SMU
SINGAPORE MANAGEMENT UNIVERSITY

AN INTRODUCTION TO SMU-X TOOLKIT TEACHING & COURSE DESIGN

Contents

DOCUMENT CHANGE RECORD

S/N	Updated Section	Effective Date	Summary of Change	Initiated by
1	2	1 April 2018	Updated welcome message from Academic Director and Team Lead of SMU-X	Magdeleine Lew (CTE)
2	4.7	16 July 2018	Included assessment guidelines for SMU-X courses	Magdeleine Lew (CTE)
3	7 (Annex K)	20 Aug 2018	Included rubrics for assessing Assurance of Learning of SMU-X courses	Magdeleine Lew (CTE)
4	4.7	21 Aug 2018	Updated assessment guidelines for SMU-X courses	Magdeleine Lew (CTE)
5	1	3 Jan 2019	Updated designation of Professor Arnoud De Meyer	Magdeleine Lew (CTE)

1. SMU-X: Message from University Professor and Executive Director, SMU-X

Dear colleagues,

The SMU Vision 2025 was launched with the ambition of positioning SMU as a Great University. One of the cornerstones of that vision is providing a transformative education for a new generation of students. During the State of University Address 2015, I described this as being a Game Changer in the Undergraduate Education scene.

The scale and complexity of the challenges facing the world and our graduates today are unprecedented. The way our students learn and are taught must also change to stay relevant and effective.

In pushing the frontiers of learning, we have moved into new learning territories with the launch of its first-of-its kind experiential SMU-X. This ground-up initiative combines academic with experiential learning through the heavy use of projects. It challenges talented students to use their disciplinary knowledge and skills and tackle real-world problems and issues through interdisciplinary approaches and activities, in partnership with corporate, non-profit and government-sector organizations.

A tripartite learning relationship emerges from involving faculty and industry practitioners deeply as active mentors for SMU students. An SMU-X course becomes a learning loop for this tripartite: our students get a better understanding of what it means to use theory learnt outside the classroom and learn how to learn from experience. Our faculty learns how real-world adapts theory and our partners deepen their own learning. This inculcates in our students and our partners the value of continuous learning which is imperative going forward given our rapidly changing economic conditions.

SMU-X has been made possible by consultative faculty who are engaged in promoting interdisciplinary project-based learning using actual problems faced by organizations. In any new endeavour, the first steps are always the hardest. I would like to recognize the efforts, vision and tenacity of the inaugural committee in setting up

"The jobs most likely to exist in the future are those that require flexibility, creativity and innovation, or social intelligence. We need to look for a different learning paradigm that optimizes the learning of this new student. At SMU, we have created an environment that takes these differences into account, with courses and learning experiences that bring the real world into the classroom."

the foundation and framework for SMU-X. I am also pleased to share that many more of our faculty are now embarking on the development of SMU-X type courses. These courses are typically interdisciplinary, anchored in real problems, project-based with faculty as facilitators. We are hoping to offer all students the chance to take at least one SMU-X course by the end of 2017. In doing so, we will prepare our students to be self-directed learners, creative, resilient and adaptable to changes in the global economy. Together, let us carry this distinctive SMU-X pedagogy forward and build the SMU brand! Professor Arnoud De Meyer University Professor Executive Director, SMU-X Singapore Management University	

2. SMU-X Toolkit: Message from the Academic Director and Team Lead of SMU-X

Dear colleagues,

The SMU-X Toolkit, jointly developed by the SMU-X Committee and the Centre for Teaching Excellence (CTE), is a one-stop resource to help faculty settle into the teaching aspects of the SMU-X role.

SMU-X is a paradigm shift, which focuses on learning as opposed to teaching, as well as a mind-set shift to get the university to collaborate both internally and with its external stakeholders. The SMU-X curriculum combines academic with experiential learning where students are challenged to use their disciplinary knowledge to tackle real world issues through inter-disciplinary approaches. Our faculty and industry partners are involved in active mentoring so that the students benefit most out of the partnership.

Through SMU-X programme, it is believed several future work skills will be inculcated in students' learning process. The skills which the programme hopes to develop include:

1. Ability to see connections and differences across disciplines and to integrate knowledge to explore an issue or meet a challenge;
2. Adaptability to new or unfamiliar environments and to exercise leadership;
3. Creativity and critical thinking when solving problems;
4. Sound decision making while managing complex situations and
5. Ability to work collaboratively and productively as a team.

These skills are consistent with major skills highlighted in both Future Work Skills 2020 report and the SkillsFuture initiative.

This Toolkit offers teaching strategies with the goal to improve instructional quality and the overall student experience. It has been developed to be used primarily by faculty members to aid the development and delivery of SMU-X courses. The Toolkit covers a portfolio of teaching instructions that include a learning framework and teaching resources for delivering SMU-X courses. Over time, this Toolkit will be updated and expanded through on-going faculty feedback and research. Come and embark on this SMU-X journey with us!

"With SMU-X pedagogy, I believe instructor's role may gradually shift from transmitter of information to facilitator of learning. The role of a student has transitioned to become that of an active learner. Student learning may be enhanced in this case especially when students are engaged in academically challenging project work with proper guidance through interdisciplinary studies and real-world problem learning opportunities."	*"SMU-X empowers students to learn through projects that combine academics with solving real world challenges. This makes learning more engaging and relevant to students. Once students make connections of what they learn with the real world, they become intrinsically motivated to drive deeper self-directed learning. To prepare students for an uncertain future and make meaningful impact to business, government and society, SMU-X provides the space (physical and otherwise) to impart 21st century skills when they collaborate on real world projects."*
	
Gary PAN Academic Director of SMU-X Associate Professor of Accounting and the Associate Dean for Student Matters of the School of Accountancy Singapore Management University	Kevin KOH Head, SMU-X Office of the Provost

Acknowledgements

This document is prepared by Dr. Magdeleine Lew, Assistant Director, CTE, with inputs from Associate Professor Tan Swee Liang, School of Economics and Director (CTE), Mr. Tan Yee Ping, Senior Manager (CTE) and the SMU-X team (Associate Professor Gary Pan, Mr. Tan Gan Hup and Ms. Grace Koh). For queries regarding the toolkit, please contact cte@smu.edu.sg.

3. SMU-X[1]

3.1 An innovative approach to prepare our students with skills for the future

SMU-X is a paradigm shift which focuses on learning as opposed to teaching, as well as a mindset shift to get the university to collaborate more internally and with our external stakeholders. SMU does this by innovating curriculum based on an experiential approach that is interdisciplinary and hands-on. It gets the SMU community to collaborate and step out of their silos by encouraging group effort in solving complex issues. All SMU-X courses are characterised by four principles: (i) interdisciplinary content and activities, (ii) experiential learning via an actual problem or issue faced by an organization, (iii) active student-mentoring by faculty and industry, and, (iv) a tripartite learning loop for the faculty, student and industry.

Every SMU-X course challenges and inspires our undergraduates to use their disciplinary knowledge and skills in tackling complex issues faced by the partner organizations. By deep-diving into current and actual problems and constraints, SMU-X courses can accelerate students' learning to go beyond hypothetical classroom exercises. Courses span across different disciplines and students get to help improve individual well-being, contribute to society, or come up with innovative new business models for partner organizations. In building up an ecosystem for students, faculty and our partners to interact, we look to creating physical environments and learning spaces to support the collaboration and project work that takes place within the curriculum.

We think that the concept of SMU-X, i.e. creating a collaborative mindset, experiential curriculum and space, will bridge the gap between academia and practice, and prepare undergraduates for the challenges of the future. To us, 'X' stands for many things: experimentation, experiential, excitement, cross-interaction, collaboration and the unknown. However, there are three parts that makes up SMU-X:

I. Mindset

First and foremost, SMU-X is a mindset, one that gets SMU members to collaborate and step out of their current silos. Universities have traditionally been slow to innovate and collaborate; are good at the "deep" but rarely look at problems that are "broad". There is merit in encouraging group effort in solving complex issues. With SMU-X, we want to be a better city university and for our students and faculty to work actively with the community as well as our research centres. Each party brings with them their expertise and industry-specific viewpoints in a collaborative approach using both disciplinary knowledge and multi-faceted perspectives. To do so, we have two strategies: SMU-X pedagogy and Space.

[1] Write-up contributed by SMU-X team

II. Pedagogy

An SMU-X course is a structured 14-week course which combines academic theory with EL through the heavy use of real unresolved issues and projects that students work on. It is interdisciplinary either in the topic or approach and/or the student mix to ensure that the problems are viewed in from multiple angles. We partner with the industry, non-profit and government-sector organizations to develop and teach our courses and projects.

Our partners and our faculty are involved in active mentoring so that the students benefit most out of this deep relationship. Lastly, an SMU-X course serves to help: our students get a better understanding of what it means to use theory learnt outside the classroom, our faculty on how real world adapts theory, and our partners to build up a culture of learning. This inculcates in our students and our partners the value of continuing education which is imperative going forward given our rapidly changing economic conditions.

III. Space

Physical space is still relevant and important even as we move towards an increasingly virtual world. There is scope to improve the learning environments, both in-class and out-of-class to create a 24-hour, co-working, learning hub with active learning classrooms. This caters to the differing learning styles and at the same time, extends space through time where student can now work on their projects with their industry partners even till late in the evening. The SMU Labs comprises three levels of people-friendly space, characterized by colour, flexible use, and informality conducive to 24/7 work, play and relaxation.

3.2 SMU-X progress

Since August 2014, SMU has started to pilot SMU-X electives to test out the SMU-X methodology of providing an environment for all of SMU that acknowledges experience-based learning and doing as part of all activity. As of AY 2016/ 2017 Term 1, 23 SMU-X courses have been designed. The feedback collected on the courses provided many insights. Students commented that SMU-X courses were intensive, time-consuming and provided them with many challenges. To add on, students reported that they were overwhelmed by the workload as they had to manage and live up to the expectations of real clients in addition to striving to attain academic success in their courses. Nonetheless, students were positive as the electives enriched their learning experiences, reporting that they enjoyed doing work that had a real impact and could see applications to real-life. Faculty members who have piloted the SMU-X electives also reported that they benefited from the experience. Many felt that the rich data from industry projects gave them ideas for conducting their own disciplinary research. SMU sees this as an opportunity to further bring the faculty closer to current industry practice.

3.3 Directions for SMU-X

SMU intends to scale up the number of SMU-X courses such that all SMU students have the opportunity to take at least one course by the time they graduate. At steady state, SMU-X courses will be an integral part of the curriculum offered by our schools. If you would like to convert your current course offering into a SMU-X course or start a new SMU-X course, you can reach the SMU-X team via smux@smu.edu.sg. The SMU-X team can also work with you to help find industry partners to collaborate with you on your course.

To find out more about SMU-X and its current courses, please visit: http://x.smu.edu.sg/.

Figure 1. Three components of SMU-X: Mindset, Pedagogy and Space

4. Project-Based Experiential Learning Framework for SMU-X

4.1 Definition of Project-Based Experiential Learning

The project-based experiential learning (PjBL) framework organizes learning around projects and this framework is adopted for SMU-X. Projects are complex tasks based on challenging questions or problems faced by industry partners, and involve students in designing solutions, problem-solving and decision making that will prepare them with skills for the future. According to the Buck Institute for Education (BIE), PjBL is an inquiry-based instructional approach to learning where "*students gain knowledge and skills by working for an extended period of time to investigate and respond to an engaging and complex question, problem, or challenge*[2]."

4.2 Key Elements of Project-Based Experiential Learning

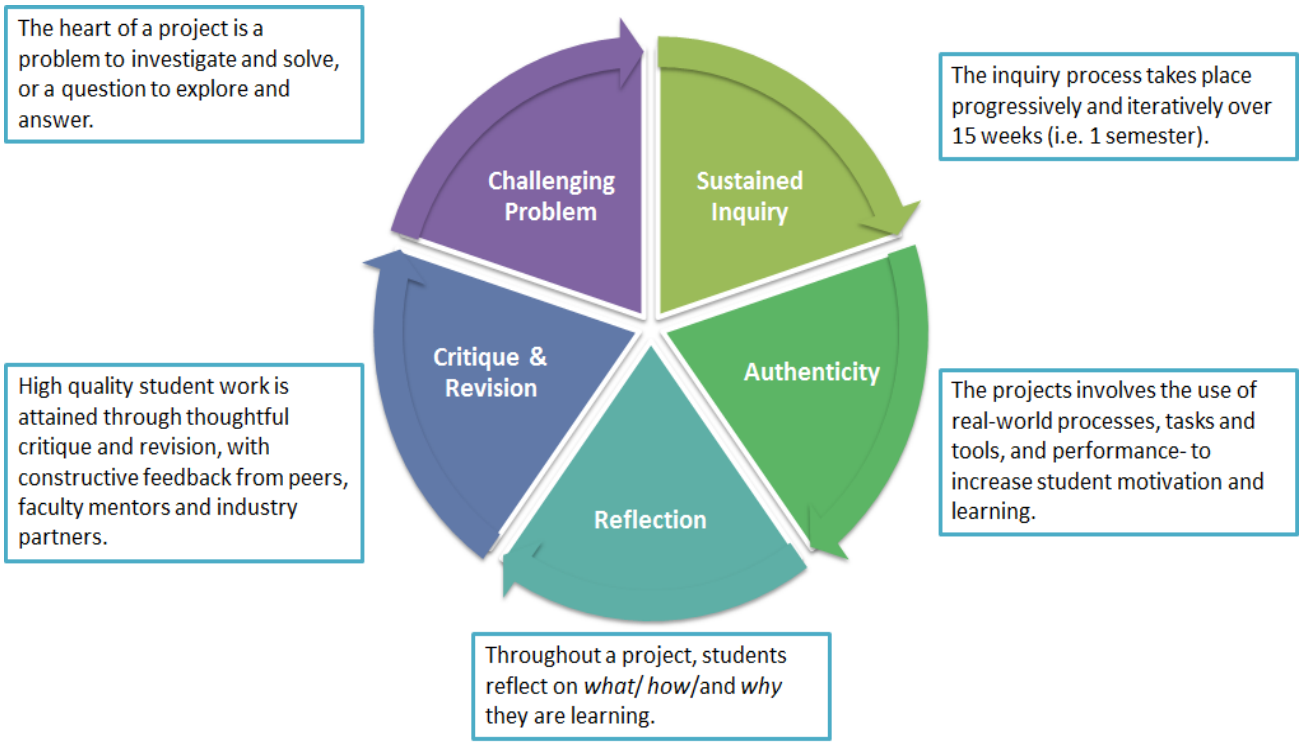


Figure 2. Key elements of Project-based Learning for an SMU-X course

The key elements of PjBL that characterizes an SMU-X course have been adapted from BIE's Essential Project Design Elements[3]. These key elements outline what is necessary for a successful project that maximizes student learning and engagement in an SMU-X course. These elements include the following:

[2] What is Project Based Learning (PBL)? (n.d.). Retrieved June 23, 2016, from http://bie.org/about/what_pbl
[3] Gold Standard PBL Essential Project Design Elements. (n.d.). Retrieved June 23, 2016, from http://bie.org/blog/gold_standard_pbl_essential_project_design_elements

1. ***Challenging problem***: an engaging problem makes learning more meaningful for students. Students are learning because they can use this knowledge to solve an actual problem or issue faced by an organization and that is relevant to them.

2. ***Sustained inquiry***: an active and iterative in-depth process which allows students the opportunity to work on the project over extended periods of time, asking questions and finding relevant resources to help answer them, until a satisfactory solution or answer is developed.

3. ***Authenticity***: the learning focuses on "real-world" context and tasks, involving interdisciplinary learning activities, the use of real-world processes, tasks and tools, and performance standards.

4. ***Reflection***: throughout a project, students reflect on *what, how* and *why* they are learning. Reflection is a critical component in assessment and forms a part of project journals, discussions at project checkpoints, and during presentations of student work. Reflection on the content knowledge helps students think about how the learning may apply in the real-world.

5. ***Critique and revision***: high quality student work is attained through constructive feedback in a tripartite learning loop between students, faculty and industry partner. Perspectives provided by faculty and industry partner, guided by assessment rubrics and real-world models, improve project processes and products.

4.3 The Role of the Student

PjBL provides the environment for supporting student learning optimally. Through PjBL, students are confronted with unfamiliar situations and tasks in a real-world context. In order to complete these tasks, students would need to figure out *what they know, what they do not know, and how to learn it.* This requires students to: (1) reflect on their prior knowledge and deepen it through reflection; (2) transfer their previous learning to new contexts; master new concepts, principles, and skills; and (3) are able to articulate how they developed this mastery (Linn, et al., 2004).

For SMU-X courses, students work collaboratively in groups for the projects. They find relevant sources, conduct scholarly research, and hold each other responsible for learning and the completion of tasks. Essentially, students must be "self-managers" in this approach to instruction. Students therefore play several roles in contributing towards a positive PjBL experience. In this section, we describe more about some of the students' roles in a typical SMU-X course (see Table 1).

Table 1. Description of the different roles of the student in an SMU-X course[4]

Roles	Description
Contributing towards a Positive Learning Culture 	• Students self-monitor classroom ground rules co-crafted with the instructor. • Students are directed by the instructor only to the extent necessary when working individually or in teams. • Students work collaboratively in healthy, high-functioning teams, much like in an authentic work environment; therefore the instructor rarely needs to be involved in handling teamwork issues. • Students understand there is no single "right answer" or preferred way to do the project, and that it is OK to make mistakes and learn from them. • The values of critique and revision, persistence, rigorous thinking, and pride in doing high-quality work are shared, and students hold one another accountable for them.
Self-assessing Learning and Progress 	• Students give and receive constructive feedback to inform learning decisions and actions. • Students regularly self-assess their progress and, when appropriate, assess peers on their performance. • Assessment rubrics are used by students to guide both formative and summative assessment, and to guide students to deeper levels of thinking.
Taking Ownership of the Project 	• Students and instructors co-define goals and benchmarks for the project, (e.g., by co-constructing assessment rubrics) guided by learning outcomes. • Students' engagement and sense of ownership of the project is maintained by the shared nature of the work between instructors and students. • Student questions play the central role in driving the inquiry and product development process; the driving question is actively used to sustain inquiry. • Appropriately high expectations for the performance of all students are clearly established and shared by instructor and students.
Managing Expectations of Instructor, Industry Partners and Team Members 	• Students clarify their roles together with the instructor and industry partners, by having an initial meeting prior to or at the start of the course. • Students sign an agreement with the industry partner (negotiated and approved by the instructor), outlining legal matters such as Intellectual Property, and confidentiality. • Active mentoring from instructor is sought so that students can contribute to better business relationships with the industry partner.

[4] Adapted from Project-based Teaching Rubrics, Buckwheat Institute of Education (link: http://bie.org/object/document/project_based_teaching_rubric)

4.4 The Roles of the Instructor

In an SMU-X classroom, students take on more control of their own learning. Therefore the instructor guides rather than directs the learning process. That means taking on a learner-centred approach and allowing students to experiment and discover solutions on their own. Intervention by the instructor should occur only in situations when student group lacks the skills to deal with obstacles they encounter. Once students have been provided with the necessary skills and information, the instructor then steps back and serves as a resource person, cheerleader, and facilitator (Schwartz, 2013).

Table 2. Description of the different roles of the instructor in an SMU-X course[5]

Role	Description
Planning, Designing and Managing Project-based Activities	• Realistic schedules, checkpoints, and deadlines are set but are flexible. • Resources for the project have been anticipated to the fullest extent possible and arranged well in advance. • Scaffolding of student learning, guided by critique and revision protocols, assessments and rubrics. • A balanced mixture of individual and team work, whole class and small group instruction. • Well-balanced teams are formed according to the nature of the project and student needs, with appropriate student voice and choice. • Learning outcomes crafted should be clear and are clearly communicated to students.
Creating a Positive Learning Culture	• Creates, supports and models a safe learning environment where students feel valued, trusted and respected during the learning process. • Reframes conflicts and difficulties in a positive light, shows faith in the students and exudes enthusiasm for the learning process.
Scaffolding Student Learning	• Scaffolding is guided as much as possible by students' questions; the instructor does not "frontload" too much information at the start of the project, but waits until it is needed or requested by students. • Key student success skills are taught using a variety of industry relevant tools and strategies; students are provided with opportunities to practice and apply them, and reflect on progress. • All students receive necessary instructional supports, which are progressively removed when no longer needed. • Guiding student teams to be effective. For strategies on how to form and develop effective teams, please refer to Oakley et. al. (2014) paper[6].

[5] Adapted from Project-based Teaching Rubrics, Buckwheat Institute of Education (link: http://bie.org/object/document/project_based_teaching_rubric) and the works by Cord and Clement (2010) and Schwartz (2013)

Role	Description
Assessing Student Learning and Progress	• Project products and other sources of evidence are used to thoroughly assess subject-area standards as well as student success skills. • Individual student learning is adequately assessed, not just team-created products. • Formative assessment (i.e. feedback to students on their learning) is used regularly and frequently, with a variety of tools and processes. • Structured protocols for critique and revision are used regularly at checkpoints; students give and receive constructive feedback to inform instructional decisions and students' actions. • Regular, structured opportunities are provided for students to self-assess their progress and, when appropriate, assess peers on their performance. • Assessment rubrics are used by students and the instructor to guide both formative and summative assessment, and to guide students to deeper levels of thinking.
Setting Expectations of Students	• Appropriately high expectations for the performance of all students are clearly established and shared by instructor with students. • Ground rules to guide the classroom are co-crafted with students, which they largely self-monitor. • Student, industry partners and instructor roles are clarified, with potential challenges highlighted so that students know what they are getting into and they can then make responsible choices. • Student voice and choice is expected and on-going, including identification of real world issues and problems students want to address in projects.
Managing Expectations of Industry Partners	• Involve industry partner early on in course development, to collaborate, align course with industry expectations and ensure the pedagogical approach (knowledge, skills & behaviour) meets their needs. • Arrange a flexible schedule that minimizes business interruptions to industry partners, and which allows companies to provide more learning opportunities for students. • An industry partner agreement and a separate student agreement should be signed, outlining legal matters such as intellectual property and confidentiality.

It is also important that instructors must provide closure when bringing the experiential process to an end and help the learner notices the connections between one context and another, and between theory and the experience.

[6] Oakley, B., Felder, R. M., Brent, R., & Elhajj, I. (2004). *Turning student groups into effective teams*. Journal of Student-Centred Learning, 2(1), 9–34. http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Oakley-paper%28JSCL%29.pdf

Figure 3. An instructor facilitating a team discussion

4.5 The Role of Reflection

Reflection plays an important role in the SMU-X learning process by providing a bridge between practical experience and subject/ discipline knowledge. In order for students to take charge of their learning, they need to be facilitated to develop a basic reflective orientation (i.e. by reflecting on their experiences, beliefs and assumptions of learning). Reflection requires students to develop an explicit awareness and understanding of what it is that needs to be learnt (i.e. metacognitive awareness), and why such learning is necessary.

Reflective thinking occurs when there are structured processes of relating, experimenting, exploring, reinterpreting from different points of view, or within different contextual factors, theorizing, linking theory and practice. The testing of new ideas in practice and/or discussion of new ideas can also aid student reflection.

During reflection, students should be willing to be critical of the action of themselves and others and also to recognize that views can change with time and emotional state.

Given that reflection is such a crucial component of a successful PjBL process, it is therefore important that students can reflect on their own learning, bringing "the theory to life" and gaining insight into themselves and their interactions with the world (Moon, 2004; Schwartz, 2013). Moon (2004) gives some suggestions that the instructor can consider using to help students enhance their abilities to reflect during their process of learning when working on their projects (see Table 3).

Table 3. Suggestions to help students enhance their ability to reflect

Suggestion	Description
Provide Practice and Opportunities for Feedback	• Present students with examples of reflective writing, and are led through a discussion and some small exercises that get them accustomed to the concept and methodology of reflection • Set up situations in which students can share their ideas • Provide timely and constructive feedback when required
Allow Time to Pause and Reflect	• Take opportunities to pause in between during class to give students the opportunity to reflect or question what they've just heard
Use Concept Maps to find out how Students see a Topic	• Differences in each student's map may demonstrate differences in thinking and therefore material on which to reflect
Require Students to Explain and Apply	• Students are likely to adopt a deep approach to the learning of a particular concept/topic if they know they are required to explain or apply it to a novel situation
Use Questioning to Probe Students' Thinking	• Use open questions, leading questions, and questions set as problems (See Annex B)

After students become accustomed to the concept and methodology of reflection, the instructor can help to deepen the students' understanding of reflection, moving from basic to more complex forms. With deeper reflection, students can become more aware of one's own processes of mental functioning (i.e. metacognition). Students should also recognize that prior experience and thoughts (their own and each other's) interact with the production of current behaviour. Students should also make observations that there is learning to be gained from the experience and note the learning points.

In addition to introducing a framework that describes levels of reflection and use examples to demonstrate deeper reflection activity (see Hatton & Smith (1995)), Moon (2004) (p. 144) suggests for instructors to do the following to facilitate students' deeper reflection:

1. Introduce activities that involves:
    a. 'Standing back from oneself' (use third person to view performance or abilities objectively).
    b. Reflection on the same subject matter from different viewpoints (people, social institutions, etc.).
    c. Reflection on the same subject matter from the viewpoints of different disciplines.

2. Use *second-order* reflection, by getting students to reason, relate and reconstruct ideas, either individually or collaboratively.

4.6 Assessment of Project-Based Learning for SMU-X Courses

Assessment of PjBL is one of the least explored area in higher education and also one of the most challenging. According to Lakshminarayanan (2013), this challenge is largely due to the open-ended, authentic and complex nature of the projects that students undertake as part of their courses. Most often, each project (and therefore the student experience) is unique in terms of (i) the technical and people-related challenges, and (ii) the amount of personalized learning (compared to learning in traditional, standardized courses) depending on the nature of the assigned problem. In addition, the industry and university viewpoints on what constitutes good work can be quite different from one another.

As a consequence of such differences in expectations, students may perceive the learning outcomes for the SMU-X courses as being broad and unclear. It is therefore crucial for close and continual collaboration among the three key stakeholders involved in delivering the SMU-X course: the industry partner, the student doing the course, and the course instructor.

Besides industry projects, other types of assessments that are commonly used for PjBL include reflection journals, self-assessment, peer assessment, reports and presentations (Yate, Wilson & Purton, 2015). These are commonly used for assessing students taking SMU-X courses. More details regarding each assessment method will be shared in the following sections.

Figure 4. Different assessment methods recommended for SMU-X courses

To better overcome the challenges associated with assessing students, some recommendations to improve the assessment of the SMU-X courses are put forth in the areas of course learning outcomes; assessment rubrics and the use of multimodal assessments (see Figure 5).

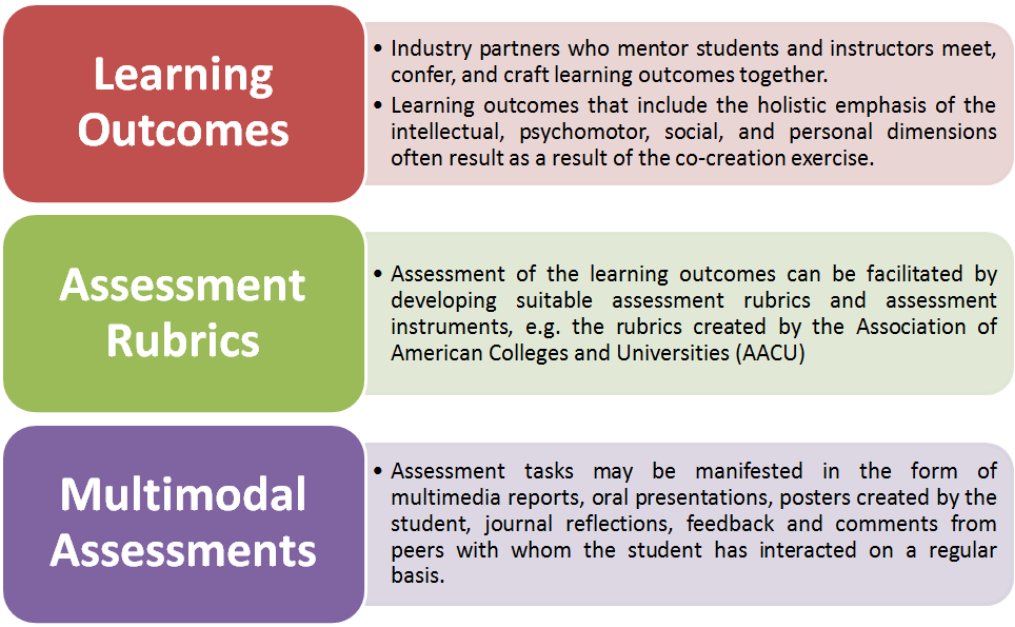


Figure 5. Recommendations to improve the assessment of SMU-X Courses

4.6.1 Student Learning Outcomes

Learning outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course or program. In other words, learning outcomes identify what the learner will know and be able to do by the end of a course or program. Some examples of student learning outcomes that can be evaluated include:

Table 4. KSA of students learning outcomes

Knowledge (K)	• **Knowledge of fundamental principles/ concepts/ theories**
Skills (S)	• Ability to see the connectivity of things • Application of fundamental principles/ concepts/ theories • Communication skills • Collaborative skills • Critical and creative thinking • Informed decision-making skills • Leadership ability • Managing complexity • Problem solving skills • Professional judgment
Attitudes (A)	• Adaptable mindset • Initiative • Punctuality and ability to meet deadlines • Resilience in dealing with uncertainty, setbacks and failures • Sense of responsibility • Self-reliance

After an SMU-X courses, students should be able to:

- be aware of the connections and differences across disciplines and to integrate knowledge to explore an issue or meet a challenge.
- adapt to new or unfamiliar environments and exercise leadership.
- think creatively and critically when solving problems.
- make sound and informed decisions while managing complex situations.
- work collaboratively and productively as a team.

4.6.2 Considerations when Designing Assessments

Several authors (e.g. Moon (1999), Lakshminarayanan (2013) and Schwartz (2013)) have suggested some factors to consider when designing assessments for PjBL. These considerations are readily applicable to the SMU-X context and are summarized in Table 5.

Table 5. Considerations for designing assessments for SMU-X Courses

Suggestion	Description
Provision of Continuous Feedback 	• Provides continuous feedback to students helps them to gauge their own success, and to identify their specific strengths and areas for improvement. • Provides continuous feedback to the instructors regarding the learning outcomes in relation to the pre-established learning goals. This gives instructors an idea of what concepts need to be reinforced or which learners need to be redirected, and helps with the assessment and improvement of the course for the future.
Prior Knowledge and Experiences 	• Students benefit from different perspectives from different learning experiences.
Motivations and Expectations 	• Influence student's readiness to learn, engage in, and benefit from the learning experience.

4.6.3 Assessing Industry Projects

Industry projects that are a part of a SMU-X course provide students with the experience of collaborating with an industry partner (i.e. a real client) and working together collaboratively in teams. Many authors have reported the benefits of students working collaboratively in teams and having unique industry projects for each student team (Clark, 2005; Fincher, Petre & Clark, 2001; Newman, 2003).

The benefits reported include:

- Students develop ability to apply skills to new contexts.
- Students experience an in-depth application of the fundamental industry practices they have learnt and therefore better able to internalise the concepts learnt, promoting deeper learning.
- Students develop improved professional communication skills with people in a variety of roles.
- Students are exposed to problems they are likely to have during employment
- Incorporating industry projects ensures that the technical skills developed by the students are relevant to the industry.

- Allowing students to work on a project of their choice increases their motivation and the experience of successfully developing something that an industry partner will use increases confidence in their abilities.
- Allowing students to explore in-depth subject areas, as well as developing students' problem-solving ability and critical-thinking skills.
- Students learn how to interact with and manage a real customer and thus develop a level of responsibility to others and an improved professional attitude.
- Students have an increased understanding of business practices, which is valued by future employers.

Figure 6. Team Hei (Academic Year 2014/15, Term 2) who won the Best IS480 award, developed a great working relationship with their IDA clients: Mr Lim Eyung, Ms Lu Shanshan, and Ms Chloe Lim throughout the course of their IS480 project

A good grading scheme must take into account a range of information, not just rely on the final product (Hayes, Lethbridge & Port, 2003). Box (2003) recommends the use of rigorous and structured formative assessment to engage students in deep learning and encourage self-directed learning behaviour. McGourty (2000) also recommends that assessment data should be collected from multiple sources such as peers, self and instructor, and linking them to the learning outcomes. However, there may be significant challenges for academic assessment to evaluate teams and individuals who develop unique industry projects.

Gates, Delgado and Mondragon (2000) described an approach that allows for the application of the same assessment criteria to all students even though they are working on different projects. It structures individual accountability to ensure all members of a team contribute and measures the individual effort of each team member (see Figure 7).

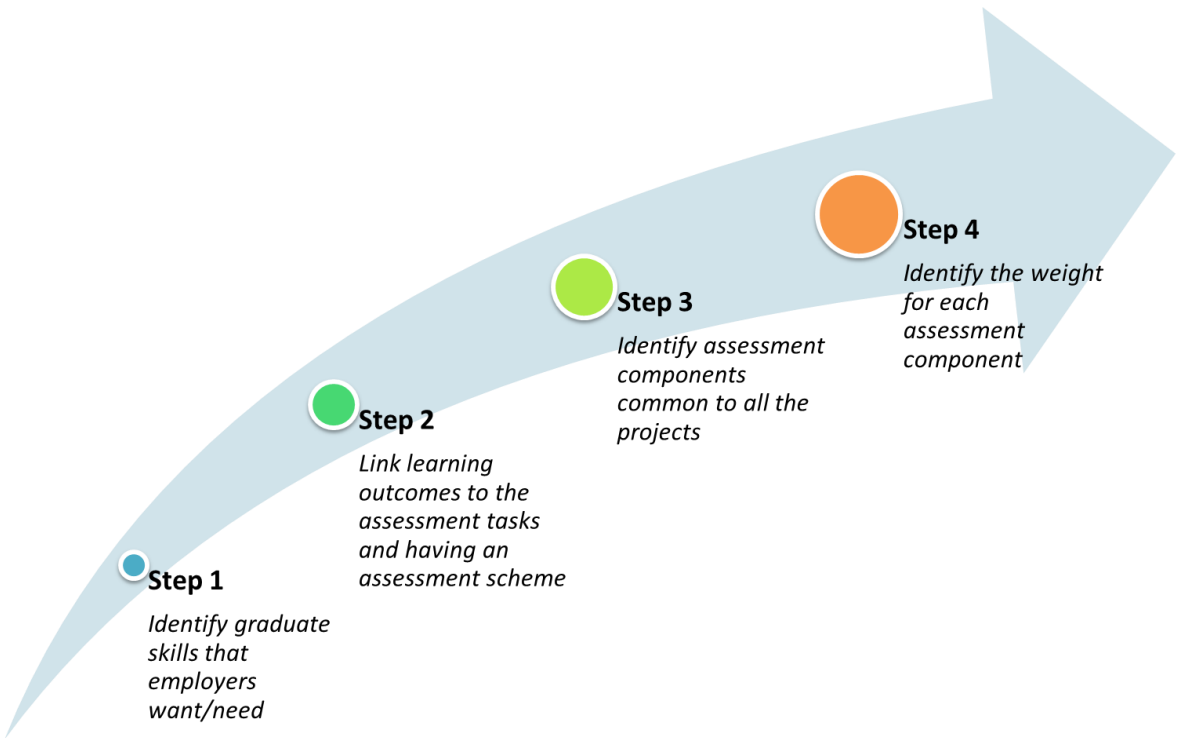


Figure 7. A four-step approach to assessing students doing industry projects (Gate et. al., 2000)

- *What type of graduate skills do employers want or need?*

In Step 1, instructors identify the graduate skills that employers want or need. Some examples of such skills include communication, problem-solving, critical thinking, collaboration, conflict negotiation, managerial skills, and time management.

- *What is the link between course learning outcomes, graduate skills and assessment tasks?*

Step 2 involves linking the graduate skills required in achieving the learning outcomes of the course, and crafting relevant assessment tasks that reflect attainment in the graduate skills (see Table 6).

Table 6. Course learning outcomes, graduate skills and assessment tasks

Course Learning Outcomes	Required Graduate Skills to Achieve Course Learning Outcome	Assessment Tasks Crafted to Measure Attainment of Graduate Skills
At the end of the SMU-X course, students will be able to work collaboratively in teams with a client in a professional manner.	• Collaborative • Communication • Professional judgement	• Self-Assessment • Peer Assessment • Reflective Report to document outcomes of and reflections of client meetings

- *What are the assessment components common to all projects?*

Step 3 is about identifying assessment components that are not affected by the uniqueness of the projects. Examples include the analysis of the driving question of the project, documentation through reflective reports, professionalism, presentation of project process and outcomes and so forth. Instructors should note that a student's result should not be based totally on successful implementation even though the project focuses on producing a quality outcome.

- *What is the weight for each assessment component?*

Identifying the weight for each assessment component is done during step 4. Each student receives a grade that reflects their contributions to the project. Providing a student with an individual grade is difficult in a project because the outcomes may vary from project to project, and an individual's contribution can be hard to identify. Nonetheless, the student grade can be based on critical information from several sources (i.e. self, peers, instructors and industry partners/clients).

Feedback on their competencies and specific behaviours and skills will provide students with a better understanding of personal strengths and areas in need of development.

An example of a grading rubric for projects is as follows. More examples of sample grading rubrics can be found on the CTE website[7].

Table 7. Project grading rubrics[8]

Assessment Component	Sub-Component	Weight (%)
Project Report	• Individual Contribution (60%) • Team Contribution (40%)	40
Reflection Journals	-	20
Peer Assessment	-	10
Team Presentation	• Instructor grade (70%) • Industry Partner/Client grade (30%)	30

- *What are some other considerations when designing grading rubrics for projects?*

Instructors should also consider the following factors when assessing SMU-X projects. In order to help instructors better tackle these factors, some assessment strategies are provided (see Table 8).

[7] Sharing of grading templates by SMU Faculty members (link: http://cte.smu.edu.sg/teaching-excellence-awards/sharing/grading-templates)
[8] Adapted from Gates et. al. (2000) and Hayes, Lethbridge & Port (2003)

Table 8. Assessment strategies to tackle considerations when assessing projects

Factor	Assessment Strategy
Project Difficulty	• Each project is given a difficulty rating that is taken into consideration to ensure equitable grades between projects
Project Quality	• Each project is assigned a rating for quality, ignoring its difficulty level
Instructor Evaluation	• By having only the instructor evaluating all the projects ensures the (intra-rater) reliability of the project grades

Industry Partner/ Client assessment	• Industry partner/client can assess students on their performances while working on the projects
	• For example, to assess the team's professionalism , the industry partner/client can rate it on a 6-point scale of very poor to excellent on the following:
	  • How the team communicated with industry partner/client between meetings
	  • How the team communicated during meetings
	  • How meetings were conducted
	  • How prepared the team was for meetings
	  • The interest that the team showed in their project
	  • The level of professionalism shown by the team

Feedback from the Instructor and Industry Partner/Client	• Students receive feedback from the instructor and the industry partner after each assessment point so that they have an opportunity to improve • Note that the industry partner/client assessment may, on average, be generally higher than the instructor's assessment and should be factored into consideration by the instructor when awarding project grades
Student Self and Peer Assessment	• Allowing students to do self and peer assessment can increase student learning • A variety of techniques to reduce the possibility of a student intentionally damaging the score of another student can be used: timesheets, self/peer assessments, surveys, individual contribution report • Instructors should corroborate students' self and peer assessments with other sources of evidence of student learning (e.g. team presentation, reflection journals, project reports etc.) when deriving the final project grades

4.6.4 Assessing Reflection Journals

Reflection is a crucial component of a successful PjBL process. One assessment method is the use of reflective journals (Moon, 2004). Students use reflective journals to record ideas, thoughts, experiences, insights, and reflections on the learning process. This can give students the opportunity to practice problem solving, think independently, or voice opinions they may be reticent to mention in class. However, students may also be wary of being fully honest in their reflections, and

may limit their comments to ones they perceive will be viewed more favourably by their assessors. Reflective journals can also be difficult for students who use English as an additional language. To circumvent these limitations, the University of South Australia assesses reflective journals for "evidence of critical thought rather than assessing students' opinion" (Chan, 2012). It can also be difficult for students to keep up with their entries, so it may be beneficial to provide alternate methods of creating entries, such as photos, videos, or audio recordings. Students should be given rubrics and examples for guidance, as many will be unfamiliar with the format. An example of grading rubrics for reflection journal can be found in Annex C.

Besides reflection journals, Moon (2004) also lists the following methods which are tied to reflection, helping students to focus their learning while also producing a product for assessment purposes:

- Maintenance of a learning journal or a portfolio
- Reflection on critical incidents
- Presentation/ essay on what has been learnt
- Analysis of strengths and weaknesses and related action planning

Some exercises, material for handouts and examples that are designed to support the introduction and use of reflection for PjBL and could be adapted for use for SMU-X courses are provided in Moon's book[9].

4.6.5 Assessing Self Performance and Learning

Involving students in both self and peer assessments can improve the quality of the students' learning experiences. Self-assessment encourages students to reflect on their role and contribution to the process of the group work. In addition, peer assessment can help to establish a clearer assessment framework, increase students' engagement in learning by fostering a greater sense of involvement and responsibility, and provide increased feedback with direct attention to skills and learning.

However, students may lack the necessary skills and judgments to effectively manage self and peer assessments. Therefore, Schwartz (n.d.) recommends that instructors prepare students for self or peer assessment and provide guidance to students on how to judge their own and others' contributions. Instructors are encouraged to develop self and peer assessment criteria together with their students so that the assessment criteria for each element are clearly communicated.

When implementing self-assessment, Schwartz (n.d.) encourages the use of reflection to get students to engage in deliberate thought about what they are learning and how they are learning it. In addition, getting students to do goal setting

[9] Resources for Reflective Learning, Moon (2004) (link: http://www.cemp.ac.uk/downloads/resourcesforreflectivelearning.doc)

can help them evaluate their progress more clearly. One strategy is to co-create a written contract with students to help them set targets against which to measure their performance. For more information on use of reflection, please refer to section 4.5 on the role of reflection and section 4.6.4 on assessing reflection journals.

4.6.6 Assessing Peer Performance and Learning

Fagerholm and Vihavainen (2013) provided an assessment framework using questionnaire items and scales (see Annex D), which is filled in by the students, instructor and the industry partner, and allows rating each student based on the questionnaire items. This can be easily adapted for use by instructors of SMU-X courses.

However, a particular concern in assessing teamwork skills is the accuracy of assessment. Van Duzer and McMartin (2000) identified two primary types of bias as especially relevant for peer assessment (as well as for self-assessment): 1) self-enhancement (one's own performance is evaluated as unreasonably optimistic and 2) downward comparison) a general tendency for positive self-bias and negative other-bias. The authors suggest some approaches to reduce self-enhancement and downward comparison biases:

1. Co-creating assessment rubrics with students helps to reduce misinterpretation and thus improves the validity of the assessment process.

2. Correlating self-assessments with scores by multiple raters (e.g. peers, instructors, and clients) enhances the reliabilities of the self-assessment scores.

3. Designing questions so that they rate past performance, not expected future performance, improves reliability by reducing the effect of downward comparison.

Willey and Freeman (2006) recommend using self- and peer assessments for both formative and summative purposes. They report that formative feedback encouraged development of collaborative skills and discourage free-riding and sabotage, thus promoting academic honesty. They also urge that feedback should be timely and constructive. If feedback is often given long after the assessable work has been completed, students' attention may already have shifted to other tasks.

Instructors should also note that there may also be peer pressure among students to apply elevated grades or that some teams may have a tendency to award everyone the same mark. There may also be times where students discriminated or 'gang up' against one group member. Therefore, instructors using peer assessment should include a short briefing session with students on how the assessment rubrics should be used as students may feel ill-equipped to undertake the assessment. It is also

recommended to involve industry partners in the evaluation of students (see Annex E).

4.6.7 Assessing Project Reports

Another example of summative assessment used for SMU-X courses are student reports. Please refer to Annex F for a sample writing rubric for Project Report.

4.6.8 Assessing Group Presentations

Many instructors of existing SMU-X courses use student group presentations as a means of summative assessment that contribute to the overall course grade. The contents of these presentations are focused on certain topics that are relevant to the course. This may involve new research and knowledge that extends how the topic has previously been taught by the instructors. It may also involve 'repackaging' knowledge already covered or further exploration of the topics by looking at different perspectives (Chivers & Shoebred, 2007). Student presentations also provide an opportunity for students to showcase their work to the clients.

An example of a grading rubric for group presentations is found in Annex G.

4.7 SMU-X Assessment Guidelines

The SMU grading system follows the grade structure given in the table below. Students are assigned letter grades as follows:

SMU Grade Structure

Grade	Grade Point	Range of marks
A+	4.3	86 and above
A	4.0	83 – 85
A-	3.7	80 – 82
B+	3.3	77 – 79
B	3.0	74 – 76
B-	2.7	70 – 73
C+	2.3	66 – 69
C	2.0	63 – 65
C-	1.7	60 – 62
D+	1.3	53 – 59
D	1.0	50 – 52
F	0.0	49 and below

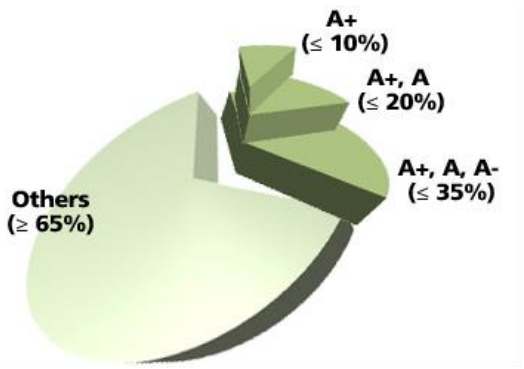
Where computations result in the cumulative GPA exceeding the 4-point grading system, a round down approach will be adopted. The highest cumulative GPA attainable is 4.00.

Assessment methods employed by faculty ought to be able to distinguish the level of student performance over a range from A+ to F. The grade descriptions of student performance are:

Grade	Description
A+	Outstanding performance
A and A-	Excellent performance
B+ and B	Good to average performance
B-	Marginally average performance
C	Below average performance
D	Marginally above a fail grade performance
F	Fail grade. Required to repeat the course if it is a compulsory course.

Most schools have guidelines on grade distribution; instructors are advised to check with their respective schools. In general, there is a cap on the total percentage of students with A-range grades (i.e. A+, A, and A-) in a course, as listed below:

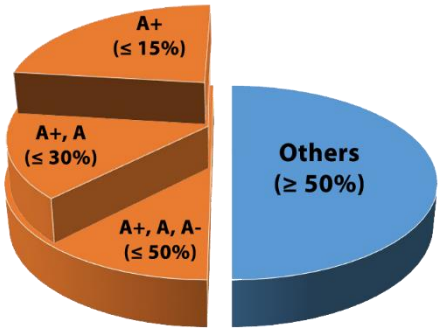
Grade Distribution



Grade	Recommended distribution
A+	Up to 10% of grades awarded
A+ and A	Up to 20% of grades awarded
A+, A, and A-	Up to 35% of grades awarded

SMU-X courses may follow a different grade cap given the nature of the course and workload involved. The University Curriculum Committee (UCC) has agreed that the cap for the "A+, A and A-" grade distribution for SMU-X courses be set at 50%, as listed below.

Grade Distribution for SMU-X Courses



Grade	Recommended distribution
A+	Up to 15% of grades awarded
A+ and A	Up to 30% of grades awarded
A+, A, and A-	Up to 50% of grades awarded

Note that for courses with both SMU-X and non-SMU-X sections, the Associate Dean has the discretion to impose the lower limit of 35% A-range grades (i.e. A+, A, and A-) on the SMU-X sections to ensure equity across all sections of the course. Instructors should discuss their grading distributions with other instructors teaching the same course (or course coordinator, if any, for the course/discipline area), in order to avoid differential grading schemes across sections.

In cases where the cap is exceeded, the Dean's Office may request instructors to moderate the students' grades, or provide justification for the grade distribution. In such cases, instructors should ensure that deserving students are not penalised and non-deserving students do not get inflated grades.

For SMU-X courses, there is a minimum weightage of 30% for projects.

4.8 Designing Projects for SMU-X Courses

Students work on industry projects that tackle real-world issues as part of their SMU-X courses. An instructor needs to consider several elements of project design in order to ensure a rigorous and effective PjBL experience for students (see Figure 8).

Figure 8. Essential Elements of Project Design

For more details regarding each project design element, see Annex H. In the design of projects for SMU-X courses, Schwartz (2013) recommends following a pattern of inquiry in which thinking occurs not only after an experience but also throughout the entire experience. The pattern begins with a student's inquiry into an industry problem. The student then develops a plan to address the problem, tests their plan against reality, and then applies what they've learnt to create a solution. The experiential component of this model is the application of knowledge. Projects are meaningful when student design their own activity, i.e. think, plan, and execute their ideas to produce something from their own creativity.

Annex I contains a template for Project Design that instructors can make use of in the planning stage of the projects for their SMU-X course. When beginning to think about converting their courses to SMU-X courses, instructors can refer to the project design elements checklist (Annex H) and consider the steps tabled in Annex J.

5. Resources

Assessment for Project-based/Experiential Learning	• Authentic Assessments (Deakin University, Australia): http://www.deakin.edu.au/__data/assets/pdf_file/0005/268511/AUTHENTIC-ASSESSMENT.pdf • Two Instruments for Assessing Design Outcomes of Capstone Projects (Montana State University): http://www.montana.edu/dsobek/career/documents/ASEE04_2425.pdf • Assessment Guidelines for Experiential Learning: https://www.mcgill.ca/tls/files/tls/guidelines_-_assessment_of_experiential_learning_1.pdf • Peer Assessment Form, Carnegie Mellon University: https://www.cmu.edu/teaching/designteach/design/instructionalstrategies/groupprojects/tools/PeerEvaluations/PeerEval-GroupWork-formsample1.docx. • Insights into Peer Assessment: http://www.celt.mmu.ac.uk/ltia/issue4/langanwheater.shtml
Experiential Teaching Handbooks	• Western Washington University - http://www.wwu.edu/teachinghandbook/teaching_delivery/experiential.shtml • University of Colorado Denver : Service Learning - http://www.ucdenver.edu/life/services/ExperientialLearning/foremployers/Documents/UC%20Denver%20Faculty%20S-L%20Guide.pdf • Lahti University of Applied Science (Finland) : Work-related Learning & Student Cooperative Company Learning - http://www.lamk.fi/projektit/forte/Documents/lamk_st_forte_opettajan_opas_a4_pysty_12-siv_REV_260913.pdf • Keuka College (New York) - http://experiential.keuka.edu/files/2009/09/KC-experiential-learning-and-field-period-handbook.pdf
Project Work	• Using Group Projects Effectively (Eberly Centre, Carnegie Mellon University): https://www.cmu.edu/teaching/designteach/design/instructionalstrategies/groupprojects/index.html
Questioning Skills	• Socratic Questioning: http://changingminds.org/techniques/questioning/socratic_questions.htm
Reflection	• Self-reflection on project work (Buck Institute of Education): http://bie.org/object/document/self_reflection_on_project_work • Critical reflection - an integral component to experiential learning: http://www.ryerson.ca/content/dam/experiential/Critical%20Reflection/Critical%20Reflection%20as%20an%20assignment.pdf • Reflection journals as an assessment method: http://ar.cetl.hku.hk/am_rj.htm#6
Technology Tools	• Collaborative platforms to generate content:https://docs.google.com, www.acrobat.com, http://collab.com, Voicethread: www.voicethread.com; Wiki: http://www.wikispaces.com/ • Concept Mapping: Popplet: http://popplet.com/; Mind42:

	http://mind42.com • Discussion forums: Proboards: http://www.proboards.com/ • Drawings and flow diagrams: Smartdraw: http://www.smartdraw.com/; Gliffy: http://www.gliffy.com/ • Polling: Poll Daddy http://polldaddy.com; Micropoll: www.micropoll.com; Polleverywhere: www.polleverywhere.com • Quizzes: Survey Monkey: www.surveymonkey.com; Hot Potatoes: http://hotpot.uvic.ca/index.php#news; Puzzle Maker: www.puzzle-maker.com; Kahoot!: https://kahoot.it/#/ • Social media sites: Twitter: http://twitter.com; Facebook: www.facebook.com; Edmodo: www.edmodo.com; Blogs with commentary pages: Wordpress: www.wordpress.com • Teaching aids like clickers and touchscreens: http://www.einstruction.com.sg/ • Word cloud: Wordle: www.wordle.net
Student Forms/ Manuals	• Student fieldwork manual (Duke Global Health Institute) https://globalhealth.duke.edu/sites/default/files/publications/fieldwork_manual_11.19.12.pdf • Post-experience reflection form (Duke Global Health Institute) https://duke.qualtrics.com/jfe/form/SV_bjRu41mwJE3OK7b

6. Contact Information

For all queries related to the Toolkit, contact CTE: cte@smu.edu.sg

For all queries related to SMU-X courses and SMU-X Labs, contact SMU-X team: smux@smu.edu.sg

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ANNEX A: Glossary of common assessment terms[10]

Term	Definition
Assessment	Any systematic method of obtaining information from tests and other sources, used to draw inferences about characteristics of people, objects, or programmes; the process of gathering, describing, or quantifying information about performance; an exercise-such as a written test, portfolio or experiment that seeks to measure a student's skills or knowledge in a subject area.
Rubrics	Specific sets of criteria that clearly define for both student and teacher what a range of acceptable and unacceptable performance look like. Criteria define descriptors of ability at each level of performance and assign values to each level. Levels referred to are proficiency levels which describe a continuum from excellent to unacceptable product.
Validity	The extent to which an assessment measures what it is supposed to measure and the extent to which inferences and actions made on the basis of test scores are appropriate and accurate. For example, if a student performs well on a reading test, how confident are we that that student is a good reader? A valid standards-based assessment is aligned with the standards intended to be measured, provides an accurate and reliable estimate of students' performance relative to the standard, and is fair. An assessment cannot be valid if it is not reliable.
Reliability	How accurately a score will be reproduced if an individual is measured again. The degree to which the results of an assessment are dependable and consistently measure particular student knowledge and/or skills. Reliability is an indication of the consistency of scores across raters, over time or across different tasks/items that measure the same thing. Thus, reliability may be expressed as (a) the relationship between test items intended to measure the same skill or knowledge (item reliability), (b) the relationship between two administrations of the same test to the same student or students (test/retest reliability), or (c) the degree of agreement between two or more raters (rater reliability). An unreliable assessment cannot be valid.
Summative assessment	A culminating assessment, which gives information on students' mastery of content, knowledge, or skills. The gathering of information at the conclusion of a course or programme to improve learning or to meet accountability demands. When used for improvement, it impacts the next cohort of students taking the course or programme. Can also have a formative function if feedback on performance is related back to students for them to improve during the course or programme.
Formative assessment	Assessment that provides feedback to the teacher for the purpose of improving instruction. The gathering of information about student learning during the progression of a course or programme and usually repeatedly to improve the learning of those students. Can also have a summative function if performance is used to determine course or programme graduation outcomes.

[10] Adapted from: American Public University glossary of Assessment Terms (link: http://www.apus.edu/community-scholars/learning-outcomes-assessment/university-assessment/glossary.htm)

ANNEX B: Questions to facilitate reflection and prompt deeper reflection

Questions to facilitate reflection

1. What is the issue / event / topic / plan /project / task / period of time etc. that is to be the subject matter of the reflection? *[It can be useful to prompt the description of the subject matter of reflection in terms of a question]*
2. Is there anything else you need to consider at the moment in terms of the context?
3. What is the nature of the significance of this issue to you?
4. How do you feel about it?
5. How do your feelings relate to any action?
6. Was it good / bad – and what are the implications?
7. What do you need to do?
8. What other information do you need (ideas, knowledge, opinion etc.)?
9. Are there previous instances of this event, issue arising that will help you to think more/ differently about it?
10. Are there others, or the views of others who are relevant to this matter – and in what way?

Questions to prompt deeper reflection

1. Has the nature of your description of the issue / event influenced the manner in which you have gone about the reflective writing?
2. Is there relevant formal theory that you need to apply?
3. How do your motives for and the context of the reflective writing affect the manner in which you have gone about the task?
4. In what way might have you tackled the task differently if the context was not one of formal education (perhaps with assessment)?
5. Is there another point of view that you could explore – are there alternative interpretations to consider?
6. Are others seeing this issue from different points of view that may be helpful to you to explore?
7. Does this issue relate to other contexts – reflection on which may be helpful?
8. If you ‘step back’ from this issue, how does it look different?
9. How do you judge your ability to reflect on this matter?
10. Do you notice that your feelings about it have changed over time – or in the course of writing this – suggesting that your own frame of reference has changed?
11. Are there ethical / moral / wider social issues that you would want to explore?

ANNEX C: Sample Grading Rubric for Reflection Journals[11]

MARKING RUBRICS	Excellent	Proficient	Average	Poor
Reflections: *Ability to integrate learning into real-world experiences and analyse issues with a critical attitude*	Ability to proficiently demonstrate reflection and deep thinking of acquired knowledge and concepts, and integrate them into different issues from wide range of perspectives (e.g. different contexts, cultures, disciplines etc.); creative solutions and critical thinking skills demonstrated in the writing	Showing satisfactory ability to relate acquired knowledge to previous experiences; demonstrating attempt to analyse the issues from a number of different perspectives	Includes description of events, and a little further consideration behind the events using a relatively descriptive style of language; no evidence of using multiple perspectives in analysing the issues	Only includes mere descriptions of theoretical knowledge; no reflection is demonstrated beyond the descriptions
Presentation: *Articulation and organization of ideas and perspectives*	Writing is well-focused; arguments or perspectives are precisely defined and explained; coherent flow in developing an insightful idea demonstrated	Arguments or perspectives are clearly stated; organized flow in writing but not deep enough to be very insightful	Arguments or perspectives are vaguely mentioned; the writing lacked an organized flow and the ideas were hard to follow	Do not show any original thinking or perspectives; chaotic in organization and presentation of ideas
Completeness: *Incorporation of the journal entries into a whole, demonstration of the learning process*	Concrete connections between journal entries into a whole; demonstrating clear steps in the developmental learning process	Journal entries can be generally connected; still able to observe how the student develops during the learning process	Weak connections between journal entries; development gained from the learning process is hardly observed	No connections between journal entries; The entries are mere descriptions of events rather than showing a sequence of learning steps

[11] Adapted from Written Communication VALUE rubric developed by ACCU (link: https://www.aacu.org/sites/default/files/files/VALUE/WrittenCommunication.pdf)

ANNEX D: Sample Peer Assessment Rubric[12]

Factor	Questionnaire Item	Scale
Presence	• How many days per week did you work on this project? • How many hours did you spend on the entire project in total (round to nearest hour)? • How much was each team member present? Also rate your own presence.	1 – Was not present at all 2 – Was sometimes present 3 – Was moderately present 4 – Was nearly always present 5 – Always present
Activity *Team member is actively involved in the project*	• How actively did each team member participate in the project? Also rate your own activity.	1 – Was not active at all 2 – Was somewhat inactive 3 – Was moderately active 4 – Was quite active 5 – Was very active
Eagerness *A positive feeling of wanting to push ahead with something. Reflects the attitude that team member takes towards the project, i.e. taking initiative and displaying a positive desire to get things done.*	• How eager was team member to participate in the course/project? Also rate your own eagerness.	1 – Was not eager at all 2 – Was a little eager 3 – Was moderately eager 4 – Was quite eager 5 – Was very eager
Commitment *Team member invests effort into carrying out planned tasks.*	• How committed was each team member to the course/project? Also rate your own commitment.	1 – Was not committed at all 2 – Was a little committed 3 – Was moderately committed 4 – Was quite committed 5 – Was very committed
Contribution *Reflects actual impact on the project, e.g. documentation, or other deliverables, or in the form of project management, customer communication, or support tasks.*	• How much did each team member contribute to the deliverables of the course/project? Also rate your contribution.	1 – Did not contribute at all 2 – Contributed a little 3 – Contributed moderately 4 – Contributed quite much 5 – Contributed very much
Group Dynamics *Each team member can influence the team spirit and the end result with their social behaviour*	• How did the group behaviour of each team member influence the meaningfulness of the course/project? • How did the group behaviour of each team member influence the quality of the project?	1 – Influence negatively 2 – Did not influence 3 – Influenced a little 4 – Influenced quite much 5 – Influenced very much

[12] Adapted from Fagerholm & Vihavainen (2013) (Link: https://www.computer.org/csdl/proceedings/fie/2013/9999/00/06685132.pdf)

ANNEX E: Sample Project Evaluation Form[13]

Company Sponsor's Evaluation of the Team's Performance

Project Title:	
Company:	
Name of student 1:	
Name of student 2:	
Name of student 3:	
Name of student 4:	
Name of student 5:	
Name of student 6:	

We thank you for sponsoring the project. We appreciate that you can provide us feedback on the team's performance in the project to complete our grading process. This form is to be returned to the SMU course manager.

Evaluation Criteria **All criteria to be graded on a scale of 0 to 3, where** **0 = poor 1 = good 2 = very good 3 = excellent**	**Score**
1. Was the team committed to the project?	
2. Did the team demonstrate the ability to understand the requirements and take initiative to get clarifications from the sponsors?	
3. When met with problems, was the team able to propose reasonable solutions and suggestions?	
4. Did the team demonstrate professionalism? 5. (Preparation for the meetings, communication during and between meetings, punctuality, demonstrates initiative and self-motivation, demonstrate maturity & reliability, etc.)	
6. Did the team deliver results of value to the sponsor company?	
Total (15 max)	

[13] Contributed by Associate Professor Gary Pan (SOA) and Professor Venky Shankararaman (SIS), instructors for ACCT 414 Intelligent Accounting Function course

Any other comments (e.g. comments on specific comments, any other comments on the team):

We deeply appreciate your sponsorship and hope that our students have indeed created value for your organization. We look forward to future project sponsorships from you.

ANNEX F: Sample Writing Rubric for Project Report[14]

Component	No/ Limited Proficiency	Some Proficiency	Proficiency	High Proficiency
1.Thesis/ Focus: (a) Originality	Thesis is missing.	Thesis may be obvious or unimaginative.	Thesis is somewhat original.	Develops fresh insight that challenges the reader's thinking.
2. Thesis/ Focus: (b) Clarity	Reader cannot determine thesis & purpose OR thesis has no relation to the writing task.	Thesis and purpose are somewhat vague OR only loosely related to the writing task.	Thesis and purpose are fairly clear and match the writing task.	Thesis and purpose are clear to the reader; closely match the writing task.
3. Organization	Unclear organization OR organizational plan is inappropriate to thesis. No transitions.	Some signs of logical organization. May have abrupt or illogical shifts & ineffective flow of ideas.	Organization supports thesis and purpose. Transitions are mostly appropriate. Sequence of ideas could be improved.	Fully & imaginatively supports thesis & purpose. Sequence of ideas is effective. Transitions are effective.
4. Support/ Reasoning (a) Ideas (b) Details	Offers simplistic, undeveloped, or cryptic support for the ideas. Inappropriate or off-topic generalizations, faulty assumptions, errors of fact.	Offers somewhat obvious support that may be too broad. Details are too general, not interpreted, irrelevant to thesis, or inappropriately repetitive.	Offers solid but less original reasoning. Assumptions are not always recognized or made explicit. Contains some appropriate details or examples.	Substantial, logical, & concrete development of ideas. Assumptions are made explicit. Details are germane, original, and convincingly interpreted.
5. Use of sources/ Documentation	Neglects important sources. Overuse of quotations or paraphrase to substitute writer's own ideas. (Possibly uses source material without acknowledgement.)	Uses relevant sources but lacks in variety of sources and/or the skilful combination of sources. Quotations & paraphrases may be too long and/or inconsistently referenced.	Uses sources to support, extend, and inform, but not substitute writer's own development of idea. Doesn't overuse quotes, but may not always conform to required style manual.	Uses sources to support, extend, and inform, but not substitute writer's own development of idea. Combines material from a variety of sources, including personal observation, scientific data, and authoritative testimony. Doesn't overuse quotes.

[14] Northeastern Illinois University (adapted from: Barbara Walvoord, Winthrop University., Virginia Community College System, University of Washington) https://www.csusm.edu/ids/course-design-and-instruction/assessment/rubrics/writing_rubric_Northeastern.pdf

ANNEX G: Sample Group Presentation Rubric[15]

Component	Sophisticated	Competent	Not Yet Complete
Content and Creativity	The presentation contained an abundance of material which clearly related to the main arguments. External research was used to justify arguments or solutions. The presentation of the material was original and presented in a creative way that held audience attention.	The presentation contained material to support the main arguments, but: 1) not all material clearly related to the main arguments; 2) limited external research was used to justify or solutions; and/or 3) the presentation of the material was appropriate, but only somewhat held audience attention.	The audience had to make considerable effort to understand the underlying logical and flow of ideas. Major aspects of the analysis or recommendations were absent. No external research was used to justify arguments or solutions. The presentation lacked creativity and did not hold audience attention.
Coherence and Organization	The argument and solution were clearly stated and the examples were appropriate. The transitions and flow were easy to follow. Slides were error- free and logically presented.	The argument and solution were clearly stated, but: 1) not all examples were supportive illustrations; 2) the transitions and /or flow were somewhat difficult to follow; and/or 3) slides were error-free and logically presented.	The argument, solution and examples were not clearly stated. The conclusion was unclear. The transitions and flow were not logical. Slides contained errors and a lack of logical progression.
Speaking Skills and Participation	Team members were poised and had clear articulation. Every team member spoke an n d participated at a very high and balanced level. Speakers demonstrated good volume, and eye contact. Enthusiasm and confidence was exuded. The presentation fit into the time allotted.	Team members were mostly audible and/or fluent on the topic, but:1) not all team members spoke and/or participated in a high and balanced level; 2) speakers demonstrated fair volume and/or eye contact was broken with audience; 3) light discomfort with public speaking was exuded; and/or 4) the presentation slightly went over the time allotted.	Team members were often inaudible and/or hesitant and relied heavily on notes. Speakers made distracting Gestures with little or no audience eye contact. A high level of discomfort with public speaking was exuded. The presentation went over the time allotted.

[15] Adapted from Grading Rubric for a Group Project in Information Systems, Carnegie Mellon University (Link: http://www.cmu.edu/teaching/assessment/examples/hss/tools/jeria.pdf)

ANNEX H: Sample Project Design Elements Checklist[16]

Project Design Elements	Description	Notes
Key Knowledge, Understanding & Success Skills	The project is focused on teaching students key knowledge and understanding derived from learning outcomes, and student success skills including critical thinking/ problem-solving, collaboration, and self-management.	Important success skills are explicitly targeted to be taught and assessed, including critical thinking/problem solving, collaboration, and self-management.
Challenging Problem or Question	The project is based on a meaningful problem to solve or a question to answer, at the appropriate level of challenge for students, which is operationalized by an open-ended, engaging driving question.	The central problem or question is framed by a driving question for the project so that students will need to gain the intended knowledge, understanding, and skills.
Sustained Inquiry	The project involves an active, in-depth process over time, in which students generate questions, find and use resources, ask further questions, and develop their own answers.	Inquiry is academically rigorous (i.e. students also gather & interpret data, develop and evaluate solutions or build evidence for answers).
Authenticity	The project has a real-world context, uses real-world processes, tools, and quality standards, makes a real impact, and/or is connected to students' own concerns, interests, and identities.	-
Student Voice & Choice	The project allows students to make some choices about the products they create, how they work, and how they use their time, guided by the instructor and depending on their age and PBL experience.	Students have opportunities to take significant responsibility and work as independently from the instructor as is appropriate, with guidance.
Reflection	The project provides opportunities for students to reflect on what and how they are learning, and on the project's design and implementation.	Students and instructor engage in thoughtful, comprehensive reflection both during the project and after its culmination, about what and how students learn and the project's design and management.
Critique & Revision	The project includes processes for students to give and receive feedback on their work (i.e. quality of their products and work-in-progress), in order to revise their ideas and products or conduct further inquiry.	-

[16] Adapted from Buckwheat Institute of Education (link: http://bie.org/object/document/pbl_essential_elements_checklist)

ANNEX I: Sample Project Design Template[17]

SMU-X Course: _____

Title of Project: _____

Element	Description	Details (to be provided by the Instructor)
Key Knowledge and Understanding	• Learning objectives • Knowledge needed by students to successfully achieve the learning objectives of the project	
Student Success Skills (to be taught and assessed)	• Skills needed by students to successfully achieve the learning objectives of the project, e.g. Critical Thinking, Problem-Solving, Collaboration, etc.	
Project Summary	• Includes student role, issue, problem/ challenge	
Driving Question	• How can/ How do/ Should/ Could/ What…. [Framing initial words] • We build/ create/ make/ design/ plan/ write/ propose/ decide… [action/ challenge] • for [audience/ purpose] e.g. real-world problem; for the organization/community	
Assessment Components	• Individual and team contributions, e.g. presentations, reflection journals, project report, self and peer assessments etc.	
Resources Needed	• People, equipment, materials etc.	
Reflection Methods	• How individual, team, and/or whole class will reflect during/at end of project), e.g. Reflection journal, focus groups, whole-class discussion, survey	

[17] Adapted from Buckwheat Institute of Education

ANNEX J: Process for adopting SMU-X Pedagogy for a Course

When beginning to think about converting their courses to SMU-X courses, instructors can consider the following steps:

Steps	Questions to think about
1. Analyse your learner population and determine their needs	• Which level are your students at? • Do they have industry attachment/ internship experiences? • What are their present levels of content mastery? • Are there any cultural needs or variations?
2. Identify appropriate activities (e.g. projects) for your learner population and course content	• Which aspects of your course content could the SMU-X pedagogy enhance? • What type of projects is appropriate for your course content and meets the students' cognitive development needs? • How do the projects meet course objectives or instructional goals? • How do the projects allow students to experience key concepts in the course? • How do the projects complement the program curriculum?
3. Identify potential issues when adopting SMU-X pedagogy	• When designing and modifying a course, will content have to be removed to make time for the projects? • Is there a need for mutual non-disclosure and confidentiality agreement? • How will industry partners be selected and how will problems with partners are dealt with? How do manage student expectations? • How will the assessment of different projects ensure the equitability of student grades?

Once instructors have decided to adopt SMU-X pedagogy for their courses, and having the identified the relevant industry partners, they can go on to think about designing the projects (usually done together with the clients), factoring the essential project design elements (Annex H) into consideration.

Annex K: Assurance of Learning Rubrics for SMU-X Courses

1. Rubrics for Assessing Inter-Disciplinary Knowledge and Skills (Graduate Learning Outcome: Disciplinary and Interdisciplinary Knowledge)

	Accomplished	Proficient	Developing	Beginning
Define the client's problem in an interdisciplinary context	Always reflects and uses analytical skills to clarify the client's problem	Frequently reflects and uses analytical skills to clarify the client's problem	Occasionally reflects and uses analytical skills to clarify the client's problem	Rarely reflects and uses analytical skills to clarify the client's problem
Draw on multiple disciplines involved in solving a real world problem	Always identifies and leverages existing knowledge that is acquired in specific disciplines to solve the client's problem	Frequently identifies and leverages existing knowledge that is acquired in specific disciplines to solve the client's problem	Occasionally identifies and leverages existing knowledge that is acquired in specific disciplines to solve the client's problem	Rarely identifies and leverages existing knowledge that is acquired in specific disciplines to solve the client's problem
Identify disciplinary knowledge and skills gap	Always identifies accurately the respective disciplinary knowledge and skills gap needed to solve the client's problem	Frequently identifies accurately the respective disciplinary knowledge and skills gap needed to solve the client's problem	Occasionally identifies accurately the respective disciplinary knowledge and skills gap needed to solve the client's problem	Rarely identifies accurately the respective disciplinary knowledge and skills gap needed to solve the client's problem
Approach to reduce disciplinary knowledge and skills gap	Always investigates ways for acquiring additional knowledge and skills to reduce skills gap needed to solve the client's problem	Frequently investigates ways for acquiring additional knowledge and skills to reduce skills gap needed to solve the client's problem	Occasionally investigates ways for acquiring additional knowledge and skills to reduce skills gap needed to solve the client's problem	Rarely investigates ways for acquiring additional knowledge and skills to reduce skills gap needed to solve the client's problem
Acquire relevant domain knowledge in an interdisciplinary context	Always acquires in-depth knowledge that contributes to solving the client's problem in an interdisciplinary context	Frequently acquires in-depth knowledge that contributes to solving the client's problem in an interdisciplinary context	Occasionally acquires in-depth knowledge that contributes to solving the client's problem in an interdisciplinary context	Rarely acquires in-depth knowledge that contributes to solving the client's problem in an interdisciplinary context

2. Rubrics for Assessing A Practical and Implementable Solution to a Real, Complex Problem

	Accomplished	Proficient	Developing	Beginning
Realistic	Comprehensive and consideration of contextual factors and practical constraints	Takes into account contextual factors and practical constraints, but with some minor gaps	Superficial consideration of contextual factors and practical constraints, with obvious key gaps	Simplistic position without acknowledgement of contextual factors and practical constraints
	Thoroughly addresses limitations and trade-offs in proposal	Addresses limitations and trade-offs in a satisfactory way	Simplified accounting of limitations and trade-offs, with some inaccuracies, omissions or errors	Addresses limitations and trade-offs in a perfunctory way or not at all
Logical Reasoning	Proposed solution is reasoned from empirical evidence and/or sound analysis	Proposed solution is, for the most part, reasoned from empirical evidence and analysis, but some logical gaps remain	Proposed solution alludes to some elements of reasoning from empirical evidence and analysis, but still contains obvious logical gaps	Proposed solution is poorly or illogically reasoned from empirical evidence and analysis
	Proposed solution in thoroughly justified as the best approach among possible approaches	Proposed solution is satisfactorily justified as the best approach among possible approaches	Proposed solution is not adequately justified as the best approach among possible approaches	No attempts to justify the proposed solution as the best approach among possible approaches

3. Rubrics for Assessing Adaptability (Graduate Learning Outcome: Interpersonal Skills – Collaboration) and Resilience[18] (Graduate Learning Outcome: Personal Mastery – Resilience and Positivity)

	Accomplished	Proficient	Developing	Beginning
Collaborative learning in a climate of ambiguity and changing priorities	Consistently and actively works towards group goal; willingly accepts and fulfils individual role within the group	Works towards group goal without occasional prompting; accepts and fulfil individual role within the group	Works towards group goal with occasional prompting	Works towards group goal only when prompted
Demonstrating flexibility and adapts readily to change	Shifts priorities in response to the changing demands of a situation; plans ahead but has alternative options in case things go wrong or alternate decisions are made	Shifts priorities in response to the changing demands of a situation; adjusts resources, tasks and schedule as needed	Looks for ways to make changes work rather than identifying why changes will not work	Clings to the original plan/process when circumstances change
Incorporating feedback	Always incorporates feedback from stakeholders to achieve significant progress	Frequently incorporates feedback from stakeholders to achieve progress	Occasionally incorporates feedback from stakeholders to achieve some progress	Attempts to incorporate feedback from stakeholders but only able to achieve little progress
Understanding, negotiating and balancing diverse views and beliefs of others[19]	Always achieve resolution of alternate, divergent, or contradictory perspectives so as to come up with a practical and implementable solution	Frequently achieve resolution of alternate, divergent, or contradictory perspectives so as to come up with a practical and implementable solution	Occasionally achieve resolution of alternate, divergent, or contradictory perspectives so as to come up with a practical and implementable solution	Acknowledges (mention in passing) alternate, divergent, or contradictory perspectives but unable to resolve the differences to come up with a practical and implementable solution
Persisting in finding necessary resources to accomplish goals	Stays on task no matter how difficult it is to find the answers to the problem; evaluates the use of a variety of strategies to solve the problem; searches for and draws on a wide range of resources	Stays on task when trying to find answers or solutions to problem; draws on available resources	Tries to complete tasks when the answers or solutions are not readily available, but gives up when task is too difficult; gets off tasks easily; draws on limited range of resources	Gives up easily and quickly on difficult tasks; is unaware of resources
Responding to setbacks	Always responds to setbacks positively by developing alternative approaches to determine the best course of action	Frequently responds to setbacks positively by developing alternative approaches to determine the best course of action	Occasionally responds to setbacks positively by developing alternative approaches to determine the best course of action	Responds to setbacks negatively

[18] Ref: College Unbound (n.d.). Lifelong Learning Competencies. Retrieved 21 March 2018 from https://2.files.edl.io/qCLnJaVfPjaABD4kLt2YK0hoRD2miiH3sVzewyZGYVEkZPsv.pdf

[19] On a cognitive level, perspective taking is related to "theory of mind" concepts, and it describes the ability to understand a state of affairs from a different spatial or psychological perspective' in
Hesse, F., Care, E., Buder, J., Sassenberg, K., & Griffin, P. (2015). A framework for teachable collaborative problem solving skills. In *Assessment and teaching of 21st century skills* (pp. 37-56). Springer, Dordrecht.