

From micro to macro levels of practice: A showcase of a SoTL journey within and beyond classroom experiences**Khairiyah Mohd-Yusof**

Centre for Engineering Education, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

khairiyah@utm.my

Narina A. Samah

School of Education, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

narina@utm.my

ABSTRACT

Scholarship of Teaching and Learning (SoTL) is closely related to a teacher's journey of personal and professional growth, which initially occurs in the classroom. In higher education, where academics are recognised experts in their fields, SoTL activities are critical for translating educational principles into innovative practices that are consistent with the body of knowledge, thus significantly facilitating the learning process of students. When implemented consistently, two components of SoTL - reflective practice and practice dissemination - have the potential to accelerate growth not only at the micro (classroom) level, but also at the meso (institutional) and macro (national and international) levels. This article showcases a SoTL journey that began with a micro level practice in engineering classes and progressed into meso and macro level implementations. Beginning with student-centred learning approaches designed to assist students with classroom engagement, motivation enhancement and contextualised learning during a challenging course, the practice expanded into institutional-level experience-sharing sessions. This resulted in the development of structured training programmes and later, a centre of excellence. SoTL practice at the institutional level paved the way for national and international professional development training. This reflection showcases SoTL implementation at all three levels while demonstrating the potential for growth from one level to another leading to wide-ranging impacts both within and beyond the classroom.

Introduction

The scholarship of teaching and learning (SoTL) has been around for more than 30 years and was initially inspired by Boyer's (1990) classification of scholarship. According to Boyer, a broader perspective of scholarship is required, one that is guided by the understanding that knowledge is gained through research, synthesis, practise, and teaching. Based on this idea, he postulated that academic activities should have four distinct but overlapping scholarly functions, namely discovery, integration, application and teaching. As explained by Major and Braxton (2020), Boyers' scholarship of discovery entails the pursuit of new knowledge through research, while scholarship of integration requires the combination of knowledge from other sources and research findings that are often interdisciplinary in nature. On the other hand, scholarship of application focuses on how acquired knowledge is being used to solve real-world problems that occur within society. Scholarship of teaching is viewed as the pursuit of creative and innovative teaching approaches as well as best practices in teaching meant for enhancing students' learning. As Wendling (2020: 131) put it: "teaching and research that works in and with community, Boyer reasoned, should be directly tied to one's field of study and, using one's advanced scholarly knowledge, work in conjunction with local communities to advance shared institutional and public goals".

Since its inception, Boyer's classification of scholarship has paved the way for an advanced conceptualisation of SoTL and the development of initial SoTL models aimed at guiding academics striving to teach with excellence (Kreber, 2013; Kreber & Cranton, 1997, 2000; Shulman, 2001; Trigwell, Martin, Benjamin & Prosser, 2000). Over the decades, SoTL has come to encompass a variety of topics, which include personal reflection and inquiry on teaching practices, instructional strategies to enhance student learning and engagement, and curriculum development. It is also related to continuing professional development, career planning, promotion and recognition among and by academics (Fanghanel, Pritchard, Potter & Wisker, 2016). SoTL has been contextualised within specific locations (Chalmers, Higgs & Ciccone, 2016; Chng, Leibowitz & Mårtensson, 2020) and specialized disciplines such as teacher education (Abrahamson, 2019; Dover, Kressler & Lozano, 2020; Plews & Ngoenha, 2020), biological education (Kinchin, 2017), medical education (Bigdeli & Mirhoseini, 2021; Cleland, Jamieson, Kusurkar, Ramani, Wilkinson & van Schalkwyk, 2021; Singh & Gupta, 2021), nursing education (Crookes, Else & Lewis, 2020; Tilakaratna, Brooke, Monbec, Lau, Wu & Chan, 2021), and engineering education (Dewar, Bennett & Fisher, 2018; Felder, 2000; Streveler, Moskal & Miller, 2012). Indeed, the progression of SoTL is evident by how it has been

conceptualised, practised, modelled, applied and embraced by academics within specific contexts and disciplines.

Context and aim of this paper

More recently, Trigwell (2021:286) viewed SoTL as “a professional way of thinking and practising that seeks to improve student learning through a process of inquiry and peer review”. Echoing this notion, we believe that teaching is not just a routine task but an important process to transform and extend the knowledge co-constructed both by teachers and students (Radcliffe, 2010). Moreover, for us, teaching is not merely about transmitting information, but connecting teachers’ understanding and students’ learning at the same time. In this paper, the context of the scholarly journey of teaching and learning (SOTL) demonstrated is deeply based on the authors’ university and aims to show that embracing teaching and learning at a scholarly level will naturally elevate efforts in the classroom whilst having the potential to evolve into higher-level pursuits with impacts beyond the classroom and institutional level. Although the journey is contextualised to one university, lessons from the journey of growth in SOTL can be extracted for others to gain insight into the dynamic nature of SoTL and the kind of context in which it has the potential to flourish.

Universiti Teknologi Malaysia (UTM) was declared as the fifth Malaysian Research University (MRU) in 2010, 35 years after it was upgraded from a technical college to a public university in Malaysia. Founded first as a technical school in 1904, UTM has always been an institution that served to develop technical talents to develop the nation. As such, the culture to develop and support students to learn in technical fields for the betterment of the citizens and nation was very strong. After being designated as a research university by the Ministry of Higher Education, the university's institutional landscape has changed dramatically, particularly in terms of research, development, and commercialization (R&D&C) activities, as well as internationalisation efforts. Being classified as a research university is important because of the additional funding obtained from the Ministry of Higher Education, which allows the university to be funded for various research activities, e.g. to disburse internal research grants for faculty members, that in turn can be used to finance the purchase of research materials and post-graduate studies, etc. The additional funding promotes the intensification of efforts in the Scholarship of Discovery. There is also a minimum key performance indicator (number of principle researchers, publication, h-index, citation, consultancy income, research collaborations, etc.) that must be fulfilled and reported to remain as a research university, a

situation of which the academic staff is aware. Many of these indicators are also reported to ranking agencies, such as QS and Times Higher Education.

As perceived by many universities worldwide, global university rankings have become “an indicator of university reputation and status and national competitiveness in the world” (Hazelkorn & Mihut, 2021: 1). Like other universities in a developing country that has been drawn to this culture partly because of the ever-changing landscape of higher education, UTM must consistently ensure that indicators of the quality of its core activities, namely teaching, research and services, are made apparent from time to time to meet the growing demands and expectations of various stakeholders. Ranking is also important in Malaysian universities’ internationalisation efforts, particularly in attracting collaborations, as well as international students and sponsorship agencies, who tend to utilise ranking in the selection of universities. This is in-line with the aspirations of the Malaysian Government to promote Malaysia as a global education hub (Education Malaysia Global Services, 2022).

In the case of engineering education in Malaysia, there is an additional quality requirement since the Malaysian Engineering Accreditation Council (EAC) has been a full signatory of the Washington Accord since 2009. To maintain the high standards of engineering graduates, all accredited engineering programmes offered by Malaysian universities must be based on an Outcome Based Education (OBE) curriculum and fulfil the programme learning outcome requirements set under the Washington Accord, which takes into account the current requirements of graduate engineers worldwide, especially those of member countries. Since all engineers practising in Malaysia must be registered with the Board of Engineers Malaysia, all engineering programmes must also be accredited. The programme outcome requirements are not limited to technical content, but also include important professional skills that graduates must have, such as complex problem solving, the use of modern tools, communication skills, teamworking and ethics, to name but a few. To fulfil these requirements, the teaching and learning environment must be designed to support students in constructing their understanding and skills in the courses that they take, which calls for academic staff to be creative and innovative in helping their students learn often challenging engineering content and skills. This fits in well with the long-held tradition of supporting students’ development in UTM, and has been well received by engineering faculty management since the introduction of OBE in 2003.

Acknowledging our important roles and responsibilities as university teachers in the context of a Malaysian public university, teaching for us is also deeply rooted in our belief that, as Muslim educators, we are accountable for the development of our students. We strive to uphold the

educational philosophy that inspires us in nurturing students to become competent individuals who, as professionals, can later contribute to the betterment of the world. Within our context as Muslim educators, our views are guided by the Holy Al-Qur'an and the sayings of Prophet Muhammad (peace be upon him). Among others, the Prophet Muhammad (PBUH) said: "God, His angels and all those in Heavens and on Earth, even ants in their hills and fish in the water, call down blessings on those who instruct others in beneficial knowledge" (Al-Tirmidhi, Hadith 422).

Such high status and reward for those who teach means that we must strive to put our best efforts into teaching something that is beneficial to others. This emphasis on beneficial knowledge strikes a chord every time we design and prepare to teach: how can we make this knowledge beneficial for our students? Can knowledge that is only good for answering written examinations be beneficial in the true sense? The case for beneficial knowledge also appears in another saying of the Prophet Muhammad: Abu Hurairah (may Allah be pleased with him) reported:

The Messenger of Allah (PBUH) said, "When a man dies, his deeds come to an end except for three things: Sadaqah Jariyah (ceaseless charity); a knowledge which is beneficial, or a virtuous descendant who prays for him (for the deceased)" (Sahih Muslim, 1631).

Such is the reward for sharing beneficial knowledge that the deed transcends the life of a person. As such, we feel that it is an honour to be educators because we have the opportunity to share beneficial knowledge with students through teaching and the educators' community when we disseminate our practice through presentations and articles in our SOTL practice.

In addition to striving with our best efforts, it is also important that our intentions to help our students learn are purely for the sake of Allah. Sincere intention is very important as explained in the saying of the Prophet Muhammad:

Narrated 'Umar bin Al-Khattab:
I heard Allah's Messenger (PBUH) saying, "The reward of deeds depends upon the intentions and every person will get the reward according to what he has intended. So whoever emigrated for worldly benefits or for a woman to marry, his emigration was for what he emigrated for" (Sahih al-Bukhari).

This saying, which happened during the migration of the early Muslims from Mecca to Medina, emphasised that the reward of any action is according to what it is intended for. This is an important reminder for us to remain true to our intention despite the challenges that we face in SoTL.

In our lives, the Holy Qur'an and the sayings of the Prophet Muhammad (PBUH) serve as our perpetual guidelines in the roles and responsibilities that both of us bear as Muslim educators. This is especially

true for the first author, whose roles and responsibilities as an engineering educator are becoming more demanding as the world has moved toward Industry 4.0, while also attempting to be a responsible citizen and meeting stakeholders' expectations. The challenges in developing 21st century graduates eventually made her turn to the paradigm of constructivism on which she planned and designed active learning classroom techniques and strategies for her engineering students. Thus, her SoTL practice is an equivalent to her personal journey of becoming a reflective practitioner, one that allows growth and continuous improvement for her teaching practice. In her view, scholarly teaching should be shared beyond the four walls of the classroom, and continuously improved within a community. This is crucial especially since engineering educators are subject-matter experts on the body of knowledge and will thus be in the best position to explore and determine how to best help students learn within a learning environment that will help them become holistic graduates by the time they complete their degree programmes. Although this is deemed ideal, it has become an aim of our SoTL journey because it is in line with the National Education Philosophy (NEP) of the Malaysian education system. The NEP stated that:

Education in Malaysia is an on-going effort towards further developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving high levels of personal well-being as well as being able to contribute to the harmony and betterment of the family, the society and the nation at large (Ministry of Education, 2019).

As an engineering educator who is trained as an engineer, the first author perceives NEP through a pragmatic lens. Such a viewpoint allows her to see that it is acceptable to fall short of the ideal state as long as continuous attempts are made to move towards achieving it.

This paper showcases the evolution of the first author's SoTL practice within the context of engineering education over the years. The chronology of her SoTL journey is anchored in Fanghanel et al.'s (2016) framework of different levels at which SoTL operates in the higher education (HE) system. The decision to adopt this particular framework was made after considering past literature with a similar scope, e.g. Myatt, Gannaway, Chia, Fraser & McDonald (2018). In this study, the researchers found that their framework is consistent with Fanghanel et al. (2016: 12) and made evident "that SoTL activities have moved away from the initial focus on individual practices, to a more strategic, institutional and national policy focus to harness SoTL and develop competence and excellence frameworks". In addition, Fanghanel et al. (2016) have also been included in more recent literature related to teaching inquiry, such as Lawrence and Herrick (2020) as well as Eady,

Abrahamson, Green, Arcellana-Panlilio, Hatfield & Namaste (2021). As illustrated in Figure 1, SoTL practice can be operated at three levels: the micro, meso and macro. At the micro level, SoTL could be practised among academics with the objective of improving their classroom teaching practice to enhance students' engagement. Academics could also carry out SoTL practice in groups at the department level because this is also considered to be the core activity at the micro level. Meanwhile, at the meso level, SoTL is practised at the institution level, and this might involve institutional practices, strategic planning or policy. Finally, SoTL practice at the macro level involves the entire HE system and includes "the national and international frameworks (regulations, incentives, and various steering policies) and national and international communities that impact and interact" (Fanghanel et al., 2016: 8).

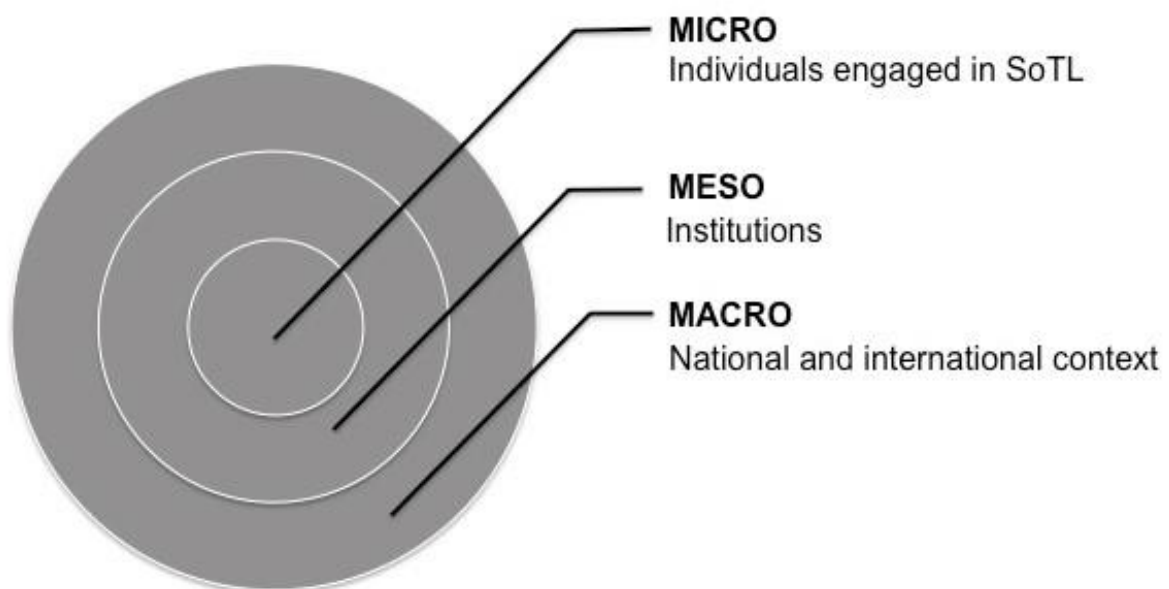


Figure 1: A framework of SoTL levels in the HE system (adapted from Fanghanel et al., 2016)

The presentation of the first author's SoTL journey follows the same sequence as illustrated by Figure 1. It begins with her initial SoTL experience at the micro level. This will be followed by the episodes that depict the evolution of her practice from the micro to the meso level. How the meso level progressed to the macro level will also be included in the chronology of her SoTL journey. However, even when progressing to the meso and macro levels of SOTL, the micro level implementation continues in her own classroom practices.

How it all began: SoTL practice at the micro level

Throughout the SoTL journey, the overarching question has always been how to educate an engineering graduate. This question is ever present in all phases of growth in engineering education involvement as shown in Figure 2: exploration, scholarship of teaching and learning, research and training, and leadership and transformation.

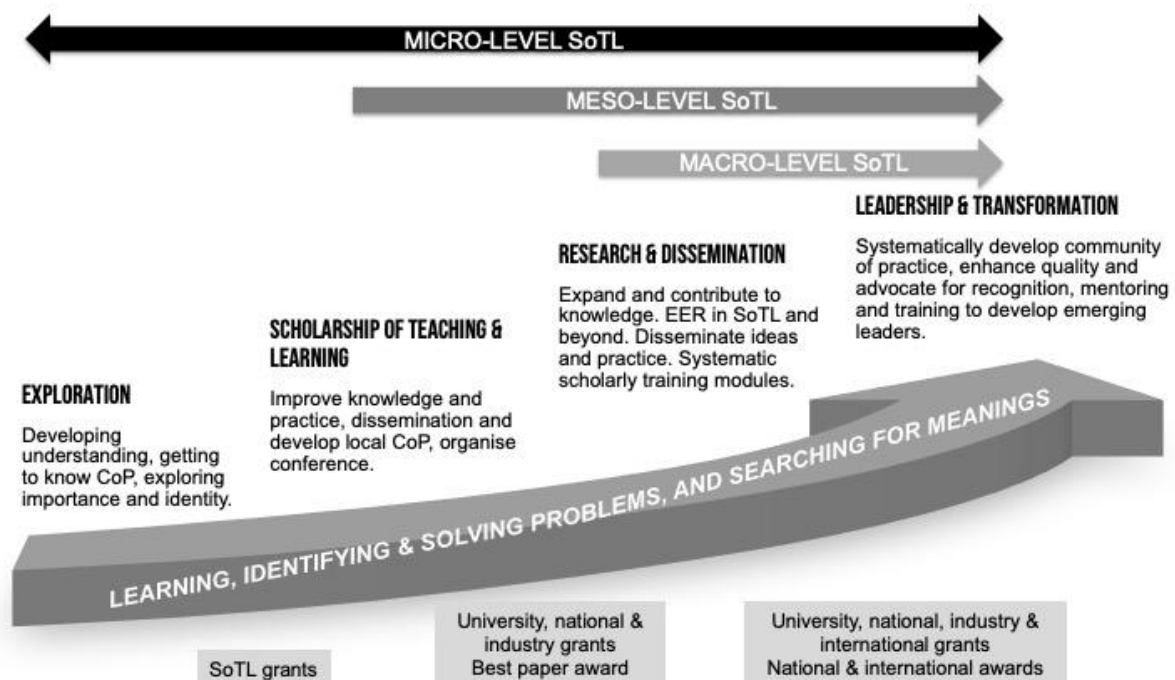


Figure 2: Progression of SoTL practice from micro to macro levels

As shown in Figure 2, the exploration phase involves learning and getting to know the local and international engineering education communities of practice (CoP), such as those under the UTM Centre for Teaching and Learning (CTL) and the community under the Malaysian Council of Engineering Deans (which later became the Society of Engineering Education Malaysia), the problem-based learning (PBL) community of practice and the Research in Engineering Education Network (REEN) community. This phase consists of activities to develop a deep understanding of Engineering Education as well as its importance, which formed the initial knowledge foundation that made it possible to venture into micro-level SOTL. This increasing understanding and reflection spurred exploration of identity as an engineering educator. Although learning starts individually from reading, learning in a supportive community spurred greater depth and opened wider

perspectives and ideas. Reflective practice, coupled with having a supportive community, resulted in sustained and continuous improvement in practice even when there was not much local interest.

In the first author's own experiences, reading about engineering education began as a Master's student in the department of Chemical Engineering at Clemson University, USA, in the early 1990's. In between conducting her research on time-optimal control of distillation columns, while waiting for the computer simulation to stop, she would go to the department library to read the Chemical Engineering Education (CEE) Journal. As a PhD candidate in Chemical Engineering at the University of Waterloo, Canada in the late '90's, subscribing to Stanford University Rick Reis' Tomorrow's Professor (TP) email list brought summaries of research findings in higher education once a week. In both cases, the articles raised pertinent issues in engineering education. Reading the CEE brought about the realisation that engineering classroom and curricula issues, design and practices are important and can be shared and discussed, providing ideas and inspiration to others. The TP articles introduced education principles and research findings, and what those principles and findings might mean when translated into practice in higher education. The TP and CEE articles showed that education issues, including engineering education, are significant to a wide community of academics. They are important enough to have communities and journals being published to disseminate innovative ideas and implementations.

So, at the start of her academic career, it became natural to think about instructional design grounded in education principles and writing up innovations that were implemented. In 1994, when the first author was assigned to develop the process control laboratory, a paper was presented and published on the equipment designed and interfaced to a microcomputer for students to conduct experiments to learn about process control at the first Institution of Electrical and Electronic Engineers (IEEE) Multimedia in Engineering Education Conference at the University of Melbourne in Australia.

In the early 2000's, the first author was assigned to teach the Process Control and Dynamics course for undergraduate chemical engineering students, a course that was notorious as a "killer" subject. Having read about cooperative learning (CL), she decided to translate what she had read into practise in her classes. This marked the start of her practical SOTL implementation, with the loop coming full circle with the publication of this effort at a conference in 2003. Detailed description of micro-level SOTL implementations can be seen below in her first reflection on micro-level SoTL.

Reflection on Micro-level SOTL 1: Cooperative Learning (CL) implementation

After obtaining my PhD, I was assigned to teach Process Control and Dynamics, which was at that time, a course for fourth year chemical engineering undergraduates. Three to five sections of the course were offered each semester with a maximum number of 60 students per section, all taught using lectures. The course had a high number of failures (usually around 30%, but sometimes as high as 45%), low passing grades (mostly around the 40-50% range) and difficult content. I gave lectures, peppered with learning activities that I had read about and tried to group students together. At the end of the semester, the grades in my class were like those in other sections that utilised traditional lectures. Although my colleagues assured me that it was normal, I wondered how I could help the students learn and understand the course better.

My earliest foray into SoTL was the implementation of Cooperative Learning (CL) in the Process Control and Dynamics course in semester 1 of the 2003/2004 academic year. I chose CL since the literature showed it could help students achieve better results (Felder, 1995). After previously grouping students together without proper planning, I studied CL deeper and planned my lessons, making sure that all the five principles of CL (positive interdependence, face-to-face promotive interaction, individual accountability, appropriate interpersonal skills and regular group function assessment) were translated into my instructional design. For example, before the start of the semester, I prepared a personal information form to get the necessary information that I was using to divide the students into teams. In CL, it is recommended that the instructor divides the students into teams. I chose academic performance, race, gender, hometown, place of residence, ownership of a personal computer and mode of transportation. The first four criteria were used to ensure diversity, while the last two were information that I needed to ensure that each team had at least one member with the resources that would make their learning process easier. A detailed description of this first CL implementation was presented at a conference (Yusof & Hassim, 2003).

At the end of the semester, there was an improvement in students' results. The systematic scaffolding provided through CL managed to turn the whole class into a supportive learning community to overcome the racial barrier, with the students developing close friendships. Most importantly, through the lively class discussions, students bonded and felt safe to open-up, asking questions and offering answers. However, I realised that there was a lot of room for improvement. At this time, Prof. Duncan Fraser from the University of Cape Town came as visiting professor and external examiner for the Department of Chemical Engineering. He gave a seminar on chemical engineering education, and I was inspired by his efforts to help support students from disadvantaged backgrounds to learn engineering, and how he advocated for quality teaching and learning throughout Africa, which strengthened my resolve to continue with what I had started in my classes.

Around the same time, the move towards outcome-based education (OBE) started in Malaysia for engineering programmes because the Engineering Accreditation Council became a provisional member of the Washington Accord, making OBE compulsory as the curriculum framework. The shift to OBE drove programme owners to seek teaching approaches to support students to reach the course and programme outcomes. In many universities, including Universiti Teknologi Malaysia (UTM), training courses and workshops were held to learn and implement OBE, as well as various student-centred teaching and learning approaches and assessments.

In 2004, champions and small communities of practice were formed and supported through the Centre for Teaching and Learning (CTL). Innovative practice-sharing sessions were arranged, and then slowly upgraded to become short training courses and workshops to enlarge the community of practitioners. In addition to providing a conducive environment to learn and build expertise, being part of a supportive community developed the champions' confidence. One of the innovative practices being promoted at that time was Problem-based Learning (PBL). A detailed reflection on the early training and initial implementation of PBL is below in a second reflection on micro-level SoTL.

The emergence of engineering education conferences hosted by UTM starting in 2004 encouraged those in the community and even new practitioners to write and publish. Taking this opportunity to become involved in organizing the Regional Conference in Engineering Education, initially as the secretary and later as the chair, experts from throughout the world were invited as keynote speakers who also conducted workshops such as Tan Oon Seng, Richard Felder and Rebecca Brent, Duncan Fraser, Karl Smith and many more, bringing the opportunity to learn about various aspects of engineering education, ranging from OBE, SoTL, student-centred learning approaches, assessment and curriculum design as well as engineering education research. Learning from and meeting the experts was indeed valuable – it allowed participants to discuss their own practices, verify understanding, ask questions, and go through ideas they might have. The conferences expanded our engineering education network beyond UTM to the whole of Malaysia and beyond. It is important to note the support of Faculty administrators in encouraging the pursuit of engineering education by the first author, who went to the extent of connecting her with possible opportunities and supporting her ideas, such as expanding the first engineering education conference to regional level and participating in the organization of the early conferences. In addition to the learning opportunities from experts during the conferences, we were able to establish a community of practice, which has proved valuable in sustaining SoTL and innovative practices in engineering education.

Reflection on Micro-level SOTL 2: CL + PBL implementation

At the turn of the century, there were discussions on the future of engineering education, and the attributes needed for 21st century engineers (Woods, Felder, Rugarcia & Stice, 2000). Reading on PBL, I could see its potential “power” (Duch, Allen & White, 1999) in developing future engineers. In 2004, I assisted the CTL to invite experts on PBL, such as Prof. Nor Azila Mohd Adnan from Universiti Malaya Medical School (UMMC) and Prof. Tan Oon Seng from the National Institute of Education, Singapore, to conduct training at UTM. The CTL funded me to visit and observe PBL implementation in UMMC and institutions in Singapore. However, implementing PBL was more challenging than CL because there was no clear model to use for a typical engineering classroom. In medical schools, PBL is implemented in small groups of up to 12 students with a tutor to facilitate learning. In Singapore, each PBL class had 25 students, with 4 to 5 teams. With a typical engineering class size in UTM around 60 students, I had to adapt PBL to our constraints.

After analysing various PBL models, I decided to use the floating facilitator model with students divided into small groups (Duch, 2001; Tan, 2003). CL helped me to guide students to become functioning teams to support learning. With a young colleague, Mimi Hassim, who had undergone the PBL training, we decided to implement CL from the beginning of the semester and PBL from weeks 8 to 12. Crafting the problem for the four-week duration, we divided it into two parts, each with a full PBL process so that we could monitor and provide feedback to guide the students better, and to give students the opportunity to improve and learn better in the second PBL process. I was nervous because I had never implemented an inductive learning approach and wondered if students could learn without first having lectures.

Experiencing CL early in the semester, students’ resistance to PBL was minimal. Some expressed skepticism since the learning process arose from the problem instead of a lecture, which made me doubt myself regarding my own implementation. When I had fears, I would call my PBL partner, Mimi – talking things through was helpful because it clarified the objectives and process in my mind. Although some students were not happy that I did not give lectures at the beginning of the PBL implementation, I decided to persist, reminding myself that as a Muslim educator, I need to know my true aim of implementing PBL and be sincere in only hoping for God’s pleasure in making this change, and not giving up just because some students were unhappy. Change takes time, and I made sure that I motivate and explain the benefits of PBL to students. Guiding students to understand the problem and identify the learning issues to help them come up with their peer teaching notes, I was amazed to see their depth of comprehension – how they used analogies during the class peer teaching session to illustrate understanding. During facilitation, I must admit that I had to keep reminding myself not to blurt out answers or to immediately answer whether the approach taken was correct or not. Instead, I had to guide them using questions and feedback that could guide their thinking process towards deep learning. At the end of week 12, I was relieved that students were able to learn the required content, but most importantly, they became articulate and confident in learning new concepts and facing new problems. Their deep understanding was attested when the majority were able to do well in the test on the topics learned using PBL. The paper written on this implementation was submitted to the International UNESCO Centre on Engineering Education 4th Asia Pacific Conference on Engineering Education in Bangkok. It was a pleasant surprise when the paper was accepted as the opening address, and won the Diamond Award for Best Paper, which led to an invitation to publish the expanded paper in a journal (Yusof, Tasir, Harun & Helmi, 2005).

With more knowledge and experience, the quality of classroom implementation and SoTL practice steadily increased. PBL implementation had grown to all sections of the Process Control course, and a Cooperative Problem-based Learning (CPBL) framework was developed by formally infusing CL principles into the PBL process. Details of the framework and the impact of CPBL can be found in the third reflection on micro-level SOTL. Correspondingly, the quality of papers and knowledge dissemination programmes conducted, such as training workshops and seminars, also increased. Regular sessions were conducted at UTM, and invitations received from various universities in Malaysia.

2008 marked the start of the PhD in Engineering Education programme and concerted efforts to establish rigorous research in engineering education in UTM. The multi-disciplinary programme was launched in collaboration between the Engineering and Education faculties to enable quality engineering education research expected at the PhD level. Some of the PhD research had started from the SOTL work. A PhD study of how students who had undergone CPBL developed team-based problem-solving skills (Helmi, 2011) allowed further improvements in its implementation. The findings also provided insights leading to better training and guidance for others on implementing Cooperative Problem-Based Learning (CPBL).

Continuous progression: From micro to meso levels of SoTL

Experiences acquiring knowledge of engineering education and related areas had proven to be the means of expanding SoTL practice at the meso level. After leading a task force for the university's CTL, the first author was appointed as CTL Deputy Director responsible for academic staff teaching and learning development programs. These experiences, especially those gained while developing modules for the Malaysian Higher Education Leadership Academy (AKEPT), propelled her to systematically develop a four-part series of student-centred learning (SCL) teaching and learning training modules. A more detailed description can be seen in the first meso-level SoTL reflection.

Reflection on Micro-level SOTL 3: PBL + CL = CPBL

After the initial PBL implementation, we decided to use PBL to cover 80% of the course syllabus as well as to expand it to other sections. At the same time, in 2005, I was entrusted by my department to create and teach an Introduction to Engineering course for the chemical engineering programme. I was wondering how to better infuse CL explicitly into the PBL process to better guide students and other lecturers, when I noticed that there is a pattern in most CL activities to embed that part of the principles which drives students to collaborate. So, I embedded the pattern into the PBL process and came up with the Cooperative Problem-based Learning (CPBL) framework (Mohd-Yusof, Helmi, Jamaludin & Harun, 2011). Using the framework as a scaffolding to guide and explain to students new to CPBL, I received feedback that it gave them an overall view of what they would be doing, and how they would go through each phase step-by-step. PhD research is continuously conducted on the CPBL implementation. For example, from PhD research on metacognitive skills development (Jumari, Mohd-Yusof & Phang, 2018), I was able to identify that students must be guided to think about their goals in life and their time at university, and how they are related to the learning goals for the course. This is to help students monitor and reflect on their progress, helping them to develop self-regulation, which is very important especially when they had to learn in remote classes during the COVID-19 pandemic.

The main aim of the Introduction to Engineering (ITE) course is to support students in bridging the gap between learning in school and learning to be an engineer in the university. CL and CPBL were implemented to help students learn about engineering and engineering processes while solving an environmental-sustainability-based problem (Sadikin, Mohd-Yusof, Phang & Abdul Aziz, 2019). In addition to teaching one section of the course, as the course owner, I design and guide other faculty members in implementing CL and CPBL in the course. Based on recent research conducted on my own implementation, I would suggest improvements based on evidence and principles, and open discussions on what we can implement together for all sections. It became the norm for all of us who teach the course to discuss plans for the coming semester one to two months before it began. We work as a team to craft the problem and arrange for industry or stakeholders to be involved as seminar speakers, collaborators, and judges. Working together made it easy for us to craft real-world problems related to environmental sustainability involving stakeholders, and to organise a competition and poster sessions for students to present the engineering solution that they came up with to solve the problem at the end of the semester. I had also initiated and established a culture of writing and publishing with the ITE team on scholarly practices, which helped lead them to read and reflect on their own practice. Working in a team certainly brought the course to great heights – I am truly amazed by the creativity and support of the team for new and challenging ideas that we translate into the problems and activities in the course. We have indeed managed to embody CPBL in working as a team, upholding the spirit of PBL as we chart a course through new areas hitherto unexplored as sources of impactful learning.

Reflection on meso-level SOTL 1

Heading the Active Learning Task Force under the CTL in the early 2000's, I started designing 1-day, and then 2-day workshops on active and cooperative learning as well as PBL, in addition to the practice-sharing seminars. This forced me to read and learn the principles behind the approaches and reflect on my own practice at a deeper level. I also invited other lecturers who had similar interests and have implemented active and Cooperative Learning from other fields, including those from the Faculty of Education. Forming the core community, we developed and conducted the workshops in UTM. A couple of years after conducting these courses, I began to receive invitations to conduct them in other institutions of higher learning in Malaysia.

When I was appointed as the Deputy Director of CTL in 2007, I became involved with the newly established Higher Education Leadership Academy (AKEPT) under the Ministry of Higher Education. AKEPT organized various high impact programmes with experts such as John Biggs and Catherine Tang on 'Constructive Alignment', Mike Prosser on 'Understanding Learners', Tony Harland on SoTL, Tan Oon Seng on PBL and many more. These programmes, as well as support and opportunities for academic leadership development in AKEPT, prepared me with the necessary competencies for developing systematic training programmes. I was awarded a grant from AKEPT to lead a group with members from universities in Malaysia to conduct research and design training modules on industrial training and practicum at three successive levels of expertise. These opportunities gave me the confidence to develop my own modules to train and develop other lecturers.

As in my own classes, I apply instructional design based on constructivism to design the training workshops. Understanding that many engineering lecturers are pragmatic, I let participants experience active learning approaches as they learn various aspects of implementation. I post scenarios or questions that normally lead them to challenge their own thinking, letting them form their own conclusions. I also introduce some fundamental principles halfway through the workshops so they can see the basis for effective implementation to help students learn. This is useful in empowering participants to design learning environments suitable for their own classes. The requests for training seemed to take on a life of their own. Although we never advertised them, except for displaying training workshops available at the CEE website, requests kept pouring in from institutions in Malaysia and beyond.

In 2010, the Centre for Engineering Education (CEE) was formed to assist the Graduate School to manage the programme. The CEE also provides support and resources to the community of practitioners within engineering education for its educators to implement scholarly practices and to conduct education and SoTL research. Other than hosting conferences and developing communities, the CEE also received grants for conducting research, and published a research book and journal papers in addition to conference publications. For example, the first author received a grant from the Ministry of Higher Education to develop a module and conduct research to guide other faculty members when implementing CPBL, and an industry grant to develop a research-based course for learning inventive problem-solving using the Theory of Inventive Problem-Solving (TRIZ).

Outperforming expectations, UTM top management at the end of 2013 saw fit to upgrade the CEE to become a research Centre of Excellence directly under the Deputy Vice Chancellor for Research and

Innovation. This meant that CEE's output would be closely monitored, whilst at the same time receiving support from the university.

To introduce the Malaysian engineering education research community to the worldwide community of engineering education and PBL researchers, CEE hosted the Research in Engineering Education Symposium (REES) in collaboration with the Research in Engineering Education Network (REEN), and the International Research Symposium on PBL (IRSPBL) in collaboration with the UNESCO Chair on PBL in Engineering Education at Aalborg University, Denmark, back-to-back in 2013. These events created interest in scholarly engineering education not only at UTM, but also across Malaysia. Most importantly, the conferences provided opportunities for those already involved in engineering education (including our PhD students) to gauge their work against that within the worldwide community, as well as to create personal ties and get feedback on their work. SoTL research began to include institutional-level projects. Among them was a study on engineering educators' transition involving shifting their teaching paradigm and approach after receiving training. The phenomenology research suggested that among the engineering educators, the conception of teaching influenced the implementation of SCL, and that the factors that bring successful change are training, support and appraisal (Radzali, Mohd-Yusof & Phang, 2018). Another example of meso-level SoTL is on the conation (or volition) of first year engineering students who experienced different learning environments in introductory engineering courses. These meso-level projects are elaborated upon in the second meso-level SoTL reflection.

Moving forward: SoTL at the macro level

The SoTL practice at the meso level has undoubtedly accelerated highly structured professional training workshops as well as research projects, both at the national and international levels. Even though most of the studies conducted at the macro level are educational research in nature, the element of SoTL research is still embedded in scholarly activities. Considering the experience of the CEE, since its inception in 2010, the centre has grown to become the catalyst for scholarly activities in engineering education. This was made possible through extensive strategic networking and collaboration with the other Malaysian public and private universities, as well as cooperation with universities and institutions worldwide. From these collaborations, professional training events were offered to, and conducted among, the academics at Malaysian universities that shared the same vision and mission for elevating the quality of engineering education in Malaysia.

Reflection on meso-level SOTL 2

We usually receive positive feedback from the workshops, but I always wondered if they lead to any change in the classroom practice of the participants. This became a research topic for one of my PhD students in Engineering Education who studied what happened to three engineering lecturers from different schools in UTM after attending the active learning and then after several months, the CL workshop. This was also important to help determine the support needed for SCL implementation. The research found that although the workshop participants were motivated to try active learning in their classes, translating their intention into action could be challenging. Teaching is a personal belief that is shaped by the lecturer's experience when learning, even though the experience might not be well-liked. It is easier for a lecturer who had undergone student-centred learning experiences in school or university to implement active learning in his/her classes. In the case of lecturers who had mostly experienced lecture-based courses as a student, a supportive community and faculty environment, positive students' reception and confidence in the content will help them to change towards implementing SCL in their courses (Radzali et al., 2018).

Another meso-level study explored conative domain activation among first-year students who experienced different teaching and learning environments in introductory engineering courses from three engineering schools in UTM. I was wondering if the Introduction to Engineering (ITE) course was effective in activating students' conation towards learning to become an engineer. Conation is defined as volition, or the purposeful drive to complete an action. At the same time, there were simpler models of introductory engineering courses that other engineering schools were using in UTM that led me to wonder if they had different impacts on students' conation. Employing the Bransford, Vye and Bateman (2004) framework of How People Learn (HPL) to define the different teaching and learning environments in the introductory engineering courses, the findings revealed that students who had completed an introductory engineering course that met the four HPL criteria of an effective learning environment attained the highest degree of conative domain activation (Samsuri, Mohd-Yusof, Phang & Helmi, 2019). This meso-level SOTL study affirmed that the efforts invested in our ITE course were worthwhile, looking at the significant impact on the conation of students who had taken the ITE course. Sharing the outcomes of the research with other lecturers teaching the course renewed the team's resolve to persist and continuously improve our implementation.

Consequently, this allowed research projects to be conducted nationwide. An example of such research was a longitudinal study to specifically examine engineering lecturers' perspectives on the characteristics of meaningful learning (Mohd-Yusof, Phang & Hassan, 2018). The findings from the qualitative research had indicated that educators perceived SCL as an effective approach because, as learners, they had preferred such memorable approaches. However, this was found to be the opposite when they switched their roles from learners to teachers. As teachers, they tended to forget this preference and reverted to how they were predominantly taught based on their past experiences as learners. At present, there are several on-going lines of research focusing on educators, especially engineering educators. A reflection on macro-level SOTL is given below.

Reflection on macro-level SOTL

My SoTL practice expanded to the macro level when I started to implement SoTL in the teaching and learning workshops that I have been conducting for lecturers. When I conducted workshops in other universities, there were times when the participants were selected and made to attend when they did not have any interest in learning. There were also some who attended to learn but were not really convinced why certain changes needed to be made. This resulted in some disagreements and questions on the principles explained during the workshop.

I had wondered if lecturers really do not like student-centred learning (SCL) approaches, or perhaps they had some bad experiences with SCL. So, at the beginning of the Active Learning workshops which were conducted throughout Malaysia, I started to ask participants to work in small groups and discuss their most meaningful and their worst formal learning experiences. From these discussions, we gathered the information and classified these learning experiences to see if they could fit into SCL, as defined by the How People Learn (HPL) framework (Bransford, 2001). It was interesting to find out that all the meaningful and none of the worst learning experiences can be classified as SCL. Thus, we concluded that as learners, lecturers do appreciate SCL and dislike teacher-centred approaches. However, when they changed roles and became lecturers, they found it difficult to implement SCL, and gravitated towards teacher-centred approaches even though they may not have liked them as learners (Helmi, Mohd-Yusof & Phang, 2016).

While there were other macro-level SoTL events conducted, such as on the OBE and SCL workshops conducted to train Afghan lecturers for the Afghanistan Ministry of Higher Education that was funded under the Higher Education Development Program by the World Bank, SOTL led me to venture into conducting education research on other questions and topics of interest. Among these were students' and lecturers' perception of various industrial training models in Malaysia (Phang et al., 2013) which was funded by AKEPT, and, most recently, a policy study on the support needed for developing lecturers who can educate future-ready students for Industry 4.0 funded by the Malaysia Ministry of Higher Education. Embracing SoTL was instrumental in helping me learn about education theories and education research and helping me identify issues that I could study and overcome using a scholarly approach. Even with funded projects to work on, I still continue to perform micro-level SoTL in my classes. I am currently adding elements of emotional empathy in my classes and working to examine its impact to see how it can best be implemented.

The effectiveness of training workshops conducted at the national level, as evidenced by the above studies, had gained the confidence of international bodies and organisations so that CEE has been asked to organize similar activities that could be offered to academics from other countries. Among the notable training programmes offered were those funded by the World Bank to train educators in institutions of higher learning in Afghanistan over three years. From 2016 to 2018, 68 Afghan educators attended the Training for Trainers (TOT) programme conducted by the first author and her CEE team members. The trainers were then responsible for organizing similar programmes during which “more than 300 were trained in outcome-based education and active learning strategies, with about 50 of them selected to undergo the training of trainers program” (World Bank, 2018).

Currently, structured training and workshops are being held to cater for academics in Indonesian universities funded under the Engineering X Program by the Royal Academy of Engineering and Lloyd's Register.

Fundamental studies on workshops conducted and the development of SCL among engineering educators enabled the CEE to examine the effectiveness of its training programmes. This helps the CEE to refine its training designs to nurture faculty members to become competent teachers and leaders in engineering education. In return, research projects and training programmes conducted by the Centre yielded more opportunities for applications for grants and funds. The Centre had successfully secured research grants from both local and international sponsors.

Addressing the challenges of SoTL

In this paper, we have extensively elaborated how SoTL had been practised within an engineering-based university in Malaysia at three different levels, namely – the micro, meso and macro levels. We have also demonstrated the progression of SoTL practice that took place across the three levels, as well as the scholarly elements embedded in each level of practice, as shown in Figure 2.

The descriptions of each SoTL practice and the critical reflections accompanying the SoTL episodes were not merely meant for showcasing our efforts to adhere to the high standards and best practices in SoTL (Felton, 2013; Wilson-Doenges & Gurung, 2013). We also made no attempt to assess the impact of our SoTL practices and programmes, as highlighted by Hoessler, Britnell and Stockley (2010), Trigwell (2013) and Pechenkina (2020). Pechenkina (2020:91), for instance, proposed “a rubric by which to judge various levels and dimensions of impact achieved in SoTL-focused projects” which also involves a micro-meso-macro-mega framework.

Instead, through this sharing of experience, we hope to be able to generate new insights among the community of practitioners. Our suggestion is based on the premise that, if SoTL is genuinely embraced and authentically practised at the micro level, it will lay a strong foundation on which advanced practices can be elevated to the meso and macro levels of practice. In embracing micro-level SoTL, it became a habit that is implemented in the courses taught, making it natural to extend to other situations that involve teaching and learning practices. By making our SoTL experiences visible, we welcome scrutiny and feedback from the community of SoTL practitioners to enable us to make further improvements and enhance the scholarly aspect of our practice. These, we believe, are

essentials for us as reflective practitioners who are constantly striving to engage ourselves in the cycle of improvement. Hence, we ensure that the aim of this paper is in line with Trigwell's (2013) notion that "evidence is needed on whether SoTL is achieving its purposes and whether those purposes are worthwhile" (p.95).

Furthermore, by making our SoTL journey transparent, we hope that the insights obtained will shed light on how practitioners address the challenges while operating SoTL at each level of practice. At the micro level, the struggle in developing an academic's identity as a SoTL practitioner is one of the main challenges (Kim, Popovic, Farrugia, Saleh, Maheux-Pelletier & Frake-Mistak, 2021; McGrath, 2012; Samah, 2013, 2019; Simmons, Abrahamson, Deshler, Kensington-Miller, Manarin, Morón-García, Oliver & Renc-Roe, 2013). This is especially so when the academics are unfamiliar with the fundamentals of SoTL, such as the conceptualisation of SoTL and educational research (Larsson, Mårtensson, Price & Roxå, 2020), or the methodologies employed in conducting SoTL research (Hubball & Clarke, 2010), to highlight but a few instances. The reflections shared by the first author that accompany the description of her SoTL practice at the micro level accentuate one of the many examples of this challenge. Such a personal dilemma resonates with the work of Godbold, Irving-Bell, McSweeney-Flaherty, Prusko, Schlesselman & Smith (2021) on having the audacity to engage in SoTL especially when they argue that "consequently, there is courage in simply naming oneself a SoTL scholar, particularly when your research may not fit with professional, disciplinary, and/or institutional understandings of what constitutes SoTL" (p. 383).

In the case of the first author, there was a dilemma in implementing PBL because it is common for students to dislike undergoing CPBL, given the starkly different inductive learning approach. As described by Woods (1996), students undergoing PBL for the first time go through a myriad of emotions similar to the grieving process. The tutor had to motivate and encourage students to transform into self-directed learners in the first half of the semester or suffer a terrible teaching evaluation because of the low rating given by a few who still dislike CPBL. Despite this dilemma, many alumni had come back to her on the benefits of the professional skills and the experience of learning using real industrial problems when they started working. It was certainly not pleasant to have some students dislike her teaching approach in the initial part of the semester, especially since she really cared about them, and the efforts that she had put in to prepare and implement CPBL. It did not help matters when those who disliked PBL in the initial part of the semester also started to voice their complaints to other faculty members during the early years of implementation on all sections in the Process Control course. Her SOTL approach in the implementation actually "saved" the day because

the data collected on students' feedback in the first half of the semester showed that the majority appreciated and were able to cope with learning through CPBL despite the vocal few who voiced their unhappiness. There were times when she wanted to just abandon CPBL and her SOTL practice. However, based on the research evidence and knowing the positive impact, she had to remind herself to be sincere in her intention, remain steadfast and continue to strive to the best of her ability. Being part of a supportive community also helped support her along her SOTL journey.

Similarly, one could stumble upon many other unique challenges at the meso and macro levels of SoTL practice. In our context, among the related issues is the willingness of academics to embrace SoTL to develop themselves in becoming reflective practitioners and demonstrate the commitment towards becoming part of the SoTL community at the institution level. Other issues at the meso level are the appreciation of SoTL by the institution, with regards to academic acknowledgment, rewards and promotions. These are also the concerns shared by researchers such as Demetry, Lingo and Skorinko, (2020), as well as Smith and Walker (2021). We hope that sharing our SoTL journey would provide some perspective for those attempting to address the issues, especially those regarding the career pathway for SoTL practitioners.

Conclusion

Documenting and disseminating SoTL practices is an essential part of personal development as well as raising the standard for SoTL's best practices to ensure the institutional acceptance of the scholarship of teaching. The sustainability of SoTL practices relies on a supportive community for growth and enhancement of quality practice. As such, one must never underestimate the sincere efforts to conduct micro-level SoTL in classrooms because it has the capability of making a bigger impact at the higher level of SoTL practices. Since the ultimate aim is to improve learning in our courses, good teaching should definitely be shared beyond the four walls of our classrooms.

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