ASSESSMENT FOR ACADEMIC LEARNING DURING THE COVID-19 PANDEMIC

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ABSTRACT

The COVID-19 pandemic has caused the closure of university campuses around the world including RMUTT, Thailand. The on-site classroom sessions are replaced by full online learnings. One of the most challenging issues the teaching staff encountered is how to deal with the usual midterm and final examinations which normally take place on campus. This paper presents the results of the experiment focusing on an Assessment for Academic Learning with assessment activities which are designed and practiced with the aim to promote the students' learning. The experimental subjects are a Hydrology Engineering course at the agricultural engineering department and a Production Planning and Control course at the industrial engineering department. The objectives of the experiment are to implement self-, peer- and rubric assessment tools, observe perception changes on ourselves and our students, and provide feedback to assist students in improving their learnings. The methodology includes the implementation of a constructive alignment and a four-step teaching-learning-assessment process. An online survey was conducted to collect students' comments on the online teaching-learning-assessment activities. The results show positive changes in our students, fully engaging with the given task. The assessment tools involved more active participation from the students. The self-, peer-, and rubric assessment helps the student review their learnings, ask for clarification, prepare themselves for next classes, and improve quality of their individual and group assignments. The crucial points for successful online learning and assessment reflected from the students are self-management and time management, as well as a quick feedback from the teachers.

KEYWORDS

assessment for learning, peer feedback, self-assessment, Standards: 8, 11

INTRODUCTION

Assessment methods and requirements probably have greater influence on how and what students learn than any other single factor, (Boud, 1988). In the context of CDIO framework, Crawley et al. (2014) states the importance of learning assessments to support student and program success. This includes assessing the students' achievements from multiple and diverse sources, integrating teaching and assessment, so that the improvement of assessment also improves teaching. Berglund and Karltun (2016) shared their experiences in using several assessment methods to fulfil learning outcomes and encourage deep learning. This included objective tests, essays, case studies, problem-based assignments, professional practice, seminars, oral presentations, oral examination, reflection tasks and open-book examination.

Leong et al. (2016) publicized a systematic approach in enhancing students' self-directed learning and motivation at Singapore Polytechnic. At the same time, the institute provided faculty development programs to enhance teaching skills. One module is an Assessment for and of learning, in which the teacher should be able to design and implement formative and diagnostic assessments, design and implement summative assessment to record the students' achievement (Leong et al., 2016). Harlen (2005) suggested that the teacher should explain the purpose of summative and formative assessments to be used in the course, use formative assessment to express a sense of student's learning progress, provide feedback to help the students develop their learning further and support the development of students' self-assessment skills.

The COVID-19 pandemic has caused the closure of university campuses around the world including RMUTT, Thailand. The on-site classroom sessions are replaced by a full online learning. A number of literatures recommend ways to teach online and give feedback (Puffelen et al, 2018, Meikleham and Hugo, 2017, Lauritsen, 2017). When the teaching and learning activities take place, it is important that students receive guidance on how to study and work to meet the learning goals (Puffelen et al., 2018). Moreover, Meikleham and Hugo (2017) suggested that instructors who are considering implementing online components in their course delivery should consider creative ways to open informal channels of feedback.

How to enhance our students' learning with formative assessment and valuable feedback becomes a point of discussion in today's education. Black et al. (2004) has stated that formative assessment is an activity that provides information that teachers and learners can use as feedback in assessing themselves. Moreover, good feedback involves the teacher to facilitate the development of self-assessment, encourage dialogue around learning, clarify performance criteria and goals, provide opportunities to close the performance gap, deliver high quality of learning information, and encourage positive motivation, (Nicol and Macfarlane, 2006). Lauritsen (2017) researched on how the student experienced the quality of feedback on a digital platform with rubric criteria. The findings revealed that rubric criteria and feedback were helpful to the student. The students required more explanation of their mistakes as well as how to improve their work in the best way.

This paper presents a result of the experiment focusing on an Assessment for Academic Learning (AfAL) which the assessment activities are designed and practiced with the aims to promote the students' learning. CDIO Standard 11 states that assessment methods should address both disciplinary knowledge as well as personal, interpersonal, and system building skills. A variety of methods also allows for different learning styles and results in increased reliability and validity regarding the assessment process. Teaching and learning activities in 2 engineering courses are based on Active Learning concept (CDIO Standard 8)

The experiment objectives are:

1) Implement self- and peer-assessment tools as a part of formative assessment
2) Observe the change in the perception of assessment from ourselves (as teachers) and from our students.
3) Use the information to learn more about our students' learning and to improve our teachings.
4) Provide feedback to the student to help them improve their learnings.

METHODOLOGY

The authors have implemented the theory of Constructive Alignment (Biggs & Tang, 2011) since the adoption of CDIO at RMUTT in 2014. It becomes our routine when planning the course. Moreover, in order to close the loop to improve student learning, the authors implemented Suskie (2018)'s four-step teaching-learning-assessment process. Each step was explained below:

1) Establishing clear, measurable expected *outcomes* of student learning. Revised Bloom's Taxonomy (RBT) is used to define intended learning outcomes (ILOs) of the course and each chapter.
2) Ensuring that students have sufficient *opportunities* to achieve those outcomes with several active learning methods.
3) Systematically gathering, analyzing, and interpreting *evidence* to determine how well student learning matches our expectations.
4) Using the resulting information to understand and *improve* student learning.

Table 1 shows details on 2 engineering courses in the experiment.

Table 1. Details of Two Courses in the Experiment

Course Name	Production Planning & Control (PPC)	Hydrology Engineering (HE)
Department	Industrial Engineering	Agricultural Engineering
Student	Year 3	Year 3
Type of course	Mandatory 3 credits	Mandatory 3 credits
Length	15 weeks	15 weeks
Class size	Big (100-200 students)	Small (20-30 students)
ILOs	1) Forecast the future demand by using quantitative analysis 2) Aggregate plan and issue a master production schedule 3) Manage inventory by using deterministic and stochastic models 4) Generate a material requirement plan 5) Plan a short term schedule 6) Manage project using CPM and PERT techniques	1) Understand the hydrologic cycle 2) Understand the hydro-meteorology equipment and station 3) Realize the analysis of hydrological data 4) Understand relationship between rainfall and run off 5) Create the unit hydrograph 6) Create the IDF curve 7) Analyse flood frequency

This experiment requires us to meet, discuss and select and plan new formative assessment methods for self- and peer-assessment purposes. The selected assessment tools are listed in Table 2. The result from self- and peer assessment will be used to improve student learning. For teacher's assessment, we have determined a clear rubric in order to give valuable feedback for performance improvement. All observations and data are collected for comparing and discussing the results.

Changes during the Pandemic

Due to the COVID-19 situation in Thailand, the government announced a full online teaching and learning policy. RMUTT provides Microsoft Team and Moodle as default platforms available to instructors and students. However, the instructors can use other online platforms such as Google Classroom and Zoom Meeting. Even though the classes have changed from on-site to online, the teaching concept, learning outcomes and active learning activities remain.

Table 2. Formative Assessment Tools for the Experiment

Formative Assessment Tools	Description	Online Tools
Traffic light	Self-assessment Use green, yellow and red to reflect how well they understand the topic.	Students check their self-assessment on Google form or MS form
3 Stars 2 Questions	Peer-assessment After listening to a group presentation, the listeners give feedback to the presenters Write 3 things their peers did good jobs Write 2 things for things that their peers should have done or should improve in the future	Students post their comments on Moodle or MS Team
Rubric	Teacher's feedback will be given regarding the rubric which is given along with the assignment	Teachers type feedback on Moodle or MS Team

One of the most challenging issues the teaching staff have encountered is how to deal with the usual midterm and final examinations which normally take place on campus. For the PPC course, the instructor replaced on-site examinations with 2 group projects. For group projects, both formative and summative assessment were used to evaluate students' learning and performance. Table 3 displays the grading criteria between on-site and online classes.

Table 3. On-site and Online Scoring Criteria for PPC Course

Assessment	On-site (Regular) Class		Online Class	
Summative Assessment	Midterm examination Final examination	30% 30%	Group project 1 Group project 2	20% 20%
Formative Assessment	Individual assignment Group work	10% 20%	Group project 1 Group project 2 Individual assignment	10% 10% 40%
Class Participation		10%		0%
Total		100%		100%

For the Hydrology Engineering course, the summative assessment (midterm and final examinations) reduced from 60% to 50%. The assignment with formative assessment increased from 10% to 20% as shown in Table 4.

Table 4. On-site and Online Scoring Criteria for HE Course

Assessment	On-site (Regular) Class	Online Class
Summative Assessment - Midterm examination - Final examination	 30% 30%	 25% 25%
Laboratory	25%	25%
Formative Assessment - Report - Presentation	10%	20%
Class Participation	5%	5%
Total	100%	100%

Noted that, this experiment focused on the effect of formative assessments.

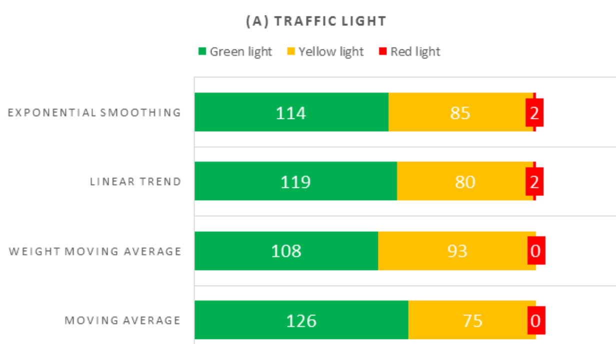
RESULTS OF THE EXPERIMENT

Experiment 1: Traffic Light (Self-Assessment)

Course: Production Planning and Control

Student groups studied the different forecasting methods using a Jigsaw classroom as an active learning technique, followed by working in groups to solve problems. After the class, the students did a simple self-assessment on how well they think they achieved the ILOs by using a traffic light technique. The green light means “I got it!” representing a full understanding of the content and being able to achieve the ILOs. The yellow light means “There are some doubts' ', showing a partial understanding of the content, needing some clarification or reviewing the materials. Lastly, the red light represents “Cannot do it at all”, requiring further support. There was also an open-ended question for the student to type-in which topics that they need clarification or guidance.

Figure 1 shows the result of experiment 1. Figure 1 (A) demonstrates reflections of a total of 201 students, 2 students cannot do the exponential smoothing and 2 students cannot do the linear trend equation methods. The open-ended question “How can I help you?” allows the student to type-in what they are confused about and what they need to help them improve their learning. Figure 1 (B) shows that 6 of them need more explanations, a step-by-step calculation on both forecasting methods. Five students said they would need to go back and review the materials again. Four students were confused which methods to apply, while 2 students needed more examples. One student asked how to answer correctly on a rounded decimal.



(B) “HOW CAN I HELP YOU?”

Open-ended answers	Frequency
I need more explanation on how to calculate step by step for Linear Trend Equation and Exponential Smoothing.	6
I will go back and review the material again.	5
I confused which method to use.	4
I need more examples.	2
How to answer correctly with rounded decimal.	1

Figure 1. Result of Using a Traffic Light Technic

Course: Hydrology Engineering

Week 4 topic was “Rainfall Data Analysis”. After finishing the class, the student should be able to create an Intensity Duration Frequency curve and design a reservoir and drainage system. During class time, the students worked in groups to analyze the consistency of rainfall, calculate the rainfall return period, and create the curve. Then the student designed a reservoir and drainage system. A Traffic light technique was used for a self-assessment after the class. All 20 students marked a yellow light which means partly understanding with some doubts. There were no green lights or red lights selected. After getting the result, the instructor asked which part the students needed more clarification, allowing the instructor to review the topic again the following week, giving additional assignments for the student to practice.

Our reflection on the traffic light was that it enabled instant feedback on how well the students see themselves at the end of the class. It was an easy self-check with a quick result. The instructor can provide support right away by answering the questions or reviewing on the specific topic. Moreover, after class support can be video clips that are available online or additional exercise for self-studies.

Experiment 2: 3 Stars 2 Questions (Peer Assessment)

Course: Production Planning and Control

At the end of chapter 1, the students presented their group work to their peers. Each group chose their own business, collected historical sales data, implemented forecasting methods, calculated the forecast errors, and finally suggested which forecasting method was the best suitable for their business.

Course: Hydrology Engineering

Towards the end of the semester on week 10, the topic is “Flood Frequency”. The student should be able to analyze the flood frequency and propose solutions for flood protection. Six groups were assigned to study 6 different models, submit reports and prepare oral presentations.

After each presentation, the audience gave a peer feedback using the “3 stars 2 questions” technique. For 3 stars, they wrote 3 things that they think their peers did well. For 2 questions, they gave comments on what to improve in the future. Figure 2 displays an example of a peer feedback using 3 Stars 2 Questions technique.

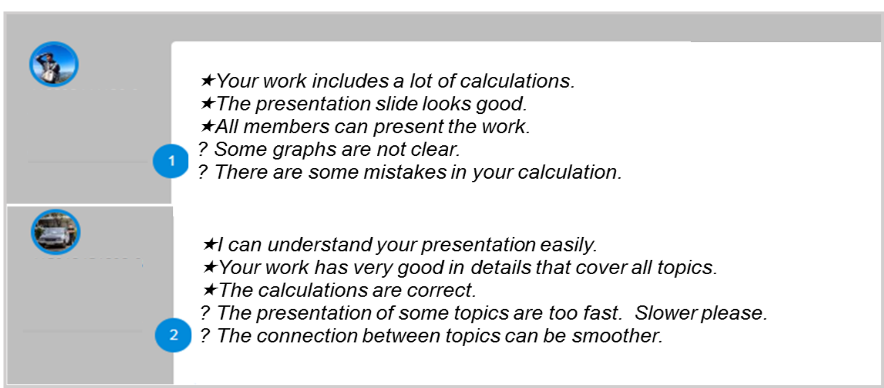


Figure 2. An Example of 3 Stars 2 Questions Peer Feedback

Our reflection on the 3 stars 2 questions method was that it was an easy-to-use peer feedback system for the students. The instruction was given before the presentation started. Since the listeners need to type-in the feedback right after the presentation, they highly focused on their peer’s presentation and jotted down interesting points. After reading the feedback, we were impressed with the high quality of feedback that the students can utilize to improve their works later on.

Experiment 3: Rubric (Instructor Assessment)

Course: Production Planning and Control

For group assignment, a rubric criteria was given along with the instruction. So the students knew what the teacher expected from their works. Table 3 demonstrates a rubric criteria for the instructor assessment.

Table 3. Rubric for Instructor Assessment

Level	Criteria A: Understanding, Inquiring, Designing	Criteria B: Investigating, Communicating, Evaluating
Excellent	• Use correct formula and perform correct calculation perfectly. • Show a systematic and complete problem solving process. • Make a complete summary with suggestions.	• Use correct engineering language frequently. • Present appropriate mathematical data frequently. • Communicate a complete problem solving process. • Illustrate data with suitable reasons frequently. • Reflect their own work and make suggestion for future improvement.
Substantial	• Use correct formula and perform correct calculation mostly. • Show a systematic and problem solving process. • Make a summary with suggestions.	• Use correct engineering language. • Present appropriate mathematical data. • Communicate a problem solving process. • Illustrate data with suitable reasons. • Reflect their own work substantially.
Adequate	• Use correct formula and perform correct calculation sometimes. • Show a problem solving process. • Make an adequate summary.	• Use appropriate engineering language. • Present data mathematically. • Communicate proper problem solving process. • Illustrate data with adequate reasons. • Reflect their own work.
Limited	• Use formula and perform calculation with difficulties. • Show limited problem solving process. • Make a limited summary.	• Use partly engineering language. • Partly present data mathematically. • Communicate limited problem solving process. • Illustrate data with limited reasons. • Partly reflect their own work.
Incompetent	• Cannot use formula and perform calculation. • Have difficulty in problem solving process. • Cannot make a summary.	• Cannot use partly engineering language. • Cannot present data mathematically. • Cannot communicate a problem solving process. • Illustrate data without reasons. • Cannot reflect their own work.

After the student submitted their report and excel spreadsheet files, the instructor gave feedback and comments based on the rubric criteria. After receiving the feedback, the students had 2 weeks to correct and improve their work. The instructor, then, graded the group work based on the same rubric criteria. Figure 3 shows an at least 1-level improvement of the quality of the student's work after receiving the teacher's comment.

Course: Hydrology Engineering

While the students used 3 stars 2 questions to give peer-feedback, the instructor assessed the student work with a 5-scale rubric. The scale was 5-excellent, 4, substantial, 3-adequate, 2-limited and 1-incompetent.

Our reflection on the assessment with rubric criteria was that it was time consuming, but was worth it. The instructor was able to make a clear evaluation of the achievement of ILOs. Additionally, feedback and comments on the good points and areas for improvement played a vital part in supporting the students' learning. As seen in the 2nd submission, it confirmed the effectiveness of rubric and constructive feedback with great improvements on students' works.

Group Name	SUBMISSION 1		SUBMISSION 2 (After receiving feedback)	
	Criteria A: Understanding, Inquiring, Designing	Criteria B: Investigating, Communicating, Evaluating	Criteria A: Understanding, Inquiring, Designing	Criteria B: Investigating, Communicating, Evaluating
Top Planning	Limited • Incorrect use of formula • Incorrect in steps of calculations • Not enough evidence for conclusion	Limited • Limited engineering reasoning and investigation • Limited communication and evaluation	Substantial • Correct use of formula and calculation • Correct calculations with systematic problem solving process	Substantial • good engineering reason and investigation • good communication and evaluation
Banana	Limited • Incorrect use of formula • Incorrect in steps of calculations • Not enough evidence for conclusion	Adequate • adequate engineering reasoning and investigation • adequate communication and evaluation	Adequate • Fair use of formula and calculation • Fair calculations with some mistakes	Substantial • good engineering reason and investigation • good communication and evaluation
Mission complete	Adequate • Fair use of formula and calculation • Fair calculations with some mistakes	Substantial • good engineering reason and investigation • good communication and evaluation	Substantial • Correct use of formula and calculation • Correct calculations with systematic problem solving process	Substantial • good engineering reason and investigation • good communication and evaluation
I believe I can fly	Limited • Incorrect use of formula • Incorrect in steps of calculations • Not enough evidence for conclusion	Limited • Limited engineering reasoning and investigation • Limited communication and evaluation	Adequate • Fair use of formula and calculation • Fair calculations with some mistakes	Adequate • adequate engineering reasoning and investigation • adequate communication and evaluation
Horizon	Substantial • Correct use of formula and calculation • Correct calculations with systematic problem solving process	Adequate • adequate engineering reasoning and investigation • adequate communication and evaluation	Excellent • Complete use of formula and calculation • Completely correct calculations with systematic problem solving process • Make a correct conclusion	Substantial • good engineering reason and investigation • good communication and evaluation

Figure 3. Example of Student's Work Improvement after Receiving the Feedback

DISCUSSION

The formative assessment tools that we experimented involved more active participation from the students. We experienced positive changes in our students to fully engage with the given assessment tasks. They used the self- and peer- assessment to help them review their learnings, ask for clarification from peers or teachers, prepare to study for the next session, improve the quality of their individual and group work. Moreover, they had opportunities to develop self-assessment skills.

For ourselves as teachers, we are more attentive and care more to our student's reflections on their learnings. Our perspectives changed gradually along the process. We focused more on how we can support their learnings and achieving the intended outcomes, rather than getting high scores in the examination. We concern more on the on-going process of learning, not only at some point of the semester such as midterm and final summative assessment. When changing from numerical score which represents judgment to text comments, we found that qualitative feedback from the formative assessment was valuable. These experiments allowed us to use the obtained data more effectively to improve our teachings, search for additional resource materials, communicate openly and more often with our students, as well as, help them overcome their struggles.

The effectiveness of the experiment was discussed within 3 criteria as following:

1) Accessibility
   Online platforms and Learning Management System provide user friendly and ready-to-use quiz, template, exit survey, self-assessment, peer-assessment and teacher feedback. It yielded satisfied accessibility to everyone. The data can be preliminary accumulated and analyzed instantly. The peer comment and teacher assessment can be accessed easily.
2) Usability
   Before letting the student perform the assessment, the instructors explained clearly the objectives of each tool, how to do the task, the expectation of receiving critical feedback. We found that the student followed the instruction eagerly and were able to use the assessment tools successfully.
3) Measurability
   Both quantitative and qualitative data in the result section provide evidences the achievement of the experiment's objectives.

CONCLUSION

During this tough time of the pandemic, the authors implemented the Assessment for Academic Learning concept in which the assessment activities are designed and practiced with the aims to promote the students' learning.

To sustain this change, the authors will continue implementing the formative assessment tools in these 2 courses, and to other courses that we will teach in the future. For running the same courses, we may see similarities and differences of the outcomes with different cohorts of students. We plan to try new formative assessment tools and repeat this type of a small experiment together. Future works can expand to comparing the result from changing examination to another type of summative assessment.

In conclusion, the objectives of the experiment were accomplished. It revealed a successful implementation of online tools for self-assessment, peer-assessment, and rubric criteria for teacher assessment. The authors observed changes in the perception of assessment on both teachers and students. The information obtained from the experiment was discussed to understand our student's learnings and improve our teachings. Last but not least, the students used feedback and comments to improve their learnings and increase the quality of their work.

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http://hplengr.engr.wisc.edu/Rubric_Presentation.doc

BIOGRAPHICAL INFORMATION

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