

FACILITATING STAFF IMPLEMENTATION OF TEAMWORK MEASUREMENT FOR ENGINEERING-RELATED PROJECT-BASED MODULES

Lim Joo Ghee, Tan Kwee Teck, Safura Anwar

School of Electrical & Electronic Engineering, Singapore Polytechnic

Toh Ser Khoon

Department of Industry & Partnerships

ABSTRACT

In Singapore Polytechnic, teamwork is valued as one of the graduate attributes expected of our students. Teamwork is an important part of the needed interpersonal skills to be developed and assessed as part of the learning outcomes of an engineering curriculum in part 3 of the CDIO (Conceive Design Implement Operate) syllabus. This paper shares the perspectives of teaching staff in implementing teamwork measurement for project-based modules in the School of Electrical and Electronic Engineering. All students will do at least one project-based module in Year 1 and Year 2 for their three-year-long diploma course of study. For the first time in the second semester of the academic year 2021/2022, teamwork measurement in self- and peer-assessment was implemented. In the next academic year, 40 teaching staff responsible for 68 classes of these project-based modules were involved in the first semester. For the second semester, 31 teaching staff, responsible for 52 classes, were involved. Survey findings gathered on staff perspectives in implementing teamwork through self and peer assessment, suggested that amongst others, staff supported its use to develop students' teamwork skills further as their students were able to gauge their own contributions, as well as those of their teammates. Staff also found it was easy to use for their classes, supported their observations of the students' teamwork skills and helped staff to identify the "free riders" in a team project. Overall, the findings will pave the way for improvements in the implementation so that both teaching staff and students are better prepared going forward, to meet the institutional requirement of teamwork measurement. The paper also shares the considerations and challenges faced for such a large-scale implementation.

KEYWORDS

Keywords: staff development, teamwork, project-based modules, CDIO Standards 2, 9

NOTE: Singapore Polytechnic uses the word "courses" to describe its education "programs". For example, a "course" in Diploma in Electrical and Electronic Engineering consists of many subjects termed as "modules"; which in the universities' contexts are often called "courses".

INTRODUCTION

Since the School of Electrical and Electronic Engineering (SEEE) of Singapore Polytechnic adopted CDIO as the engineering education framework for the delivery of its various diploma

courses, it has over the years successfully implemented Standards 2, 4, 5 and 8. Students are involved in experiential learning (Standard 8) when carrying out project-based modules, centred on introduction to engineering (Standard 4) and design-build experiences (Standard 5) to achieve the desired learning outcomes (Standards 2) (Chong, Chua, Teoh, & Chow, 2010) (Voon & Sale, 2009) (Pee, Leong, & Sale, 2009).

All Year 1 students, from its four diploma courses take up a common project-based module in their first year; Introduction to Engineering and Design. In Year 2, most students take up Microprocessor Applications as their project-based module, depending on their diploma course of studies. Aligned with the CDIO approach, interpersonal skills like teamwork, are done through the introduction and teaching of the skills. In the polytechnic, these are taught through institutional-wide modules in Year 1. These skills are put into practice by the students through the integrated learning experiences in the project-based modules offered by the school.

Singapore Polytechnic lists collaboration or teamwork, as one of the graduate attributes that it seeks to imbue in its students. In the academic year of 2020/2021, the polytechnic embarked on a pilot polytechnic-wide educational teamwork research project. The initial focus was on the systematic measurement of teamwork skills through self and peer assessment of its students. The project-based modules of the school provided a natural fit for this.

For the teaching staff, this represented a change in their usual practice of assessing the teamwork skills of their students. Typically, teaching staff use their own observations and interactions with the students while doing the group projects. They may gauge the teamwork skills from the contributions of individual students towards group project deliverables such as presentations, reports, and completed projects. With the additional aspect of self and peer assessment by the students, the teaching staff's assessment of the teamwork skills would be augmented by the input from the students themselves. This required the preparation of the teaching staff for its implementation (Standards 9).

This paper sought teaching staff's perspectives on using the instrument for teamwork measurement, and their experiences on the learning activity management system, on which teamwork measurement was carried out. To this end, a staff survey was conducted to gather their views. With these perspectives, the school aims to improve its implementation going forward to meet the institutional requirement to reflect students' teamwork skills.

LITERATURE REVIEW

Beyond acquiring technical knowledge and skills, the engineering graduate is also expected to possess teamwork skills. Most tasks in the engineering workplace are complex, and teamwork skills, amongst others, are needed for the engineering graduate to be able to perform and contribute effectively (Cerri, 2016). Teamwork skills thus become an important learning outcome of an engineering education and are included in part 3.1 of the CDIO Syllabus –Teamwork and Collaboration.

Appreciating the need for teamwork skills to be developed, engineering education programs seek to provide opportunities for students to work in teams. These include, through project work, team-based learning, and avenues for peer feedback amongst the students (Gibbard, et al., 2018). However, assessing an individual student's teamwork skills may not be so straightforward for teaching staff, for cases where the group project tasks take place outside the physical purview, of the teaching staff themselves.

An identified disadvantage of students working together on group projects is the possibility of "free riding" students, assessed to the same extent as the rest of the teammates, despite lacking the contribution to the team efforts. Understandably, not all students favour working in

teams. Self and peer assessment that allow students to comment on their own efforts and those of their peers, could be used to minimise such incidences of free-riding, and to support the appropriate teamwork skills development of the engineering students. This can be done with relative ease of implementation for the teaching staff involved (Willey & Freeman, 2006). One other possible approach is to use web-based collaboration tools to capture students' off-class contributions and activities towards the team projects and these provide evidence of the teamwork skills of students (Lingard & Barkataki, 2011) (Beddoes, 2020). However, this could be more demanding on teaching staff in terms of having to go through this evidence.

A tool that has found use in teamwork measurement in engineering education is the Comprehensive Assessment of Team Member Effectiveness (CATME) (Ohland, Loughry, & Moore, 2007) (Chowdhury & Murzi, 2019) (Sripakagorn & Maneeratana, 2009), which incorporates assessing teamwork with self and peer assessment. Teamwork measurement has also been carried out in other schools within the polytechnic itself, centred on the students' perspectives (Soo-Ng & Tao, 2021), hence, the focus for this paper is on gathering the perspectives of teaching staff instead.

(For this paper, the terms "team" and "group" are used interchangeably, although the literature suggests distinctions such as common goals and task interdependence (Siha & Campbell, 2015), (Smith, 2014).)

IMPLEMENTATION AND APPROACH TAKEN

The school carried out teamwork measurement through self and peer assessment for the first time in the second semester of the academic year 2020/2021. In the first semester of the next academic year, 40 teaching staff were responsible for 68 classes for these project-based modules. In the second semester, 31 teaching staff, responsible for 52 classes, were involved. Given the considerable number of teaching staff involved, the school aims for a consistent implementation to simplify the tasks to be carried out by teaching staff who could be taking students from different diploma courses, even for the same project-based modules.

Instrument and Platform for Teamwork Measurement

As done in Singapore Polytechnic, the teamwork measurement instrument is adapted from CATME (Ohland, et al., 2012). For the self and peer evaluation, students are expected to report on the following five aspects on a 5-point Likert scale from 1 to 5, for themselves and their team members:

1. Contributing to the team's work
2. Interacting with teammates
3. Keeping the team on track
4. Expecting quality and
5. Having relevant knowledge, skills, and abilities

From the quantitative inputs, the Self and Peer Assessment (SPA) factor, and Self-Assessment to Peer Assessment (SAPA) factor are computed. The SPA factor shows how the individual student has performed relative to his teammates. A SPA factor of more than 1, indicates the student has done better than his peers. The SAPA factor is the ratio of the student's own rating as compared to his ratings by other teammates. A SAPA factor of more than 1 means that a student has rated himself higher than how the rest of the teammates have viewed him (Willey & Freeman, 2006).

In addition, each student also provides open-ended qualitative inputs on each individual teammate in two areas; firstly, on things that they appreciate of their teammates and secondly, on things that they hope their teammates can do better.

In Singapore Polytechnic, the Learning Activity Management Systems (LAMS) is the platform used for teaching staff and students to carry out the teamwork measurement. This is a separate platform from the learning management system (LMS), Brightspace, for the delivery of asynchronous learning contents in the polytechnic.

Considerations for the implementation of teamwork measurement

Two main factors of the project-based modules considered prior to the implementation of the teamwork measurement to assess their suitability are:

- Group projects contribute a significant percentage towards the overall assessment of the modules
- Number of students required to work in the groups for these modules

For the targeted project-based modules, the percentage weighting of the group project against the overall marks' ranges from 40% to 45%. The high weighting suggests task complexity of the group project requirements for these modules. To this end, teaching staff could find the teamwork measurement through self and peer assessment viable for implementation for their classes, as the SPA factor obtained can be used to moderate a part of the assessment to reflect the teamwork and the individual contributions of students.

Students typically work in groups of three to four, on the group projects for these project-based modules. Teaching staff typically have five groups per class and aim to have uniform student group size for fairness and equity in achieving learning goals and assessment. However, as actual class size may differ, if a larger group size is formed, teaching staff can set stretched project outcomes, for fairness in assessment.

The teamwork measurement ideally should be carried out twice, midway through the project undertaking, for formative assessment. This provides students the opportunity to improve for the rest of the project undertaking, and to motivate students further through affirming the individual student's positive contributions so far. The second measurement is carried out after completion of all group project deliverables, usually at the end of the semester. This serves as a summative assessment of students' teamwork skills.



Figure 1 Timeline of Teamwork Measurement for Microprocessor Applications

Figure 1 shows the timeline for such an implementation for the Microprocessor Applications module. Teaching staff introduce teamwork measurements at the start of the semester. Prior to mid-semester, they carry out administrative tasks on setting up teamwork measurement for their classes and form groups in LAMS. Upon students' completion, staff can export the results in the form excel spreadsheets and use the computed SPA and SAPA factors and look up the qualitative feedback from the students. After the mid-semester before students resume on the group projects after the term break, they will need to follow up to share the feedback to their students' group if the teamwork assessment is used as part of formative assessment for students to improve. For summative measurement, teaching staff could use the results to moderate the individual marks through the SPA factor.

7Resources and Support for Teaching Staff Role in Teamwork Measurement

As with any change implementation, the teaching staff's concerns needed to be addressed. The extra administrative tasks required are to be seen against the possible advantages of having the additional insights that could be gained from self and peer assessment by the students. Apart from serving as an additional lens on students' teamwork skills, it helps to detect dysfunctional teams in the case of "free riders" and for staff to intervene as needed, and to moderate group marks to produce individual marks for assessment.

For teaching staff concerned with developing their students' teamwork skills, the teamwork measurement exercise helps students to develop and practise their judgement and evaluation of what makes good teamwork skills in scenarios that mimics the engineering workplace. Students are also given the chance to develop and exercise individual accountability.

Before the start of the semester, communication and briefing to all teaching staff involved was provided. Resources available for teaching staff's use included the following:

- Introductory slides on Teamwork Measurement for staff to brief their students
- Self and peer assessment statements and rubrics for staff to share with their students
- Step-by-step how-to-guides for teaching staff in both pdf form and video recordings on the use of LAMs, the use of SPA and SAPA factors and exporting results
- Frequently asked questions.

These were done so that the administrative and preparations tasks required of staff were as minimal as possible. In the initial stages of implementation, and for staff new to teamwork measurement, there was also support extended to help them set up the self and peer assessment activity within LAMS.

Beyond these administrative tasks, the real value that the teaching staff can bring is to facilitate honest and objective self and peer assessment by the students for the teamwork measurement. This will provide meaningful SPA and SAPA factors to help students in developing their teamwork skills further. Through doing these teamwork measurements more than once in different module settings guided by the teaching staff, students will hopefully appreciate aspects of teamwork skills to help them to become effective team contributors.

Flexibility of implementation

While the School aims for consistent implementation, in some respects, room must be made for flexibility in implementation. For some of the project-based modules, the group projects take place in the later part of the semester. For such cases, only summative teamwork measurements can be carried out, as within the relatively short time remaining for the rest of the semester, to carry out meaningful formative assessment of teamwork skills may not be feasible.

For forming groups within the classes, staff were encouraged to form mixed groups. For example, in terms of academic capabilities, teams can consist of students with a mixture of abilities, say high and medium capabilities, so that the groups are uniform in terms of overall capabilities (Francis, Allen, & Thomas, 2017). Students do also tend to form their own groups, preferring to team up with classmates they know and trust, based on experience. Some teaching members offer this autonomy to students.

The use of SPA is also strongly encouraged, though not mandated. For the SPA to be used, this depends on the extent of the objectiveness of the students in carrying out the peer and self-assessment, and the full completion by all students in the team. The SPA factor will not be valid otherwise, and staff can use the SPA factor where these two aspects are present.

RESULTS AND DISCUSSION OF STAFF SURVEY

Teaching staff who have taught the project-based modules and used the teamwork measurement (self and peer assessment) for at least one semester were sent email invitations to complete the survey voluntarily. The questionnaire is a quantitative part to gather staff's perspectives on various aspects of the teamwork measurement and one open-ended question.

Quantitative Results

Out of the more than 40 staff approached, 29 staff responded. Almost half or 48% have implemented teamwork measurement for one to two semesters, 13 staff or 45% of them for three to four semesters, and two staff or 7% have implemented for more than four semesters.

Figure 2 shows the survey results to gather staff's perspectives on various aspects of the teamwork measurement. For each of these, the responses required were on a 5-point Likert scale. For simplicity, responses for strongly agreed and agreed were combined, and similarly those for disagreed and strongly disagreed, while neutral responses were left intact. Overall, for all aspects, the percentages of staff who strongly agreed or agreed ranges from a high of 86% to the lowest of 52%.

A high percentage of 86% strongly agreed/agreed, on the following factors:

- i) Ease of setting up the self and peer assessment lesson on LAMs
- ii) Staff know how to interpret the self and peer evaluation results
- iii) That teamwork measurement was useful for students to give feedback on teammates on their contribution to the project and
- iv) That teamwork measurement was useful for students to evaluate themselves on their own contribution.

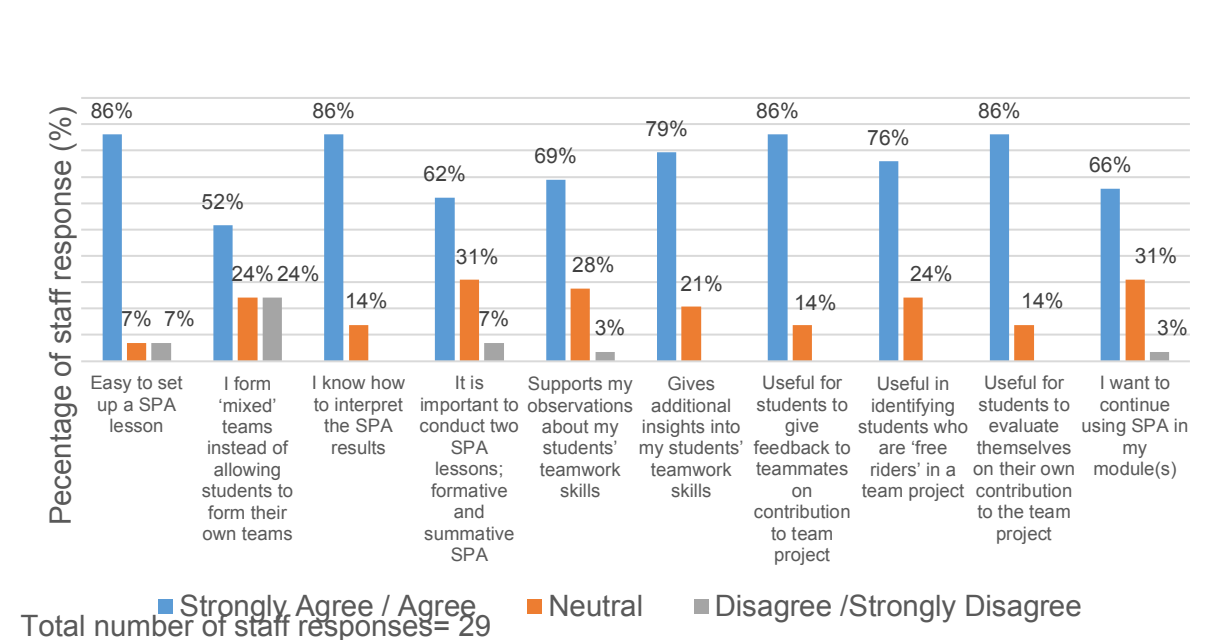


Figure 2. Staff response on the use of Self and Peer Assessment for Teamwork Measurement for project-based modules on various aspects

Similarly high percentages of 79% and 76% of staff strongly agreed/agreed that the teamwork measurement provides additional insights into their students' teamwork skills and is useful to identify "free riders" in the project groups, respectively. Slightly lower percentages of 69% and 66% of staff strongly agreed/agreed to the statement that it supports their observations about

their students' teamwork skills, and that they will continue to use self and peer assessment in their modules if available, respectively.

A lower percentage of 62% of staff strongly agreed /agreed that it is important to have two teamwork measurement points, formative and summative. The lowest percentage of 52% of staff who strongly agreed/agreed, was obtained for the formation of "mixed" groups. This suggests that the teaching staff value "mixed" teams and took the extra effort to form such groups, though this formation of mixed groups was not mandated.

Qualitative Results

This section discusses the responses received to the open-ended question of "Additional useful feedback I have on the use of Self and Peer Assessment". The viable use of teamwork measurement through self and peer assessment is supported through statements like

- *"useful tool" and*
- *"Good tool to assess the team projects".*

However, staff's statements such as

- *"could only be useful if students give sincere feedbacks",*
- *"Insights more significant in groups with free riders",*
- *"If members are not prepared to be honest in their feedback, then it will be difficult to meet the objectives of using it",*
- *"Students always give the highest marks to each other", and*
- *"The usefulness of this tool depends on the truthfulness of assessment given by students to their peers",*

Suggest the need that the students could be more conscientious and objective in completing the self and peer assessment. This calls for teaching staff themselves to actively facilitate the exercise, spelling out these aspects to the students. They could caution students not to beat the system, as free riders could be called out based on much higher SAPA factors, while high ratings for team members must be supported by corresponding evidence in the qualitative part of the teamwork measurement.

The need for the teaching staff to actively facilitate the actual teamwork exercise is further inferred through statements like

- *"Some students not really spend much time to complete the Peer Assessment i.e., completed in less than 1 minute", and*
- *"Only very few students write comments. Others write NIL or leave blanks which defeats the purpose".*

Staff may need to provide students with the time and space within the scheduled lesson so that students can carry out meaningful self and peer assessment.

Despite the availability of resources on the use of the SPA factor and how-to-guides to download the results, statements such as

- *"Some difficulties understanding the downloaded results initially when I started to use SPA for my modules. Would be good if there is a guide to explain the downloaded results" and*
- *"Staff need to understand the SPA".*

suggests that staff may need easy access to refer to the resources provided. A central prominent one-stop resource may be needed as currently the resource is a shared link provided to staff, and more detailed slides for staff's reference.

There is a suggestion to

- *“Just use Brightspace for all teaching and assessment matters”.*

This points to the use of the polytechnic's learning management system (LMS) as a platform for teamwork measurement. Unfortunately, the current LMS does not lend itself as a viable platform for the purpose. A link to LAMS can be provided in the LMS for each project-based module site, if this is not already provided. Similarly, a link to a future one-stop resource can be provided in the LMS for the teaching staff.

In a similar vein, suggestions for improvements to the current implementation include

- *“More friendly form or interface for students to enter their reflection and for staff to provide feedback”* and
- *“Need for breakdown of the tasks associated with formative and submitted assessment test so that students are clear on what they need to provide in terms of feedback for the open-ended qualitative inputs”.*

The first part of the first suggestion may not be so viable as the LAMS platform itself may not be so easily modified to meet the suggestion. Instead, a self-access video can be provided to students themselves or for staff to share this with students. Feedback from the staff themselves to students in person is better than through the LAMS interface, even if this is possible, as this allows for easier clarification.

The second suggestion may be better taken up by the respective project-based modules' subject matter experts and teaching members themselves. Together they can draw up a viable list of tasks expected of students while working in the group projects. This list can be shared with students at the outset, in terms of the expected end-products (whether proposals, presentations, or working projects) and the processes to achieve these in terms of teamwork behaviours and activities (Marin-Garcia & Lloret, 2008).

There is one suggestion on *“marks awarded for teamwork should remain low as it is not a fair judgement of students' willingness to work in teams the reason being that some students tend to do more than others”*. This suggests the need for task complexity of the group project requirements to be re-examined and could be made more substantial, rather than the teamwork measurement itself being wanting.

Another feedback is that having to conduct both formative and summative teamwork measurements pose time constraints, a possible contributing factor for the earlier result of only 62% of staff strongly agreed /agreed on two teamwork measurement points, formative and summative. Apart from making the implementation as easy as possible for the teaching staff and for students, there is already provision in place that when the group project work happens in the latter half of the semester, then summative teamwork measurement suffices. Another suggestion is to enable the teaching staff to reject student inputs and asked them to redo if they did not complete the assessment well. While this feature can be made available, it is better if the teaching staff could guide their students to get these “right” the first time and makes further the case that the teaching staff facilitate the students actively during the process.

Limitations of the survey

The survey did not make any specific attempt to further breakdown the results in terms of the diploma course taught by the staff as the teaching staff could be assigned to teach students from different diploma courses for the same project-based modules. Also, the survey did not seek the teaching staff's views on how they perceived their role in developing students' teamwork skills, beyond administering and facilitating the self and peer assessment for teamwork measurement, as this is expected of them in their role as teaching staff.

CONCLUSION

The use of teamwork measurements for assessing teamwork for the project-based modules for first year and second year students administered by the teaching staff in the School of Electrical and Electronic Engineering has overall received positive responses. Teaching staff found it is easy to do the required tasks on LAMs and the students' inputs support their own observations of their students in terms of the students' teamwork skills.

The degree of usefulness, however, require the active facilitation of the teaching staff to guide and remind students on the need for conscientious and objective inputs so that the feedback gathered will be of use to benefit students' further development of teamwork skills. This is also to reflect the true extent of the individual contribution to the group project for assessment moderation.

Easy availability of resources, including access to a one-stop resource that the teaching staff can use to guide their students to carry out meaningful teamwork measurement exercise can help to further improve the implementation. On the curriculum side, the project requirements may need to be re-examined to ensure the group project demands, and the associated learning activities can both justify and guide students on essential teamwork aspects of group projects for the project-based modules. Teaching members of the project-based modules could be brought together in a workshop-style arrangement so that these could be explored further. Such sessions can also be conducted to seek their views on what they themselves have done, and what could have been done better to facilitate their students to carry out the self and peer assessment teamwork exercise meaningfully (Matusovich, Paretti, Motto, & Cross, 2012).

The use of teamwork measurement through facilitation of teamwork skills of students by teaching staff in carrying out group projects and assessment by rewarding individual contributions can pave the way for development of student teamwork skills, needed for the actual engineering workplace.

FINANCIAL SUPPORT ACKNOWLEDGEMENTS

The authors received no financial support for this work.

REFERENCES

- Beddoes, K. (2020). Interdisciplinary Teamwork Artefacts and Practices: A Typology For Promoting Successful Teamwork in Engineering Education. *Australasian Journal of Engineering Education*.
- Cerri, S. T. (2016). *The fully integrated engineer : combining technical ability and leadership prowess* . New Jersey: John Wiley.
- Chong, S. P., Chua, K. C., Teoh, C., & Chow, P. (2010). Integrating CDIO Skills and Technical Knowledge from Different Modules in a Project. *Proceedings of the 5th International CDIO*

- Conference, *École Polytechnique de Montréal, Canada, 14-16 June 2010*. Montréal, Canada.: École Polytechnique de Montréal.
- Chowdhury, T., & Murzi, H. (2019). Literature Review: Exploring Teamwork in Engineering Education. *Research in Engineering Education Symposium*. Cape Town, South Africa.
- Davies, M. (2009). Groupwork as a form of assessment: Common problems and recommended solutions. *Higher Education*, 563-584.
- Francis, N., Allen, M., & Thomas, J. (2017). *Using group work for assessment – an academic’s perspective*. Retrieved from <https://www.advance-he.ac.uk/sites/default/files/2022-03/Using%20group%20work%20for%20assessment%20%E2%80%93%20an%20academic%E2%80%99s%20perspective.pdf>
- Gibbard, K., Grocutt, A., Turner, A., O’Neill, T., Brennan, R., & Li, S. (2018). Assessment of Individual and Teamwork Attributes in Undergraduate Engineering Students. *Canadian Engineering Education Association*.
- Lingard, R., & Barkataki, S. (2011). Teaching Teamwork in Engineering and Computer Science. *41st ASEE/IEEE Frontiers in Education Conference*. Rapid City, USA.
- Marin-Garcia, J. A., & Lloret, J. (2008). Improving Teamwork with University Engineering Students. The Effect of an Assessment Method to Prevent Shirking. *WSEAS Transactions on Advances in Engineering Education*.
- Matusovich, H. M., Paretti, M. C., Motto, A. M., & Cross, K. J. (2012). Understanding Faculty and Student Beliefs about Teamwork & Communication Skills. *American Society of Engineering Education*.
- Ohland, M. W., Loughry, M. L., & Moore, D. (June, 2007). Development of a Theory-Based Assessment of Team Member Effectiveness. *Educational and Psychological Measurement*, 505-524. Retrieved 28 January, 2023, from https://www.researchgate.net/publication/247728711_Development_of_a_Theory-Based_Assessment_of_Team_Member_Effectiveness
- Ohland, M. W., Loughry, M. L., Woehr, D. J., Bullard, L. G., Felder, R. M., Finelli, C. J., . . . Schmucker, D. G. (Dec, 2012). The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self-and Peer Evaluation. *Academy of Management Learning and Education, The*, 609-630.
- Pee, S. H., Leong, H., & Sale, D. (2009). CDIO Design Build Project: Implementation in the Singapore Polytechnic. *Proceedings of the 5th International CDIO Conference*. Singapore: Singapore Polytechnic.
- Siha, S., & Campbell, S. M. (2015). Retrieved 2023, from <https://www.westga.edu/~bquest/2015/teamwork2015.pdf>
- Smith, K. A. (2014). *Teamwork and project management (4th ed.)*. New York: McGraw-Hill.
- Soo-Ng, G. L., & Tao, N. (2021). Developing and Assessing Teamwork with Enhanced Team-based Learning Approach. *Proceedings of the 17th International CDIO Conference* (pp. 304-313). Bangkok, Thailand: Chulalongkorn University & Rajamangala University of Technology Thanyaburi.
- Sripakagorn, A., & Maneeratana, K. (2, 2009). *Use of CATME for teamwork assessment in engineering projects*. Retrieved from <https://www.academia.edu/>: https://www.academia.edu/3872708/Use_of_CATME_for_teamwork_assessment_in_engineering_projects
- Voon, C. C., & Sale, D. (2009). Implementing CDIO In Electrical & Electronic Engineering Modules: Practical Challenges And How To Meet Them. *Proceedings of the 5th International CDIO Conference*. Singapore: Singapore Polytechnic.
- Willey, K., & Freeman, M. (January, 2006). Improving Teamwork and Engagement: The case for self and peer assessment. *Australasian Journal of Engineering Education (Online)*.

BIOGRAPHICAL INFORMATION

Lim Joo Ghee is the Director of the School of Electrical & Electronic Engineering (EEE) of Singapore Polytechnic. A strong believer in pedagogical innovation and offering differentiated learning experiences within the classroom to shape students to be self-directed learners, he leads the school in its endeavour to constantly innovate new Teaching & Learning approaches to train engineers for today and tomorrow's industry. His technical domain interest lies in Internet of Things, Wireless Communications, Networks, 5G and Digital Transformation. He holds a B Eng in Electrical Engineering, a Master's in electrical & Computer Engineering and a PhD in Computer Science and Engineering.

Tan Kwee Teck is currently the Deputy Director (Course Management), School of Electrical & Electronic Engineering, Singapore Polytechnic (SP). With SP for over 20 years, he teaches modules in communication systems, computer networking, network security, software programming, Internet of Things, etc. Before joining SP, he worked as a Test System engineer with Motorola Electronics (Singapore), in charge of testing of sub-modules of radio communication systems, before pursuing his PhD in Electronic System Engineering.

Safura Anwar joined Singapore Polytechnic as a lecturer in 1986. She has served in various portfolios. She leads a team of highly experienced and dedicated staff in the School of Electrical and Electronic Engineering's Teaching Innovation Unit, with a common passion to work with colleagues and students alike, to help students become better self-directed learners.

Toh Ser Khoon currently holds three positions: Director, School of Industry and Partnerships (INP), Singapore Polytechnic; Managing Director, Singapore Polytechnic International (SPI); and Managing Director, Institute for Financial Literacy (IFL). With more than 25 years of experience in the public sector, in various management positions he helms, he leads by example to build up an innovative culture, bringing about continuous improvements. His approach is always to share innovative practices, systems and processes to build capabilities and to capitalise on collaboration efforts with stakeholders and the industry.

Corresponding author

Safura Anwar
School of Electrical & Electronic
Engineering, Singapore Polytechnic
500 Dover Road, Singapore 139651
SINGAPORE
safura_anwar@sp.edu.sg
Office Contact: +65 6879 0652



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).