessment and Feedback for Learning

In the context of collaborative active learning (CAL), learning activities such as online reading materials and quizzes can provide lecturers with continuous learning evidence of their students. Consequently, they can use the evidence to decide which instructions, assessment and feedback to implement in order to achieve the students' learning outcomes. To this end, students have to engage with the learning activities, reflect and think about what to do. If so, the functionality and success of the pedagogical features of the learning activities depend on the students' willingness to engage with the materials in the manner intended as well as their personality and learning style (Li et al., 2014). In the context of a single modality learning style under the Community of Inquiry (CoI) framework, student blended learning experience and engagement are not be jeopardised (Chang-Tik, 2018).

In this section, the focus is on how to turn learning activities into assessment and feedback activities aided by technologies. Accepting that online reading materials are normally used as pre-class learning activities, which unfortunately, are not well received by students, the author suggests adding an assessment component to it to motivate students to act. To illustrate, based on an assigned reading students have to post at least one comment on any one issue from the reading to Moodle Forum. Henceforth, each student has to critique at least one post from their peers and defend their own view when challenged. After all, CAL activities involve negotiation of shared meaning, elaboration, mutual explaining and reasoning. In this regard, the normal practice of reading passively has become active interactions among peers where marks may be awarded (assessment activity). To this end, lecturers can select posts that need further elaborations and deliberations to discuss in face-to-face or online in-class workshops. To make it more interesting and challenging to the students, lecturers can play the devil advocate by adding new disputes to the selected posts. Consequently, allow some time for students to self-reflect before placing them in groups to share their views and ideas, to debate and discuss and to provide peer feedback in support of learning (feedback activity). The time used in self-reflection as well as deep and active cognitive engagement will enable students to act upon peer feedback effectively (Yu & Lee, 2016). Importantly, the peer feedback can be either audio or video recorded so that students can revisit as many times as necessary (Morris & Chikwa, 2016) because they perceive digital recordings as detailed, personalised and usable (Ryan et al., 2019). Accepting an assessment and feedback for learning perspective, this simple exercise can be converted into a graded assignment where students as a group record (audio/video) their responses to their peer feedback and also their replies to the in-class workshop activities. Subsequently, they submit these digital files for grading and lecturers in turn, can provide feedback using video recordings that provide dual channels of information (i.e., voice and face) to enhance feedback experience (McCarthy, 2015).

Whether or not assessment of learning—tests and examinations, the primary purpose of which is to provide feedback that involves dialogue to enable students to explore, clarify and internalise the comments provided. By providing students opportunities to have shared and individual interpretations of the constructivist feedback developed through dialogue among peers and between lecturers and students, will lead to co-construction of knowledge (Price et al., 2011). In this regard, lecturers can use screencasts to give feedback to students where they can view text-based explanations while simultaneously hearing lecturers explaining and providing detailed examples of how to address issues (Soden, 2016). The benefit of this method is students can revisit and reuse the screencasts at their point of need, particularly, during the writing of their assignments (Moscrop & Beaumont, 2017). It is noteworthy that many universities are pushing ahead with online teaching and learning not because of COVID-19 but more so due to the course suitability of being developed into an online delivery mode and also there is a growing acceptance of this mode of teaching by the students and lecturers. If so, to facilitate discourse using assessment and feedback, besides screencasts, lecturers can use an audio over PowerPoint iSpring suite to scaffold the assessment requirements to students in a very structured way. Further, in line with the assessment for learning practices, students are placed in small groups or Zoom Breakout Rooms to collaborate and to peer instruct. According to Arico and Lancaster (2018), aligning self-assessment to peer instruction may benefit students in 'reflective observation' and appraising their level of knowledge and skills before engaging in group discussion. Furthermore, peer instruction is a scalable, effective and convenient solution to large group teaching in lecture theatre environments (Arico & Lancaster, 2018).

For students who are too shy to talk they can use Wiki or Chat to provide peer feedback. During the small group interactions, either face-to-face or online, students are required to negotiate and reason what the assessment requirements entail and how they can collectively work to achieve the learning outcomes through the requirements provided. In the event they encounter any difficulties or problems, they can seek assistance from the lecturers. To support student learning, assistance will take the form of socio-constructivist feedback for students to further elaborate and argue among themselves. It is important that the tasks are designed to improve students' beliefs in their own academic abilities, that is, to have mastery-focused activities supported by constructive feedback (Tanner, 2013). In what follows, given the plethora of technology available, lecturers have to acquire both technological and pedagogic knowledge so that they can pick the right technology to enrich student learning experience (Avidov-Ungar et al., 2018) and also be wary of the promises of potentiality that surround the technology. In this context, Dawson and Henderson (2017) conclude that technology interventions need to be guided by clear goals, need improvements in assessment and feedback designs, and need to address organisational matters.

The literature concurs that assessment for learning is part of everyday practice by students, teachers and peers that seeks, reflects upon and responds to information from dialogue, demonstration and observation in ways that enhance ongoing learning (Klenowski, 2009, p. 264). If so, then it is theoretically plausible to embed in the assessment processes co-assessment of students' oral presentations, where each student self-assesses his/her own presentation before agreeing on a final grade with the lecturers after critical discussion (Deeley, 2014). Through co-assessment initiative, students are afforded the opportunity to form a staff-student partnership which may result in students becoming more active and self-regulated learners (Deeley & Brown, 2014). Furthermore, in this partnership students are expected to respond and reflect upon information together with the lecturers and their peers to enhance their learning. In this manner, it fits within the framework of Vygotsky (1978) in which the experts and students are required to work together to reach a shared meaning. In order to assist them in self-assessment, Echo360 or Panopto is used to record the oral presentations. According to Murphy and Barry (2016) the recordings are helpful for students' self-assessment and conducive for co-assessment with the lecturers. Therefore, the tendency to work together in a staff-student partnership, a relatively simple assessment process of oral presentations may result in students adopting deep approaches to learning (Higher Education Academy, 2014). This suggests that the use of the partnership for student learning could contribute to enriching the feedback process too. Specifically, in terms of learning, lecturers can use Camtasia, a software for audio–video screen casting to provide socio-constructivist feedback on students' written group-based assignments. Consequently, they are given some time to collectively act on the feedback and resubmit their work indicating how they use the feedback for improvements. Accepting feedback from the assessment for learning perspective, Hyland (2000) highlights the need to turn each item of the assessed work into an instrument to feed forward on student learning. It is noteworthy that students believe that feedback from Camtasia is of better quality, easier to understand and more personal (Hyde, 2013).

Collaborative Learning Spaces

According to van Merrienboer et al. (2017) the quality of education may suffer when pedagogies and physical learning spaces are not aligned. Similarly, in the context of constructive alignment, Biggs and Tang (2011) argued that to increase the quality of learning, teaching must be designed to promote students' deep approach to learning which is more likely to enhance deep understanding (Entwistle, 2018; Trigwell, 2012). Accepting a socio-constructivist perspective for the collaborative active learning (CAL) approach, quality of education may imply strong collaboration activities like mutual explanation, elaborative questioning, analytic reasoning and collaborative knowledge construction occurring both in the face-to-face situations and in the virtual environments. In relation to that, Keppell and Riddle (2012) highlight the significance of having adaptable and flexible learning spaces to accommodate collaborative and individual learning. Interestingly, students have a much higher expectation of the flexible social spaces to support the collaborative nature of the learning activities outside the classroom (Todhunter, 2015). Indeed, today's student learning is "leaving the classroom" (Roberts & Weaver, 2006, p. 97) and "digital devices can turn almost any space outside the classroom into an informal learning space" (Johnson & Lomas, 2005, p. 16). In this context, informal learning spaces are able to offer lecturers and students supplementary platforms to enhance face-to-face and virtual participation outside the classroom. Accordingly, it would be beneficial to provide a descriptive definition of informal learning spaces, which would lead to a more informed understanding. From the university library perspective, informal learning spaces are defined as non-discipline specific spaces for self-directed learning activities within and outside the library spaces (Harrop & Turpin, 2013). Additionally, they are hybrid spaces for students to socialise with friends and to study alone and they are also known as the Third Space (Oldenburg, 1998).

It is important to note here that with the pervasiveness of Wifi and mobile devices, informal learning spaces can create a blended learning experience that models distributed learning (Keppell & Riddle, 2012). Specifically, distributed learning embraces lifelong and life-wide learning, that is, learning does not just occur in the university but also at work, home and within the community. The tools for collaboration have changed dramatically, for instance social media and Web 2.0 like Blogs and Wikis play a crucial role in student learning and socialization (Cress & Kimmerle, 2008). Furthermore, according to Woods and Bliss (2016), asynchronous online discussions are common collaborative tools used for social interaction, discussion of assessable work and group projects. Given all the insights above, it is reasonable to assume that the process of learning through social interaction is of utmost importance. This assumption suggests that, for the learning process to be successful, students have to equip themselves with self-regulated learning skills in order to manage and evaluate their learning and to provide self-feedback and judgement of the learning process. In addition, e-portfolio is a useful tool to support the development of learning skills, particularly lifelong learning skills, as it enables students to reflect on their learning and professional development (learning at work and within the community) and to construct presentations of the artefacts stored in the e-portfolio in order to share and collaborate with others (Heinrich & Bozhko, 2012). Besides lifelong learning, Keppell and Riddle (2012) state that e-portfolio together with Web 2.0 tools provide connected environments for interactive learning (student with content), networked learning (students with peers and lecturers) and peer learning where two-way feedback and dialogue happen between peers and lecturers. It is evident that learning is essentially about the interaction of three interconnected elements within the community, that is, learning tasks, technologies and learning spaces. Furthermore, the roles played by students and lecturers pertaining to the

CAL approach will describe how each element should be realised in the learning environment.

The use of e-portfolio systems such as Mahara (http://mahara.org/) and Pebblepad (http://www.pebblepad.co.uk/) for educational purposes and the integration of the system with Moodle LMS and Web 2.0 has allowed students to create an environment akin to a Personal Learning Environment (PLE). According to Attwell (2007), PLE that integrates formal and informal learning spaces supports lifelong and life-wide learning because it is based on the idea that learning occurs under different situations and contexts. It is evident that PLE is a tool that serves no specific purpose for some, and an intentional functional means for others. To illustrate, self-regulated students use the tool to support personal learning through manipulation, synthesis, and analysis of information as well as group-based learning by manipulating PLE as a communication tool to support interaction between people on the Internet (Wilson et al., 2007). On the other hand, the not so self-directed students may find it a challenge to create meaning from the large depositories of information and to organise and share the content. The reason being this group of students may be lacking in constructivism which is crucial to self-directed learning (Zimmerman, 1989). Nevertheless, evidence suggests that CAL can promote self-directed and general learning skills (Warburton & Volet, 2012) and thus may assist students in the PLE intentional functional means.

Overall, according to King (2016) collaborative active learning (CAL) has contributed to the blurring of boundaries between physical and virtual spaces as well as social and learning spaces. Specifically, student personal virtual spaces such as Facebook, YouTube, Flickr and Twitter are used to socialise with friends inside and outside the class, and they are also used for communication with peers and others over the Internet in search of information to complement learning in the classroom. Likewise, when students are physically present in the classrooms or laboratory, they are also virtually active in the Internet searching for information to corroborate their own learning and group discussion. In a study by Chang-Tik and Song (2022) students tend to share answers in WhatsApp more so than other information, therefore, lecturers should encourage them to share learning processes in order to increase their ability to co-construct knowledge and to co-regulate learning. This is because according to the social cognitive theory, learning occurs within the social community through observation and emulation of others (Schunk, 1996). Furthermore, to enhance learning in the virtual social spaces, lecturers should be educated and trained on strategies in which they can adapt to existing learning spaces to support their learning and teaching methods purposefully, rather than treating the strategies as isolated activities. Casanova (2014, cited from Carvalho, 2021) concurs that the shift in the educational paradigm requires a change in the lecturers' mentalities and continuous training.

Focusing on student learning, particularly, on the four central learning components (Vermunt & Donche, 2017) such as cognitive processing strategies, regulation strategies, conceptions of learning, and learning orientations, a learning pattern framework is developed to coordinate these components. In this respect, Lonka et al. (2004) identify four recurring learning patterns: undirected, reproduction-directed, meaning-directed and application-directed learning patterns. Consequently, Yu et al. (2021) in their study on learning patterns and learning spaces provide evidence indicating that students adopting application-directed learning patterns prefer flexible learning spaces. In addition, reproduction-directed students tend to favour traditional classroom settings and the meaning-directed students place less emphasis on the importance of learning spaces. Following these findings, it may be to the best interest of student learning to have a combination of traditional classrooms and new learning spaces (Park & Choi, 2014).

Furthermore, using high-technology active learning classrooms as a collaborative learning space does not necessarily create an environment that is conducive to engaging in this self-paced, responsible learning (Nicol et al., 2018). To achieve effective results in educational processes that include high-technology active learning classroom, interaction among lecturers, students and content should be structured effectively (Garrison & Cleveland-Innes, 2005) and a structured mechanism should be implemented (Hung & Yuen, 2010). Therefore, there is a need to ensure that students are not disengaged with high-technology and get distracted by communicating with peers on irrelevant topics (White et al., 2014). Also, the need to be wary that open and innovative learning spaces may help the more-capable students learn well but not so for the less-capable students (Yu et al., 2021). Since technology and learning spaces are already—and will continue to be—used by students, lecturers should adopt a pedagogy-driven approach to integrating technology in the learning spaces. There should also be changes to the curriculum as well as lecturers' experience, training and attitudes towards technology before benefits would be incurred by students in deeper learning through small group collaboration. According to Copridge et al. (2021), for lecturers to have a change in the pedagogical perspectives when teaching in either the normal or active learning classrooms, they should be provided professional development opportunities.

Learning spaces or, by and large, learning technologies that students are engaged with in their learning appear to stand closer to the social cognitive theory which is the ability of students to learn within a social environment through observation and emulation of others (Schunk, 1996). Accepting a collaborative active learning (CAL) perspective, it is reasonable to assume that there is a need to incorporate co-construction of knowledge and co-regulation of learning skills among students pointing at three pertinent CAL features: self-reflection, social interaction and socio-cognitive conflicts (Chang-Tik, Chapter 1 this volume). Similarly, equating learning spaces with learning technologies, Ellis (2016) suggests that certain personality types and learning styles may favour high-technology learning environments. In other words, when there are high levels of collaboration and social engagement, Nicol et al. (2018) cautions that technological renovations to the classrooms may not overcome the performance losses due to interpersonal processes as spelled out in the three CAL features.

Hospitable Learning Spaces and Active Learning Classrooms

Consequently, it is important to gain insights into some dimensions of learning spaces to grasp a full conceptual understanding of how they affect CAL from the student and lecturer perspectives. According to Kolb and Kolb (2017) these dimensions are intentionally managed to create hospitable learning spaces (HLS) for students. They are:

- Institutional space—institutional policies, goals and traditions play a crucial role in shaping student learning and in enhancing lecturer teaching. Institutions should help to create a learning environment that encourages critical thinking, higher-order learning and enhances the use of digital futures as well as the use of open access learning opportunities to such an extent that it can become the central component for CAL. If so, according to Patton (2010) institution should broadly define learning outcomes as developmental outcomes to provide flexibility to lecturers to use different teaching techniques, help attenuate the workload, and reduce monotony. Consequently, according to Apkarian et al. (2021), institutions where student evaluation of teaching is important, lecturers will place less emphasis on active learning. Given all the insights above, it is reasonable to state that lecturers need "a tremendous amount of institutional support" (Mabrito & Medley, 2008, p. 16) and a flexible 'whole-of-institution' approach (Taylor, 2001).

- Physical space—classroom setup, lighting, tables and chairs that makeup the formal physical learning space need to be adaptable and flexible to motivate student learning and provide lecturers with diverse teaching approaches (Keppell & Riddle, 2012). Nevertheless, according to Arvaja (2007) students are surrounded by a variety of resources that are utilized in CAL, therefore, the focus should be to integrate physical and virtual (Web 2.0), personal and collective as well as formal and informal learning spaces. Importantly, the physical space should reflect the pedagogy of the variety and evolving nature of activities to be undertaken (Jamieson et al., 2000). This is because physical space does have an effect on promoting active learning and engaging students (Donkin & Kynn, 2021). In this regard, physical space should be open and can accommodate a range of lecturer—and student-led activities at any one time (van Merrienboer et al., 2017).
- Cultural space—the norms, values, language and history used in the learning interactions and learning activities may affect student participation and engagement. This is because student engagement in education has behavioural and psychological components that are assimilated into the academic culture (Kahu, 2013). Specifically, according to Wright et al. (2019), lecturers may find it productive to establish norms in high lecturer-to-student contact learning spaces like CAL that involve students' new roles, experiencing key differences in learning and also for lecturers to negotiate role expectations with students. Moreover, this negotiation should include many Asian cultures that support collectivist goals (Miyahara et al., 1998) which may be detrimental to CAL, particularly in the computer-supported version (Zhong, 2010). Still though, some lecturers may be concerned with violating departmental norms and some cited

the "publish or perish" culture where universities value research productivity over teaching effectiveness (Michael, 2007).

- Social space—focuses on the lecturer-student relationships and among the peers and others in the learning communities that support learning, and it encourages students to think more deeply about a subject in the pursuit of their interests. As discussed in Chapter 1 (Chang-Tik, this volume), social interactions and social anxieties combine all elements of CAL in such a way that serves learning, and students as well as lecturers should employ more effort to elicit and interpret the evidence of learning. If so, there is a need for the institutional, physical and cultural spaces to complement and enrich the social space in order to facilitate discourse and to bring about a more insightful debate and argument. In this context, social presence is crucial in the development of a sense of community to motivate and facilitate peer collaboration in CAL (Smith & Flaherty, 2013). In a similar vein, Solomon et al. (2010) claimed that group work creates opportunities for social comparison, social learning and social cognition. As a result of this comparison, students make gains in achievement, motivation and self-efficacy (Hernandez et al., 2013).
- Psychological space—individual psychological characteristics that include learning style, personality traits, values and learning skills. It pertains to a space where students receive psychological safety while participating actively in CAL. According to Edmondson and Lei (2014, p. 24), psychological safety "describes the perceptions of the consequences of taking interpersonal risks in a particular context". Very similarly, when there is a high level of psychological safety, cohesion and interdependence, it will strengthen students' belief that it is worthwhile to engage in group activities which is key to learning (Van den Bossche et al., 2006). In what follows, Kolb and Kolb (2017) suggest lecturers treat students with unconditional positive regard, that is, by tailoring the learning process to accommodate student's individual needs and developments, and showing warm and caring acceptance when interacting with them. In this regard, students may perceive feelings of acceptance and respect from the lecturers in the psychological space. In a similar vein, through peer interaction students may generate contact leading to feelings of acceptance and connectedness to their peers (Sidelinger & Booth-Butterfield, 2010) which is crucial in facilitating conversations.

Viewed from this lens, the negative teaching and learning experiences in CAL classes may be the consequences of the failure to create and maintain an HLS. In this respect, Kolb and Kolb (2017) argue that without this space even the most engaging and well-designed CAL approaches may fail. From a methodological perspective, Appreciative Inquiry (AI), which is founded on the principles of social constructionism and positivity (Cooperrider et al., 2008), uses four-phase scaffold to stimulate CAL in large classes in the context of HLS. Consequently, with hospitable learning spaces and an effective AI approach lecturers should be able to implement CAL in a normal classroom with a class size of at least 100 students. If so, is there a need for an active learning classroom?

To answer this question, let's start with the definition of active learning classrooms (ALCs), which according to Baepler and Walker (2014), ALCs are student-centred learning spaces that facilitate collaboration, promote interaction and engagement as well as minimise barriers between lecturers and students. To illustrate, a typical classroom layout can be transformed into different settings to accommodate various in-class learning activities, and supported by sufficient power outlets and wireless networks. It can hold between 50 and 60 students in a single session. In the context of the physical space of HLS, it is theoretically plausible to expect any positive impacts of ALCs to align with the pedagogy applied to the nature of the learning activities (Jamieson et al., 2000). If so, the strong relationships between the five spaces of HLS may indicate that besides the physical and technological aspects of ALCs, the other variables like social, cultural, institutional and psychological aspects of teaching and learning also play a significant role, independently of ALCs. Using ALCs as a means of teaching would not necessarily lead to a positive result in the learning process because not all lecturers will use the classroom as intended as they need training in order to use the rooms effectively (Knaub et al., 2016). Likewise, according to Avidov-Ungar et al. (2018), lecturers who are low in pedagogic and technological knowledge may find ALCs a barrier for teaching. Indeed, today's ALCs are generally high-technology and unfortunately these classrooms do not always create an environment conducive for self-paced responsible learning. This is because it takes numerous years for the curriculum to change and also for lecturers to build up a certain level of experience before any benefits would be incurred (Rogers et al., 2015).

Consequently, to achieve effective results in educational processes that include ALCs, interaction among all the five spaces of HLS should be structured effectively and a structured mechanism should be implemented. Therefore, an applicable framework should be executed for the integration of physical and virtual (Web 2.0), personal and collective as well as formal and informal learning spaces (Arvaja, 2007). The theoretical background employed is based on the Community of Inquiry (CoI) framework, which aims to develop effective online and offline learning communities to support learning (Akyol et al., 2009). According to the framework, learning is about the interaction of the three interconnected and dynamic presences (social, cognitive and teaching) within the community (Garrison & Cleveland-Innes, 2005) realised in the hospitable learning spaces. Upon successful execution of the applicable framework, it is reasonable to expect some positive effects of ALCs in enhancing engagement and encouraging interaction (Baepler & Walker, 2014) and to reinforce collaborative teaching and learning methods that enable students to construct knowledge by themselves (Avidov-Ungar et al., 2018).

Conclusion

Before universities jump on the bandwagon to convert classrooms into active learning classrooms (ALCs), it may be plausible for the management to align the universities policies and goals with the pedagogical shift to blended and/or fully online learning. Additionally, the management needs to consider the synergy between technologies with pedagogies in both formal and informal CAL environments in order to bring about fun, meaningful and interactive learning. Therefore, to bridge a gap from a perspective of lecturers and students having to be physically present in campuses against them working and learning from home, universities may have to reconsider the purpose of learning spaces and technologies. On one hand, when there are high levels of face-to-face contact required in teaching and learning, it is not easy to conclude that students can achieve self-learning on their own without the physical presence of lecturers. This point becomes important when combined with van Merrienboer et al. (2017) finding that pedagogies and physical learning spaces need to be aligned. It is also important to check for practical significance of ALCs in relation to the five spaces of HLS, if a decision is made to set up such classrooms. On the other hand, to make the transition from face-to-face delivery to either blended or fully online, a richer understanding of informal learning spaces is required. In this respect, distributed learning spaces recognise that learning has increasingly occurred at work, home and within a community (Keppell & Riddle, 2012). Importantly, the availability of Wifi and mobile devices give students a blended learning experience outside the classrooms that models distributed learning. In other words, learning does not just occur in the formal university setting but also at work as in work integrated learning, in the community as in community-based learning and the Personal Learning Environment (PLE) as in distributed learning.

It is noteworthy that a substantial shift in the instructional delivery and learning spaces within the CAL environments may lead to the lecturers and students to be more inclined to view assessment and feedback as effective tools for deep approach to learning. According to Asikainen et al. (2013), assessment has a strong influence on students' learning and may either encourage or discourage deep approaches to learning. Therefore, when students are better informed about the learning outcomes that are manifested in well-designed activities and assessment methods aided by appropriate technologies, they are more likely to embrace assessment and feedback for learning and possibly form a staff-student partnership to bring assessment to a new level of learning. On the contrary, if assessment guides students towards memorisation instead of knowledge construction (Asikainen et al., 2013) and the learning environment is too challenging, then students are likely to adopt unreflective approaches to learning. In this regard, it is crucial that lecturers must constructively align the learning outcomes to assessment and teaching–learning activities in HLS environments to enhance deep meaning-oriented learning.

References

Akyol, Z., Garrison, D. R., & Ozden, M. Y. (2009). Online and blended communities of inquiry: Exploring the developmental and perceptional differences. *International Review of Research in Open and Distributed Learning, 10*(6), 65–83. https://doi.org/10.19173/irrodl.v10i6.765

Apkarian, N., Henderson, C., Stains, M., Raker, J., Johnson, E., & Dancy, M. (2021). What really impacts the use of active learning in undergraduate STEM education? Results from a national survey of chemistry, mathematics, and physics instructors. *PLoS ONE, 16*(2), e0247544.

Arico, F. R., & Lancaster, S. J. (2018). Facilitating active learning and enhancing student self-assessment skills. *International Review of Economics Education, 29*(2018), 6–13. https://doi.org/10.1016/j.iree.2018.06.002

Arvaja, M. (2007). Contextual perspective in analysing collaborative knowledge construction of two small groups in web-based discussion. *International Journal of Computer-Supported Collaborative Learning, 2*(2/3), 133–158. https://doi.org/10.1007/s11412-007-9013-5

Asikainen, H., Parpala, A., Virtanen, V., & Lindblom-Ylanne, S. (2013). The relationship between student learning process, study success and the nature of assessment: A qualitative study. *Studies in Educational Evaluation, 39*(4), 211–217. https://doi.org/10.1016/j.stueduc.2013.10.008

Attwell, G. (2007). Personal learning environments—The future of eLearning? *eLearning Papers, 2*(1). http://www.elearningeuropa.info/files/media/media11561.pdf

Avidov-Ungar, C., Leshem, B., Margaliot, A., & Grobgeld, E. (2018). Faculty use of the active learning classroom: Barrier and facilities. *Journal of Information Technology Education: Research, 17*, 495–504.

Baepler, P., & Walker, J. D. (2014). Active learning classrooms and educational alliances: Changing relationships to improve learning. *New Directions for Teaching and Learning, 137*, 27–40.

Benton, S., & Pallett, W. (2013). In higher education, class size matters. *APA PsycEXTRA Dataset*. https://doi.org/10.1037/e610512013-001

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). Open University Press.

Brooks, D. C. (2012). Space and consequences: The impact of different formal learning spaces on instructor and student behaviour. *Journal of Learning Spaces, 1*(2). Retrieved from https://files.eric.ed.gov/fulltext/EJ1152694.pdf

Buchs, C., Butera, F., Mugny, G., & Darnon, C. (2004). Conflict elaboration and cognitive outcomes. *Theory into Practice, 43*(1), 23–30. https://doi.org/10.1207/s15430421tip4301_4

Carvalho, A. R., & Santos, C. (2022). Developing peer mentors' collaborative and metacognitive skills with a technology-enhanced peer learning program. *Computer and Education Open, 3*, 100070. https://doi.org/10.1016/j.caeo.2021.100070

Carvalho, A., Teixeira, S. J., Olim, L., de Campanella, S., & Costa, T. (2021). Pedagogical innovation in higher education and active learning methodologies: A case study. *Education plus Training, 63*(2), 195–213. https://doi.org/10.1108/ET-05-2020-0141

Chang-Tik, C. (2018). Impact of learning styles on the community of inquiry presences in multi-disciplinary blended learning environments. *Interactive Learning Environments, 26*(6), 827–838. https://doi.org/10.1080/10494820.2017.1419495

Chang-Tik, C., & Dhaliwal, J. (2022). Collaborative learning approach to teach computer coding in informal spaces. *Learning: Research and Practice, 8*(1), 5–24. doi:https://doi.org/10.1080/23735082.2021.1953571

Chang-Tik, C., & Song, B.-K. (2022). Active learning in informal learning spaces: Science students' experiences. *Pedagogies: An International Journal*. https://doi.org/10.1080/1554480X.2022.2061978

Cooperrider, D., Whitney, D. D., & Stavros, J. (2008). *The appreciative inquiry handbook: For leaders of change*. Berrett-Koehler.

Copridge, K. W., Uttamchandani, S., & Birdwell, T. (2021). Faculty reflections of pedagogical transformation in active learning classrooms. *Innovative Higher Education, 46*, 205–221. https://doi.org/10.1007/s10755-021-09544-y

Cress, U., & Kimmerle, J. (2008). A systemic and cognitive view on collaborative knowledge building with wikis. *Computer-Supported Collaborative Learning, 3*(2), 105–122. https://doi.org/10.1007/s11412-007-9035-z

Dawson, P., & Henderson, M. (2017). How does technology enable scaling up assessment for learning? In D. Carless, S. M. Bridges, C. K. Y. Chan, & R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 193–207). Springer Nature.

Deeley, S. J. (2014). Summative co-assessment: A deep learning approach to enhancing employability skills and attributes. *Active Learning in Higher Education, 15*(1), 39–51. https://doi.org/10.1177/1469787413514649

Deeley, S. J., & Brown, R. A. (2014). Learning through partnership in assessment. *Teaching and Learning Together in Higher Education, 1*(13). https://repository.brynmawr.edu/cgi/viewcontent.cgi?article=1107&context=tlthe

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning, 10*(2), 1–13. https://files.eric.ed.gov/fulltext/EJ890707.pdf

Donkin, R., & Kynn, M. (2021). Does the learning space matter? An evaluation of active learning in a purpose-built technology-rich collaboration studio. *Australasian Journal of Educational Technology, 37*(1), 133–146. https://doi.org/10.14742/ajet.5872

Edmondson, A. C., & Lei, Z. (2014). Psychological safety: The history, renaissance, and future of an interpersonal construct. *Annual Review of Organizational Psychology and Organizational Behavior, 1*(1), 23–43. https://doi.org/10.1146/annurev-orgpsych-031413-091305

Ellis, R. A. (2016). Qualitatively different university student experiences of inquiry: Associations amongst approaches to inquiry, technologies and perceptions of the learning environment. *Active Learning in Higher Education, 17*(1), 13–23. https://doi.org/10.1177/1469787415616721

Entwistle, N. (2018). *Student learning and academic understanding: A research perspective with implications for teaching*. Academic Press.

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: The importance of team and task awareness. *Computers in Human Behavior, 27*(3), 1103–1113. https://doi.org/10.1016/j.chb.2010.05.017

Fu, F. L., Wu, Y. L., & Ho, H. C. (2009). An investigation of coopetitive pedagogic design for knowledge creation in web-based learning. *Computer & Education, 53*(3), 550–562. https://doi.org/10.1016/j.compedu.2009.01.004

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education, 19*(3), 133–148. https://doi.org/10.1207/s15389286ajde1903_2

Hamalainen, R., & Hakkinen, P. (2010). Teacher's instructional planning for computer-supported collaborative learning: Macro-scripts as a pedagogical method to facilitate collaborative learning. *Teaching and Teacher Education, 26*(4), 871–877. https://doi.org/10.1016/j.tate.2009.10.025

Hamalainen, R., & Vahasantenen, K. (2011). Theoretical and pedagogical perspectives on orchestrating creativity and collaborative learning. *Educational Research Review, 6*(3), 169–184. https://doi.org/10.1016/j.edurev.2011.08.001

Harrop, D., & Turpin, B. (2013). A study exploring learners' informal learning space behaviors, attitudes and preferences. *New Review of Academic Librarianship, 19*(1), 58–77. https://doi.org/10.1080/13614533.2013.740961

Heinrich, E., & Bozhko, Y. (2012). The role of institutions in creating student-focused virtual learning spaces with e-portfolio systems. In M. Keppell, K. Souter, & M. Riddle (Eds.), *Physical and virtual learning spaces in higher education: Concepts for the modern learning environment* (pp. 119–135). IGI Global.

Hernandez, P. R., Schultz, P. W., Estrada, M., Woodcock, A., & Chance, R. C. (2013). Sustaining optimal motivation: A longitudinal analysis of interventions to broaden participation of underrepresented students in STEM. *Journal of Educational Psychology, 105*(1), 89–107. https://doi.org/10.1037/A0029691

Higher Education Academy. (2014). *Framework for partnership in learning and teaching in higher education*. The Higher Education Academy.

Hung, H. T., & Yuen, S. C. Y. (2010). Educational use of social networking technology in higher education. *Teaching in Higher Education, 15*(6), 703–714. https://doi.org/10.1080/13562517.2010.507307

Hyde, E. (2013). Taking results: Trialing an audio-visual feedback method for e-submissions. *Innovative Practice in Higher Education, 1*(3). http://journals.staffs.ac.uk/index.php/ipihe/article/viewFile/37/73

Hyland, P. (2000). Learning from feedback on assessment. In P. Hyland & A. Booth (Eds.), *The practice of university history teaching* (pp. 233–247). Manchester University Press.

Jamieson, P., Fisher, K., Gilding, T., Taylor, P. G., & Trevitt, A. (2000). Place and space in the design of new learning environments. *Higher Education*

Research and Development, 19(2), 221–236. https://doi.org/10.1080/0729436004456664

Janssen, J., Erkens, G., Kanselaar, G., & Jaspers, J. (2007). Visualization of participation: Does it contribute to successful computer-supported collaborative learning? *Computers & Education, 49*(4), 1037–1065. https://doi.org/10.1016/j.compedu.2006.01.004

Johnson, C., & Lomas, C.P. (2005). Design of the learning space: Learning and design principles. *EDUCAUSE Review, 40*(4), 16–28. https://bit.ly/3k0Akn6

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research*. Interaction.

Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education, 38*(5), 758–773. https://doi.org/10.1080/03075079.2011.598505

Keppell, M., & Riddle, M. (2012). Distributed learning spaces: Physical, blended and virtual learning spaces in higher education. In M. Keppell, K. Souter, and M. Riddle (Eds.), *Physical and virtual learning spaces in higher education: Concepts for the modern learning environment*. (pp. 1–20). IGI Global.

King, H. (2016). Learning spaces and collaborative work: Barriers or supports? *Higher Education Research & Development, 35*(1), 158–171. https://doi.org/10.1080/07294360.2015.1131251

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75–86. doi:https://doi.org/10.1207/s15326985ep4102_1

Klenowski, V. (2009). Assessment for learning revisited: An Asia-Pacific perspective. *Assessment in Education: Principles, Policy & Practice, 16*(3), 263–268. https://doi.org/10.1080/09695940903319646

Knaub, A. V., Foote, K. T., Henderson, C., Dancy, M., & Beichner, R. J. (2016). Get a room: The role of classroom space in sustained implementation of studio style instruction. *International Journal of STEM Education, 3*, 8. https://doi.org/10.1186/s40594-016-0042-3

Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Pearson.

Kolb, A. Y., & Kolb, D. A. (2017). *The experiential educator: Principles and practices of experiential learning*. Experience Based Learning Systems.

Kwon, K., Liu, Y., & Johnson, L. (2014). Group regulation and social-emotional interactions observed in computer supported collaborative learning: Comparison between good versus poor collaborators. *Computer & Education, 78*, 185–200. https://doi.org/10.1016/j.compedu.2014.06.004

Lewis, C. C., & Abdul-Hamid, H. (2006). Implementing effective online teaching practices: Voices of exemplary faculty. *Innovative Higher Education, 31*(2), 83–98. https://doi.org/10.1007/s10755-006-9010-z
Li, Y., Yu, W., Liu, C., Shieh, S.-H., & Yang, B.-H. (2014). An exploratory study of the relationship between learning styles and academic performance among students in different nursing programs. *Contemporary Nurse, 48*(2), 229–239. https://doi.org/10.5172/conu.2014.4470
Lonka, K., Olkinuora, E., & Makinen, J. (2004). Aspects and prospects of measuring studying and learning in higher education. *Educational Psychology Review, 16*(4), 301–323. https://doi.org/10.1007/s10648-004-0002-1
Mabrito, M., & Medley, R. (2008). Why professor Johnny can't read: Understanding the Net generation's texts. *Innovate: Journal of Online Eudcation, 4*(6). https://nsuworks.nova.edu/innovate/vol4/iss6/2/
McCarthy, J. (2015). Evaluating written, audio and video feedback in higher education summative assessment tasks. *Issues in Educational Research, 25*(2), 153–169. http://www.iier.org.au/iier25/mccarthy.pdf
Michael, J. (2007). Faculty perceptions about barriers to active learning. *College Teaching, 55*(2), 42–47. https://doi.org/10.3200/CTCH.55.2.42-47
Miyahara, A., Kim, M., Shin, H., & Yoon, K. (1998). Conflict resolution styles among COLLECTIVIST cultures: A Comparison between Japanese and Koreans. *International Journal of Intercultural Relations, 22*(4), 505–525. https://doi.org/10.1016/S0147-1767(98)00021-2
Morris, C., & Chikwa, G. (2016). Audio versus written feedback: Exploring learners' preference and the impact of feedback format on students' academic performance. *Active Learning in Higher Education, 17*(2), 125–137. https://doi.org/10.1177/1469787416637482
Moscrop, C., & Beaumont, C. (2017). Technology-enhanced assessment feedback. In D. Carless, S. M. Bridges, C. K. Y. Chan, and R. Glofcheski (Eds.), *Scaling up assessment for learning in higher education* (pp. 193–207). Springer Nature.
Murphy, K., & Barry, S. (2016). Feed-forward: Students gaining more from assessment via deeper engagement in video-recorded presentations. *Assessment & Evaluation in Higher Education, 41*(2), 213–227. https://doi.org/10.1080/02602938.2014.996206
Nicol, D., & Macfarlane, D. (2006). Formative assessment and self-regulated learning; A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218. https://doi.org/10.1080/03075070600572090
Nicol, A. A. M., Owens, S. M., Le Coze, S. S. C. L., MacIntyre, A., & Eastwood, C. (2018). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education, 19*(3), 253–265. https://doi.org/10.1177/1469787417731176

Oldenburg, R. (1998). *The great good place: cafés, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community*. Marlowe and Company.

Park, E. L., & Choi, B. K. (2014). Transformation of classroom spaces: Traditional versus active learning classroom in colleges. *Higher Education, 68*(5), 749–771. https://doi.org/10.1007/s10734-014-9742-0

Patton, M. Q. (2010). *Developmental evaluation: Applying complexity concepts to enhance innovation and use*. Guilford Press.

Powell, K.C., & Kalina, C.J. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241–250.

Price, M., Handley, K., & Millar, J. (2011). Feedback: Focusing attention on engagement. *Studies in Higher Education, 36*(8), 879–896. https://doi.org/10.1080/03075079.2010.483513

Roberts, S., & Weaver, M. (2006). Spaces for learners and learning: Evaluating the impact of technology-rich learning spaces. *New Review of Academic Librarianship, 12*(2), 95–107. https://doi.org/10.1080/13614530701330380

Rogers, M., Keller, L. D., Crouse, A., & Price, M. F. (2015). Implementing comprehensive reform of introductory physics at a primarily undergraduate institution: A longitudinal case study. *Journal of College Science Teaching, 44*(3), 82–90.

Ryan, T., Henderson, M., & Phillips, M. (2019). Feedback modes matter: Comparing student perceptions of digital and non-digital feedback modes in higher education. *British Journal of Educational Technology, 50*(3), 1507–1523. https://doi.org/10.1111/bjet.12749

Schunk, D. H. (1996). *Learning theories*. Printice Hall Inc.

Shea, P., Li, C. S., & Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *The Internet and Higher Education, 9*(3), 175–190. https://doi.org/10.1016/j.iheduc.2006.06.005

Shieh, R. S. (2012). The impact of technology-enabled active learning (TEAL) implementation on student learning and teachers' teaching in a high school context. *Computers & Education, 59*(2), 206–214. https://doi.org/10.1016/j.compedu.2012.01.016

Sidelinger, R. J., & Booth-Butterfield, M. (2010). Co-constructing student involvement: An examination of teacher confirmation and student-to-student connectedness in the college classroom. *Communication Education, 59*(2), 165–184. https://doi.org/10.1080/03634520903390867

Smith, R., & Flaherty, J. (2013). The importance of social presence in an online MBA program: A preliminary investigation. *Teaching and Learning Innovations, 16*. https://doi.org/10.1177/1052562916647984

Soden, B. (2016). Combining screencast and written feedback to improve the assignment writing of TESOL taught master's students. *The European Journal of Applied Linguistics and TEFL, 5*(1), 213–236.

Solomon, Y., Croft, T., & Lawson, D. (2010). Safety in numbers: Mathematics support centres and their derivatives as social learning spaces. *Studies in Higher Education, 35*(4), 421–431. https://doi.org/10.1080/03075070903078712

Tanner, K. D. (2013). Structure matters: Twenty-one teaching strategies to promote student engagement and cultivate classroom equity. *CBE—Life Sciences Education, 12*(3), 322–331. doi:https://doi.org/10.1187/cbe.13-06-0115

Taylor, J. (2001). Fifth generation distance education. In *Keynote address presented at the 20th ICDE world conference*, Düsseldorf, Germany.

Todhunter, B. J. (2015). An examination of the views of key stakeholders on the development of learning spaces at a regional university. *Journal of Facilities Management, 13*(2), 204–222. https://doi.org/10.1108/JFM-06-2014-0016

Trigwell, K. (2012). Relations between teachers' emotions in teaching and their approaches to teaching in higher education. *Instructional Science, 40*(3), 607–621. https://doi.org/10.1007/s11251-011-9192-3

Trinh, M. P., van Esch, C., Martinez, H. A., & Tracey Messer, T. (2021). Appreciating large classes: Using appreciative inquiry to foster a hospitable learning space for experiential learning. *Journal of Management Education, 45*(5), 786–819. https://doi.org/10.1177/1052562920980125

Van den Bossche, P., Gijselaers, W., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments. *Small Group Research, 37*(5), 490–521. https://doi.org/10.1177/1046496406292938

Van den Bossche, P., Gijselaers, W., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science, 39*(3), 283–301. https://doi.org/10.1007/s11251-010-9128-3

van Merrienboer, J. J. G., McKenney, S., Cullinan, D., & Heuer, J. (2017). Aligning pedagogy with physical learning spaces. *European Journal of Education, 52*(3), 247–398. https://doi.org/10.1111/ejed.12225

Vermunt, J. D., & Donche, V. (2017). A learning patterns perspective on student learning in higher education: State of the art and moving forward. *Educational Psychology Review, 29*(2), 269–299. https://doi.org/10.1007/s10648-017-9414-6

Vygotsky, L. S. (1978). *Mind in Society: The development of higher psychological processes*. Harvard University Press.

Warburton, N., & Volet, S. (2012). Enhanced self-directed learning through a content quiz group learning assessment. *Active Learning in Higher Education, 14*(1), 9–22. https://doi.org/10.1177/1469787412467126

White, C., Bradley, E., Martindale, J., Roy, P., Patel, K., Yoon, M., & Worden, M. K. (2014). Why are medical students 'checking out' of active learning in a new curriculum? *Medical Education, 48*(3), 315–324. https://doi.org/10.1111/medu.12356

Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., & Milligan, C. (2007). Personal learning environments: Challenging the dominant design of educational systems. *Journal of e-Learning and Knowledge Society, 3*(2), 27–38. http://bitly.ws/grDG

Woods, K., & Bliss, K. (2016). Facilitating successful online discussions. *Journal of Effective Teaching, 16*(2), 76–92. https://files.eric.ed.gov/fulltext/EJ1117812.pdf

Wright, M. C., Bergom, I., & Bartholomew, T. (2019). Decreased class size, increased active learning? Intended and enacted teaching strategies in smaller classes. *Active Learning in Higher Education, 20*(1), 51–62. https://doi.org/10.1177/1469787417735607

Yu, S., & Lee, I. (2016). Peer feedback in second language writing (2005–2014). *Language Teaching, 49*(4), 461–493. https://doi.org/10.1017/S0261444816000161

Yu, J., Vermunt, J. D., & Burke, C. (2021). Students' learning patterns and learning spaces in higher education: An empirical investigation in China. *Higher Education Research & Development, 40*(4), 868–883. https://doi.org/10.1080/07294360.2020.1775557

Yukawa, J. (2006). Co-reflection in online learning: Collaborative critical thinking as narrative. *International Journal of Computer-Supported Collaborative Learning, 1*(2), 203–228. https://doi.org/10.1007/s11412-006-8994-9

Zhong, Y. (2010). *Cultural influence in computer-supported collaborative learning* (Unpublished doctoral dissertation). National University of Singapore, Singapore. http://scholarbank.nus.edu.sg/handle/10635/18418

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329–339. https://doi.org/10.1037/0022-0663.81.3.329

Index

C. Chang-Tik et al. (eds.), *Collaborative Active Learning*,
https://doi.org/10.1007/978-981-19-4383-6