INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 12, Issue 2, (2023) E-ISSN: 2226-6348

Student Performance for Pre-requisite Courses ECW 231 and ECW 241 at Undergraduate Level among Civil Engineering Programme at UiTM Pasir Gudang

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v12-i2/17171 DOI:10.6007/IJARPED/v12-i2/17171

Published Online: 30 June 2023

Abstract

Diploma in Civil Engineering (EC110) being offered since 1967 by UiTM. Graduate should be able to possess relevant technical knowledge and skill to ensure the competency upon graduation. One of the comprehensive steps in providing a sustainable curriculum by UiTM is student's knowledge profile is aligned with the relevant course code via outcomes based educations that addressing 12 programmed outcomes. Meanwhile, program structured is designed to help students to scaffold the knowledge from lower difficulties level to higher order of thinking order in solving the well-defined problem as stated by Dublin Accord. Therefore, the pre-requisite course being introduced to prepare students for better understanding in certain fundamental knowledge before move to advanced phase of knowledge. ECW 231 being offered during semester 3 and considered as pre-requisite course for ECW 241 offered at upper semester. From result it shows that student scored slightly better in ECW 231 compared to ECW 241 in terms of grade and programme outcomes attainment. This finding is strengthen by survey that being conducted for 33 respondents in UiTM Campus Pasir Gudang. It is viewed that, students is agreed that pre-requisite subject help them to reinforced the basic knowledge before proceed to application subject at upper semester.

Keywords: Engineering Education, Water Engineering, Student Performance, Pre-Requisite, Student Perception, Fundamental Knowledge.

Introduction

Faculty members face significant challenges in challenging students to recall key principles from previous courses and incorporating that content into subsequent courses. True curricular integration is critical in instructional planning, and it is a professional obligation for faculty members who are involved in instructional design. During instructional design, course material is specifically selected from a variety of subject areas to emphasise a

particular concept or topic. Curriculum integration necessitates that students demonstrate knowledge, skills, and attitudes that extend beyond previously taught content or concepts to those currently taught, as well as how the concepts/content apply to future curriculum content (Muller et al., 2008).

A pre-requisite is a specific course or subject that must be completed before proceeding to the next grade level. Some courses need students to demonstrate that they have finished a similar course in the same or a related subject at a lower grade level in order to be accepted. Pre-requisites are often lower grade level courses in the same or a related field. At all educational levels, pre-requisites are frequently used to gauge students' readiness and comprehension. Pre-requisite courses are generally understood by institutions to be essential skill sets or competences that must be proven before taking a course that calls for basic knowledge. By completing a pre-requisite for a course, students are demonstrating that they are prepared to enroll in and complete the course, which typically depends on previously acquired knowledge based on prior academic performance.

Pre-requisite courses are frequently utilised at the universities and college undergraduate level to assess knowledge and evaluate if a student is prepared to progress to the next level of their academic career. This is significant for both the course and the learner. Enrolling in a course for which the pre-requisite has not been satisfied can put the student at risk of failure and interfere with other course participants' ability to learn. Many institutes of higher learning additionally impose graduation requirements, which may include courses unrelated to the student's major or minor degree. Pre-requisites are an important element in the development of curriculum for courses in which student success is heavily reliant on previously acquired knowledge or abilities. However, efficient utilisation of requirements necessitates striking a balance among a number of opposing aspects.

Student Perceptions on Pre-requisite Courses

Student perception and interest are two factors that can influence learning. A good impression is created by a positive perception, which can also spur interest in a task and the person will act more sincerely as their level of interest rises. The student perceptions are crucial in assessing a pre-requisite course's significance and effectiveness. This study will investigate on how students' perception of the pre-requisite courses relates to their academic performance. There is evidence from earlier literature that students typically have negative perceptions of pre-requisite courses. These perceptions are likely to influence students' attitudes towards learning and, as a result, their performance. As a result, it is essential to investigate the relationship between students' perceptions and performance.

Student perceptions on pre-requisite coursework can vary depending on a few different factors. Some students may feel that the pre-requisite coursework is necessary in order to ensure that they are prepared for the rigors of the higher-level coursework. But other students might believe that skipping the pre-requisite coursework is beneficial and that starting with the more advanced courses would be more beneficial. However, other students regard pre-requisite courses as an essential component of their education and view them as a necessary stepping stone to more difficult coursework. Regardless of individual student perspectives, it is clear that pre-requisite courses play an important role in preparing students for success in their chosen field of study.

Pre-requisite Courses for Diploma in Civil Engineering (EC110) Program in UiTM

According to the *Peraturan Akademik Diploma dan Sarjana Muda UiTM (Pindaan 2021 Bil. 1)*, pre-requisite courses for Diploma in Civil Engineering (EC110) program have been established by the Study College/Faculty/Academic Center/UiTM Branch and must be completed or passed in order for students to enroll in courses at the subsequent level. **Table 1** shows the pre-requisite courses for Diploma in Civil Engineering (EC110) Program based on Study Plan 7297 (ID Plan 7297). This ID plan has been used by students in the September 2020 semester. The total number of courses needed for a student to complete the pre-requisite courses is 14 (fourteen).

The pre-requisite code that has been established is crucial for students because they must pass it in order to take the relevant code the following semester. The student is not allowed to register for the relevant code in the following semester if they default or fail the pre-requisite code. Moreover, there are codes that serve as pre-requisites for several course codes. As a consequence, students will have to take more course codes and extend their study period. For instance, as shown in **Table 1**, the course code for Fundamental of Physics becomes a requirement for the course codes for Solid Mechanics (Semester 2) and Fluid Mechanics (Semester 3). Furthermore, students must pass the Basic Structural Analysis in Semester 4 in order to pursue the Structural Concrete & Steel Design and Civil Engineering Design Project course codes in the final semester (Semester 5). If they fail the pre-requisite code, they have to extend their studies.

This paper will concentrate on the performance of students in the Hydraulic (ECW 241) course and the pre-requisite course, Fluid Mechanics (ECW 231). Aside from that, this paper will focus on student perceptions of a pre-requisite course (ECW 231) that must be completed before enrolling in a high-level course (ECW 241) related to the pre-requisite course. According to **Table 1**, in order to enroll in Hydraulics (ECW 241), students must first complete or pass the pre-requisite course Fluid Mechanics (ECW 231). The requirement is based on the Hydraulics syllabus content, where some topics are related to the Fluid Mechanics course. This will be discussed in greater detail in this paper.

Table 1
EC110 – ID Plan 7297 (intake September 2020)

Semester	NO	Course	Pre-requisite
2	1	Integrated Language Skills 2	Integrated Language Skills 1
	2	Solid Mechanics	Fundamental of Physics
	3	National Kesatria II	National Kesatria 1
	4	Calculus II for Engineers	Calculus 1
3	1	Integrated Language Skills 3	Integrated Language Skills 2
	2	Fluid Mechanics	Fundamental of Physics
	3	National Kesatria III	National Kesatria II
	4	Further Mathematics for Engineers	Culculus 1
4	1	Hydraulics	Fluid Mechanics
	2	Basic Structural Analysis	Solid Mechanics
	3	Soil Engineering Laboratory	Soil Mechanics
5	1	Soil Engineering	Soil Mechanics
	2	Structural Concrete & Steel Design	Basic Structural Analysis
	3	Civil Engineering Design Project	Basic Structural Analysis

Literature Review

Numerous research on the significance or worth of pre-requisites in the total package of best practises in teaching and learning have been conducted. These have emphasized the connection between the performance of students in basic and advanced courses. For example, an observation study was performed on an introductory mechanical engineering course in which students enrolled during their first semester of engineering work and the impact of a first exam with a passing grade average or lower on a student's performance in the course, they found that students were motivated to obtain the desired grade result according to poor performance in the first exam (Boyle & Hashemi, 2023).

The contribution of physics and mathematics to engineering performance has been a subject of debate up to this point. A study was found that a foundation in both mathematics and physics is necessary for enrolling in engineering courses. In comparison to the association between physics and first-year static mechanics, the correlation between mathematics and those two subjects is more significant (Basaruddin & Ewa, 2017). In Engineering, a topic that necessitates a substantial amount of mathematical knowledge, is observing a continual change in students' prior understanding of mathematics. Results from the study shows that a mathematics diagnostic test is one of the best indicators of future performance in addition to being valuable for learning about a student's prior knowledge (Lee, Harrison, Pell & Robinson, 2008). A findings indicate a significant positive correlation between prior mathematics achievement and engineering courses and also a strong positive relationship between performance in an engineering course and its pre-requisite course (Kamal et al., 2016)

The following study examines the effectiveness of business statistics as a pre-requisite course screening approach to increase student success levels in Principles of Finance is one element that has an impact on students' success in introductory finance (Baard & Watts, 2006). Establishing pre-requisites is essential for effective curriculum creation and student course completion on schedule and more prepared students who could operate at higher levels of procedural prior knowledge and had a more solid foundation of prior knowledge

went on to excel in the course (Orynbassar et al., 2022). The performance of lower level heat transfer subject are comparable to subsequent heat transfer subject and demonstrated that if the students wish to succeed in heat transfer, the foundation must be strong (Kadirgama, Noor, Rejab, Rose, Zuki, Sani, Sulaiman, Bakar Ibrahim)

The next study was conducted by Krause-Levy et al (2020) to examined students' grades in pre-requisite courses and discovered a significant correlation between those grades and how well they did on a test of their prior knowledge and verified that the grades in the pre-requisite courses have a substantial correlation with the grade in the subsequent course, indicating that the grades in the earlier courses provide some insight into the students' comprehension of those subjects. Other than that, a study was identify that graduate students' performance in an Organizational Behavior (OB) course was affected by a pre-requisite management course and discovered a positive correlation between later performance in the organisational behaviour course and the grade received for the pre-requisite (McMillan-Capehart & Adeyemi-Bello, 2008)

Krause-Levy et al (2020) examined students' grades in pre-requisite courses and discovered a significant correlation between those grades and how well they did on a test of their prior knowledge and verified that the grades in the pre-requisite courses have a substantial correlation with the grade in the subsequent course, indicating that the grades in the earlier courses provide some insight into the students' comprehension of those subjects.

The effect of strengthening pre-requisite knowledge on student learning outcomes, as well as students' perspectives on improving pre-requisite knowledge have studied by (Siregar & Novalinda, 2020). The study's findings indicate that strengthening pre-requisite knowledge has a significant impact on student learning outcomes. Simultaneously, the results of the questionnaire distribution revealed a positive attitude towards strengthening pre-requisite knowledge in comparison to previous learning. This medium indicates that improving pre-requisite knowledge influences students' achievement, an increase in achievement, and positive student perspectives on improving pre-requisite knowledge.

Methodology

This study aimed to analyzed student's performance for ECW 241 together with pre-requisite courses which is ECW 231 and to investigate student's perception towards both subjects. The methodology adopted for this research was by conducting structured survey among students that had taken both courses.

Participants

Using a structured questionnaire, 33 students were selected to participate in the survey. The selected students are from semester October 2020-Feb 2021intake. This batch of students were already taken both subjects during their semester 3 examination for ECW 231 and semester 4 examination for ECW 241. Since ECW 231 is a pre-requisite course for ECW 241, only students who passed both courses were selected as participants as their results for both courses will be analyzed for this research. Student's performance will be study by analyzing student's grade and PO attainment to see whether the pre-requisite course is helping them to understand and do better for the next course. The course outcome for ECW 231 are at the end of the course student should be able to explain basic knowledge of fluid mechanics and formulate engineering problems related to fluid mechanics as the syllabus for ECW 231 is more to basic and fundamentals in Fluid Mechanics where students need to understand the concept and theory by applying knowledge of mathematics, natural science

and engineering fundamentals. It is very important to compare result for each students in both courses to see whether students can understand what they learn in ECW 231 course and apply it in ECW 241 course. The syllabus for ECW 241 is the continuation from ECW 231 and more to the application of basic and fundamentals in Fluid Mechanics.

Survey

The set of questionnaire for the survey had three main sections with total number of 25 questions. First section is demographic question, second section is student's perception and third section is suggestions for improvement. In section A which is demographic question, the participant will be ask regarding their gender, age, semester their currently in and examination grade for both courses.

In section B, the questions are more related to student's perception regarding the courses. The aim of this survey is to make a better understanding on how student's feel about both courses, which courses are easier to understand, are students can relate what they have learned in ECW 231 to ECW 241, are the able to apply the fundamentals of fluid mechanics in Hydraulics, did their grade reflect their understanding, do they think that their understanding in Fluid Mechanics will affect their performance in Hydraulics and can they apply the knowledge of these courses to solve civil engineering related problems.

Other than that, from the survey, it also can be identified whether the pre-requisite course is helping them to perform better during the next course, do the aware of the knowledge they have gained from these courses can be applied to a wide range of civil engineering jobs, the difficulties and struggle that students need to adapt, how much time do they spend to make revision for the courses per week and preparation for final examination and student's opinion regarding the setting of making Fluid Mechanics as a pre-requisite course for Hydraulics.

Students also being ask if there is any improvement than can be done to elevate student's grade regarding the syllabus contents, assessment and method of teaching and learning in section C of the survey. The result from the survey for each student will be analyzed and compare with their results for both courses to see whether the result from the survey is reflected with student's grade. **Table 2** shows the question provided for the survey.

Table 2
Survey Questions

Section	Question
Section A Demographic Question	1. What is your gender?
	2. Age
	3. Part
	4. Examination result for Fluid Mechanic (ECW 231)
	5. Examination result for Hydraulics (ECW 241)
Section B Student's Perception Regarding the Courses	1. A student who passes Fluid Mechanics will be able to understand Hydraulics better.
	2. In your opinion, which courses are easier to understand?
	3. I can relate what I have learned in fluid mechanics to hydraulics.
	4. I am able to apply the fundamentals of Fluid Mechanics to Hydraulics.
	5. According to your Fluid Mechanics result, did your grade reflect your understanding?
	6. According to your Hydraulics result, did your grade reflect your understanding?
	7. Do you think that your understanding of Fluid Mechanics affected your performance in Hydraulics?
	8. I can apply the knowledge of these courses to solve civil engineering related problems.
	9. I am aware of the knowledge I have gained from these courses can be applied to a wide range of civil engineering jobs.
	10. What are the difficulties during taking the courses?
	11. How much time do you spend every week on revision for Fluid Mechanics?
	12. How much time do you spend every week on revision for Hydraulics?
	13. How much time do you spend on Final Examination revision for Fluid Mechanics?
	14. How much time do you spend on Final Examination revision for Hydraulics?
	15. In overall, do you agree Fluids Mechanics is pre-requisite course for Hydraulics?
Section C Suggestions For Improvement	1. Syllabus contents
	2. Assessment
	3. Methods of teaching and learning

Finding and Discussion

This study was conducted during semester October 2022 -January 2023 (20224) which consists of 33 respondents of students from Semester 5 that have seated for ECW 231 and ECW 241 courses in UiTM Pasir Gudang Campus. There are 16 males and 17 females in this study, and most of them are 20 years old. According to **Fig. 1**, students scored slightly better for ECW 231 compared to ECW 241. The highest grade for ECW 231 was A, while for ECW 241

it was A- and all student has passed ECW 231 and 2 students fail ECW 241 for that session. Majority of student score grade B during ECW 231 and B- for ECW 241.

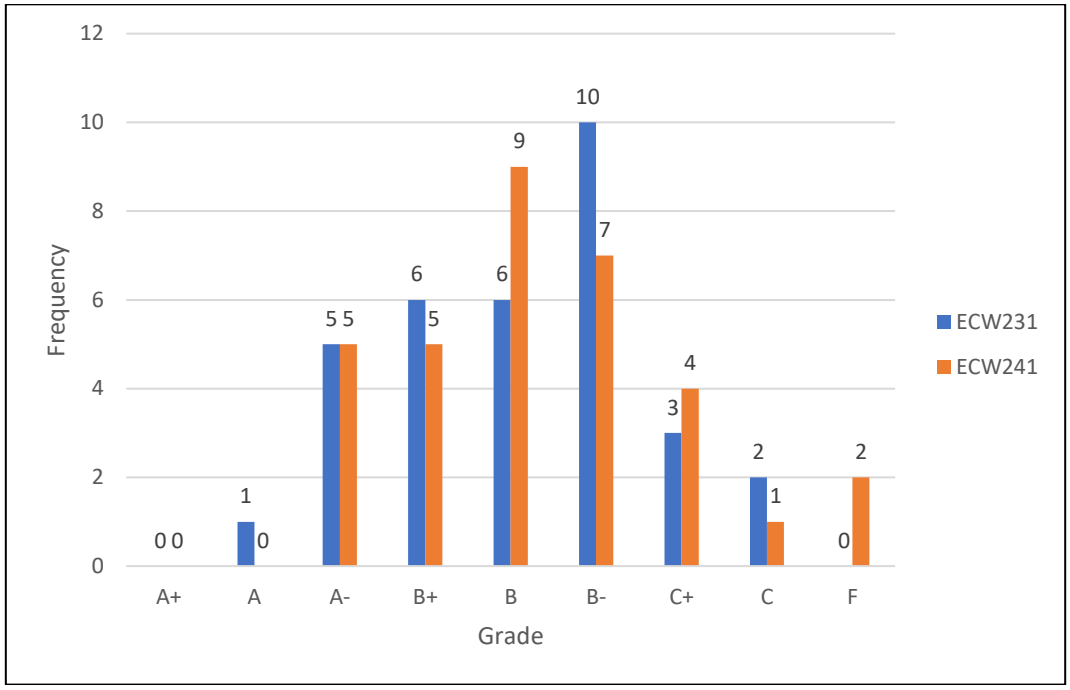

Fig. 1 Student attainment based on grade for ECW 231 and ECW 241

Meanwhile, **Fig. 3** shows the attainment of programme outcomes (POs) for ECW 231 and ECW 241. Both subjects is measuring the same POs which required students to fulfil PO1 (fundamental knowledge) and PO2 (problem analysis). It is found that, students performed better for PO1 during ECW 231 compared to ECW 241, which is 83% and 66% respectively. Although, the result shows the decreasing trend on fundamental knowledge at upper semester, but it is acceptable because the level of difficulties of PO1 is increasing parallel to semester. This result is strengthening by student response that shows that most students find ECW 231 easier than ECW 241. Among respondents, more than half (54.5%) find ECW 231 easier to understand than ECW 241 as in **Fig. 2**. The reason for this is that ECW 231 in civil engineering is a fundamental course, whereas ECW 241 exposed student toward application in engineering that provides students with greater depth of knowledge on the subject.

However, for PO2 students scored slightly higher during ECW 241 compared to ECW 231. ECW 241 recorded 61% meanwhile ECW 231 recorded 60% for PO2 as in **Fig. 3**. Indirectly, it shows that student development on thinking skill for problem solving is increasing at upper semester compared to fundamental class. In the previous semester, students were exposed to questions that required thinking skills to analyse the problems. The students of the upper semester are already familiar and understand how to apply higher thinking skills in analysing problems in assessments.

As survey has conducted among students using rating score from 1 to 5 for expressing the level of agreement on statement given in questionnaire. Score 1 is represent strongly disagreed and 5 is strongly agreed. Based on **Fig. 4**, 48.5% student voted agreed, and 18.2% student strongly agreed that ECW 231 should be pre-requisite course for ECW 241. This finding being supported by statement on a student who passed ECW 231 will be better able to understand ECW 241 , where more than 70% of respondents giving rating 4 and 5 respectively. In addition, students found out they can relate the knowledge in ECW 231

toward ECW 241 at upper semester, where the level of agreement of agreed and strongly agreed is 63.6%. However, the findings recorded 63.6% of student giving fair score rating on applying knowledge from ECW 231 to ECW 241. It is viewed that, students having slightly difficulties in applying the knowledge from ECW 231 in ECW 241. This statement is reflecting the student attainment on student grade performance as in **Fig. 1**. More than half of students (57.6%) perceived that they can apply the knowledge from both courses to solve civil engineering problem related problem at fair level. This is because, these students are enrolling the subject during second year of diploma level and the exposure to real engineering problem is limited compared to third year students. But the level of agreement on awareness of both courses can be applied in civil engineering job is increasing, where the result recorded 45.5% and 15.2 % agreed and strongly agreed, respectively.

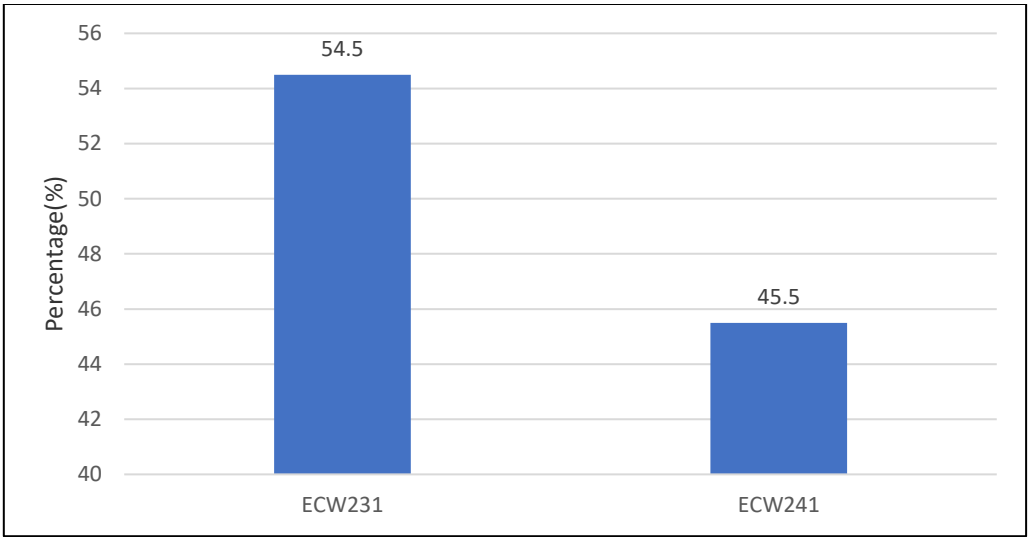

Fig. 2 Student opinion on level of easiness of course code.

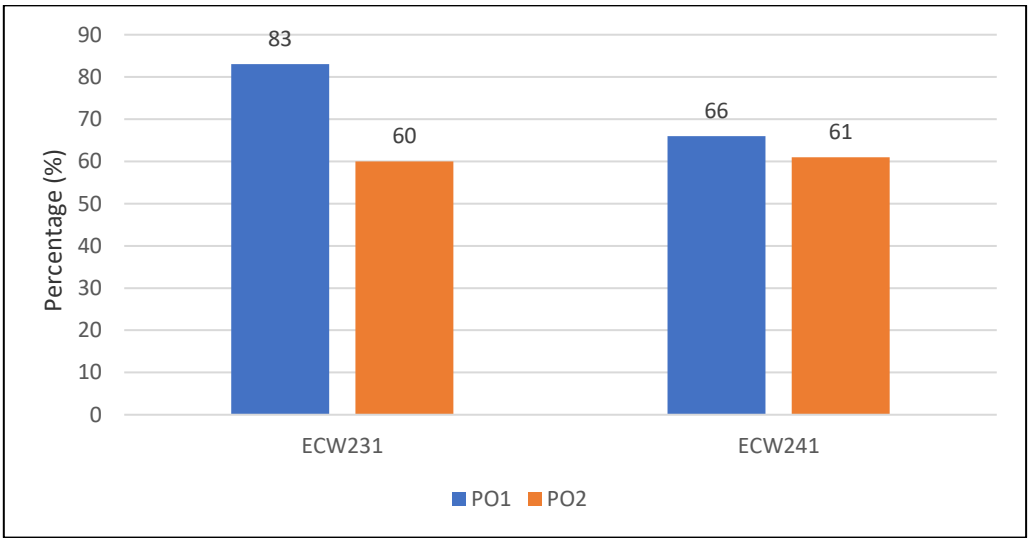

Fig. 3 Student attainment based on Programme Outcomes for ECW 231 and ECW 241

Meanwhile **Fig. 5** is represent the overall perception of student toward both courses which can contribute to student performance in **Fig. 1** and **Fig. 3**, 63.6% students feels there too many equations need to be understand, followed by condensed syllabus content and difficulties in understand the lecture content during teaching and learning process. 3% of

respondents finds not enough preparation for final exam and final exam question is tough. Student might have a perception on having lots of equations need to be understand for each semester and syllabus content is to condense due to Engineering Technology Accreditation Council, ETAC requirement need students to enrolled 7 courses in one semester to full fill 99 total credit hours for 6 semesters for diploma level. Students are struggling to understand the courses and completing all assessments within almost the same time frame. Very little of respondents saying that final exam questions are tough because the question had been prepared according to standard procedure from college and designed based on bloom taxonomy according to examination specification table (EST) as in syllabus. Syllabus are designed to adapt with fundamental on fluid and hydraulics and that is tailored to current industry practice and provides a basic understanding. It may affect student understanding during face-to-face classes when students feel that there is a lot of content. The fact that students are having difficulty understanding the first subtopic of a topic with many subtopics will affect their understanding of the next subtopic, because the subtopic is related to the previous one.

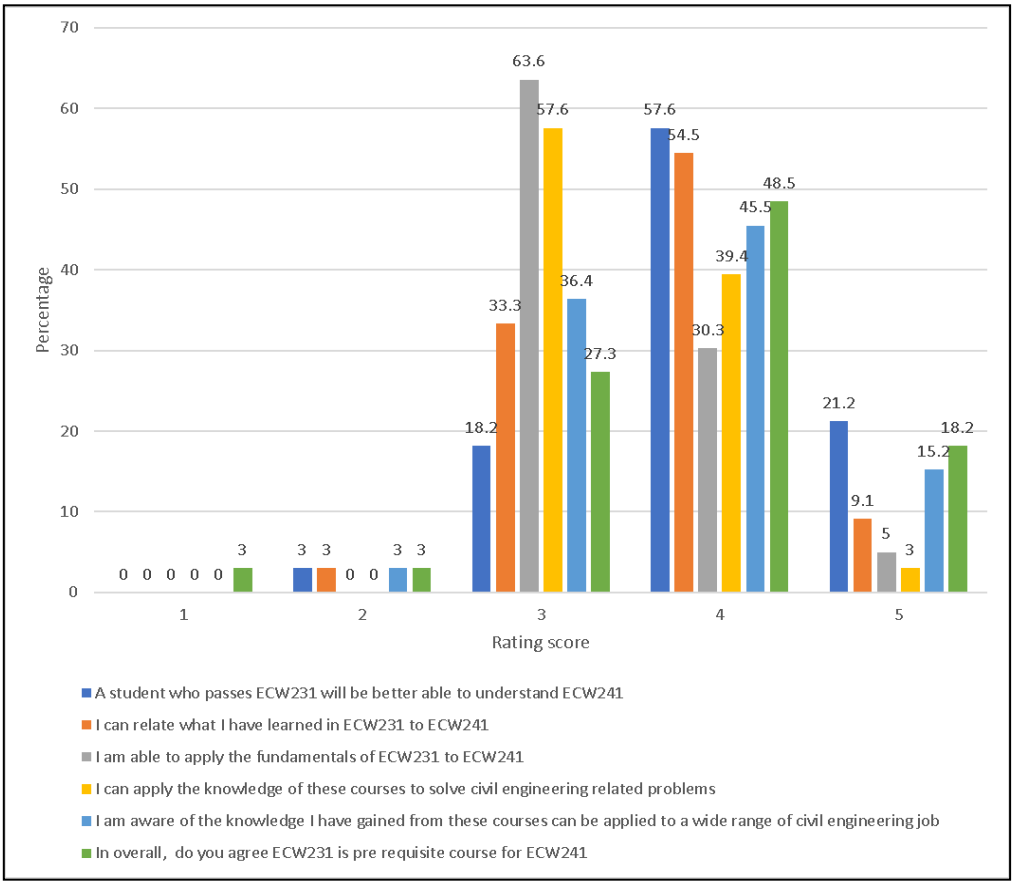

Fig. 4 Student perception on ECW 231 and ECW 241

This study also would like to observed the trend of student learning behaviour for both courses and the awareness of students to allocate the time for self preparation time (SPT) for both courses as stipulated in syllabus. Each course code had been designed based on Student Learning Time (SLT) according to credit hours as in **Table 3**.

According to **Table 3**, both courses have similar credit hours, contact hours, and student learning time (SLT). The time allocated to students for lecture and tutorial preparation is 3 hours on average each week, while 12 hours are allocated to final exam preparation.

However, study results show that most students do not allocate revision time by weeks but spend a lot of time revising during assessment weeks as indicated in **Fig. 6a** and **Fig. 6b**. Based on **Fig. 6a**, students only study if there is necessity to study for 14 weeks within semester and students have tendency to spend more time during final exam preparation. 51.5% student allocated 1to 6 hours for final exam preparation for both courses as depicted in **Fig.6b.** This scenario seems to not healthy among student in getting better grade during final exam. This due to final exam schedule arrangement is pack depending on HEA judgment for all campuses. Sometimes, student need to seat for different paper which not having any day gap in between. Therefore, students will have tendency to stay up and did not perform during final exam. It is proved by **Fig 5**, student claimed not enough preparation for final exam. Based on result, it shows that, student did not follow the ideal SLT as stipulated by syllabus. Hence, lecturer may play important roles in giving awareness to students on SPT at early semester. Thus, student will be more efficient on time management for each course and not be stressful at the end of semester. It is hoped that student performance should be better in future if student would be able to follow the ideal SLT. Students should be emphasis on SPT should 42 hours for the whole semester to ensure student are not over burden and give up during final exam. Implementation of Structured Assessment Mechanism (SAM) since October 2022 - January 2023 shows that UiTM is committed to improve the SLT of the student via management of teaching, learning and assessment activity throughout semester. It is hoped that student burdened can be reduce by having earlier plan for 14 weeks lesson activity.

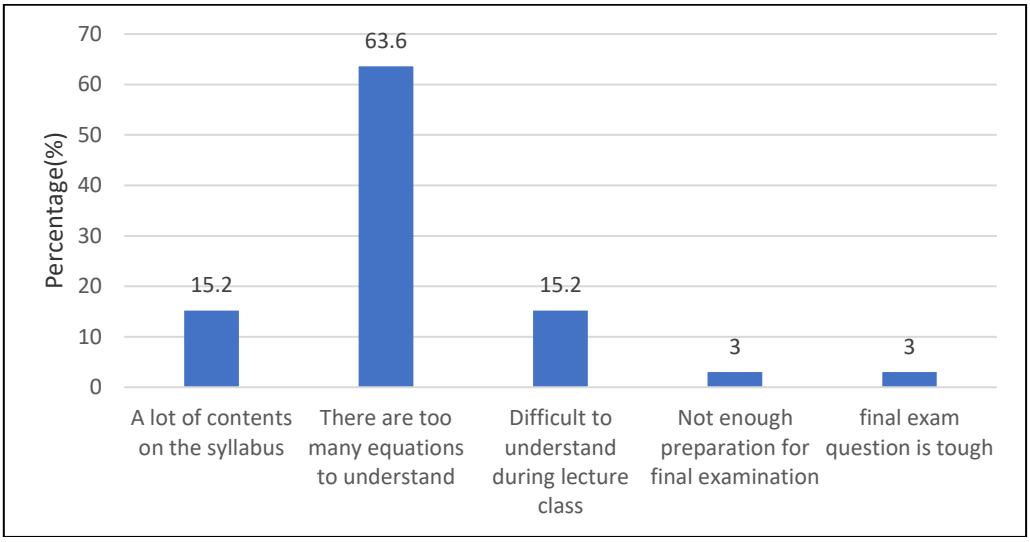

Fig. 5 Perception student on challenge during enrolling both courses

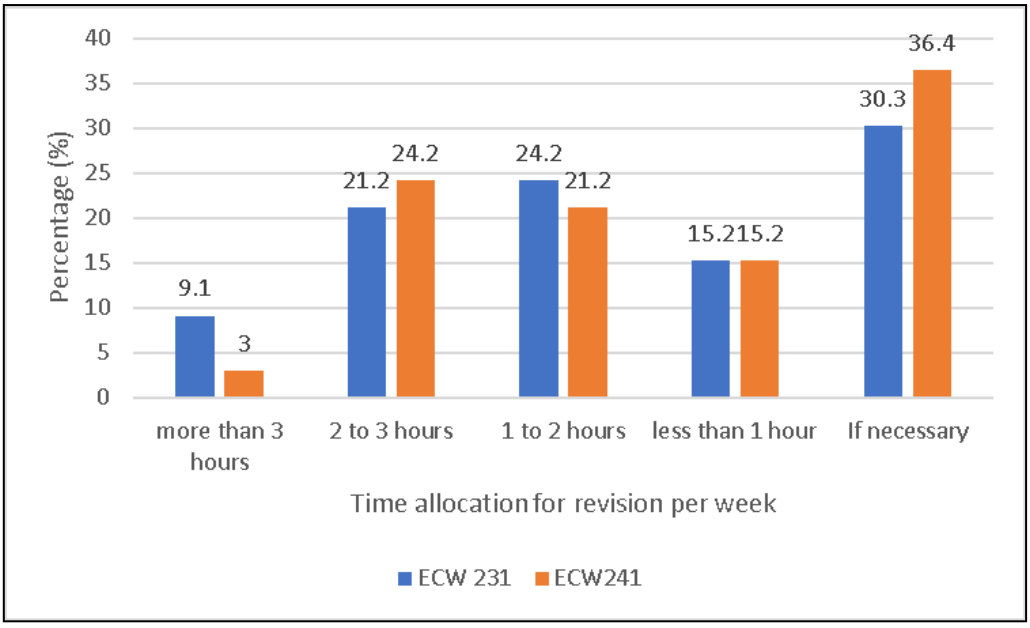

Fig. 6a Self preparation time per week for both courses

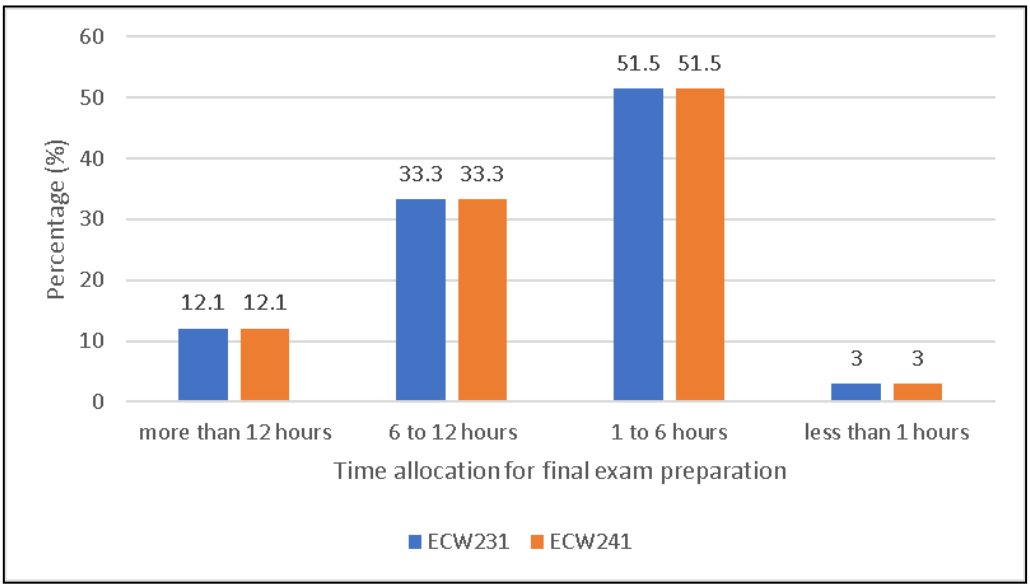

Fig. 6b Self preparation time for final exam for both courses

As a continuous quality improvement (CQI) for both courses, numerous suggestions were provided by students regarding how to enhance the student performance both courses. The first suggestion from students is to reduce the contents syllabus for both courses. As a next suggestion, it would be useful to provide more exposure to final examination questions and examples during teaching and learning. Furthermore, teaching and learning should correspond to students' understanding phases. Another suggestion would be to simplify notes and content during the teaching delivery process. In addition, both courses should increase the time allowed for assessment submissions for continuous assessment. Another key point is paper setter for final exam questions should provide any relevant equations with permission of head of department. It hoped that student's burden can be reduce during final exam. This suggestions should be highlighted toward management level for the relevant further action in improvise the syllabus and curriculum structure for achieving all university

quality objective especially for graduate on time (GOT) and cumulative grade point average (CGPA) more than 3.0.

Table 3
Student learning time for ECW 231 and ECW 241

Course Code	Credit Hours	Contact Hours	Allocation SPT (hours per week)	Allocation SPT for final exam (hours)
ECW 231	3	4/week	3	12
ECW 241	3	4/week	3	12

Conclusion

On overall, student score better in ECW 231 compared to ECW 241 and student agreed ECW 231 should be pre-requisite for ECW 241. A few issues should be addressed to management level on syllabus content, equation should be given during final exam and awareness of SLT should be promoted among student knowledge for better time management in reducing student burden within semester. It is hoped that, with all findings in this study would be able to be resolved issues on graduate on time (GOT) and student graduate with 3.0 cumulative grade point average (CGPA). This study, should also being conducted to other course code in validating the findings and the same study can be expended for full face to face teaching, learning and assessment method in UiTM. Further improvement can be done is to provide the necessity equation for both courses during assessment period. The findings of this study should also make it evident how crucial the prerequisite code is for students to comprehend the fundamental concepts of the code. This is demonstrated by the fact that by taking the prerequisite code, students can grasp the relationship between the prerequisite code and the code taken the following semester. It is also intended that it could change some students' perceptions of required codes, which they believe to be burdensome and lengthens the study duration.

Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Juwita Asfar prepared the framework of the research, literature review and overlook the writeup of the whole article. Noor Raifana Ab Rahim wrote the research methodology and did the survey among respondents. Meanwhile Nur Zaidani Wati Mohd Darwis and Narita Noh carried out the statistical analysis and interpretation of the results, hence draw the conclusion of the study.

Acknowledgements

Author would like to thanks to all respondents, which give fully cooperation in answering the survey for this project.

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