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STUDENTS' PERFORMANCE IN LEARNING AIR CONDITIONING BUILDING SYSTEM THROUGH EXPERIENCE BASED LEARNING METHOD

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Abstract:

Building services are integral to civil engineering, contributing to functionality, sustainability, and efficiency. The Building Services course (ECM346) in the Civil Engineering Diploma Program (CEEC110) at UiTM involves theoretical and practical components, emphasizing electrical and mechanical system in buildings. Heating, Ventilating and Air Conditioning (HVAC) systems, a crucial aspect of building services, are examined in detail, given their importance in maintaining optimal indoor environments. However, teaching these services to diploma-level civil engineering students is challenging because of the technical and dynamic character of the subject. This study aims to compare the performance of two groups from different semesters using two teaching methods: conventional teaching and experience-

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based learning with a site visit. The research explores the impact of these methods on students' understanding of Air Conditioning Systems (ACS), considering factors such as gender and site visit experience. Data collection involves information on student participation, demographics, and performance in the summative assessment, focusing on air conditioning system-related questions. Statistical analysis, including t-tests and box plot analysis, is employed to compare the two groups of students based on teaching methods and gender. The students with a site visit experience perform significantly better in understanding ACS compared to those without. The box plot analysis illustrates the higher median and better distribution of scores for students with a site visit. A gender-based analysis indicates no significant difference in understanding between male and female students with a site visit. In contrast, a significant difference exists in the group without a site visit. The study recommends integrating more experiential learning in civil engineering education to enhance practical understanding and prepare students for industry challenges. This research contributes to the pedagogical understanding of effective teaching methods in civil engineering education, emphasizing the importance of practical experiences, such as site visits, in enhancing students' comprehension of complex topics.

Keywords:

Building Services, Civil Engineering Education, Air Conditioning System, Teaching Methods, Experiential Learning

Introduction

Building services are crucial in civil engineering, contributing significantly to a building's functionality, sustainability, and efficiency (Clements-Croome, 2011). These services comprise elements such as electrical systems, plumbing, heating, ventilation and air conditioning, which ensure the safety, comfort, and well-being of occupants. By integrating effective building services, civil engineers can minimise energy usage, lessen environmental effect, and improve the overall performance of the built environment (Illankoon & Lu, 2019). Moreover, the design and implementation of building services require careful coordination and collaboration between architects, engineers, and contractors to meet the specific needs and requirements of each project (Pikas et al., 2020). In addition, civil engineers responsible for building services design must consider factors such as energy efficiency, environmental impact, safety regulations, and user comfort in order to create optimized and sustainable building systems (Tran, 2020). The integration of building services into the overall design is essential to ensure efficient operation and minimize costs while providing a safe and pleasant environment for occupants.

However, learning building services can be a challenging task for civil engineering students (Alanne, 2016). One of the problems is the technical nature of building services, which involves understanding and applying principles of mechanical, electrical, and plumbing systems, requires a solid foundation in engineering fundamentals. As civil engineering students primarily focus on structural design and construction, getting acquainted with the complexities of building services can be overwhelming. Additionally, the dynamic nature of building services, which constantly evolves with advancements in technology and regulations, necessitates students to continually update their knowledge. Moreover, the interdisciplinary nature of building services, requiring coordination with other engineering disciplines and

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architectural design, adds another layer of difficulty for civil engineering students who may not have prior exposure to these fields (Behan et al., 2015). In light of this, the study aims to compare the attainment of students' performance in learning one main aspect of building services namely Air Conditioning Systems (ACS) using two different teaching methods which are a conventional method and an experience-based learning approach.

Building Services Course in Civil Engineering Programme

Building Services is a compulsory course which required to be taken by all students enrolled in the Diploma of Civil Engineering Programme (CEEC110), UiTM. According to the CEEC110 program plan, this course should be taken by students in their fourth semester. This course is 2 credit hours where students are required to attend 1 hour lecture and 2 hours of laboratory work in a week for 14 weeks in a semester. Therefore, students are officially required to attend 14 hours for lectures, and 28 hours for laboratory sessions.

Generally, this course provides the knowledge and comprehension of the principles of electrical and mechanical equipment to civil engineering students. The syllabus emphasises on learning electrical systems and mechanical equipment installed in the various buildings. Students will be given an exposure to the operation and maintenance of those systems outlined in the course information. The Air Conditioning Systems (ACS) is one of the mechanical systems that is highlighted in this course material. According to the designated lesson outcomes, students should be able to know the basic principles and mechanisms of various types of air-conditioning systems at the end of this topic.

ACS play a critical role in maintaining optimal comfort levels within buildings, making them an integral component of the overall building services (da Fonseca et al., 2021). These systems are designed to regulate indoor temperature, humidity, and air quality, creating a conducive environment for building occupants. An effective air conditioning system is vital for producing comfortable and healthy indoor environments (Dong et al., 2019). The system can regulate temperature, humidity, and air quality enabling occupants to work or reside in a pleasant and productive setting. By understanding the key components and functionality of an air conditioning system, building managers and engineers can effectively design, install, and maintain these systems to ensure optimal performance and energy efficiency (Pikas et al., 2020).

According to a recent study conducted by civil engineering students, it was found that there is a noticeable deficiency of comprehensive knowledge regarding air conditioning systems (Balbis-Morejón et al., 2021). Despite being an essential component of building design, only a small percentage of students demonstrated a solid understanding of the principles and techniques involved in the installation and maintenance of these systems (Mckoy et al., 2023). The study also revealed that most students lacked awareness of the latest advancements and sustainability practices in the field of air conditioning. These findings underscore the need for educational institutions to revisit their curriculum and incorporate more comprehensive and up-to-date courses on ACS in preparing future civil engineers to face the industry's challenges.

Literature Review

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Teaching and Learning Method

Academic institutions have a significant influence in shaping the teaching and learning methods that are used. These methods are designed to assist the comprehensive acquisition and application of knowledge. Teaching and learning methods at the institutional level play a significant role in creating effective learning environments (Munna & Kalam, 2021). By incorporating various approaches such as lectures, group discussions, and technology-based tools, institutions strive to prepare students with diverse opportunities to acquire knowledge, develop critical thinking skills, and apply their learning in practical settings.

Traditional teaching methods usually employ a lecturer-centred approach, in which the lecturer is the main source of knowledge and shares information with students (Sardar, 2023). This method often incorporates lectures, textbooks, and multimedia resources to convey theoretical knowledge (Batubara et al., 2023). In parallel, practical sessions may involve laboratory experiments, simulations, and case studies to provide students with a tangible understanding of system components, performance metrics, and troubleshooting techniques. In the context of the civil engineering field, the conventional teaching approach for ACS topics typically involves a structured combination of theoretical principles, practical applications, and hands-on experiences. Students are only exposed to the basic operation and maintenance of a mechanical system installed in a building. In classroom settings, lecturers explain the basic concepts, such as the main components, their functions, and the basic operation, including heat transfer, as all of this is related to ACS. This theoretical knowledge serves as the basis for understanding the principles governing the design, installation, and operation of ACS (Lam et al., 2021). Generally, the purpose of the traditional method of teaching is to ensure all students receive identical knowledge and to cultivate certain interests among students throughout the course.

Therefore, this method has been applied to teach ACS topic with the incorporation of visual media during the lectures such as slides, multimedia, and videos. In the meantime, various forms of teaching modules were adopted, including problem-solving learning and task-based learning, to help students have an in-depth understanding of this topic (Hobri et al., 2020). Moreover, this method of teaching incorporates small group learning to find out students' misunderstandings and correct them. However, the significant weakness of this method is that some students may remain silent in the lecture class and misunderstand a word that has been spoken by a lecturer because they are not fully involved in class activities.

Experience Based Learning Method

In recent years, there has been a rising concern in the field of air conditioning systems among civil engineering students. Recognizing the importance of equipping future engineers with the knowledge and skills necessary to design and implement sustainable Heating, Ventilating and Air Conditioning (HVAC) systems solutions, lecturers have developed comprehensive teaching methods to effectively teach ACS in the civil engineering curriculum. Leveraging a combination of theoretical lectures, hands-on experiments, and interactive computer simulations, students are introduced to the principles, components, and operation of ACS. Furthermore, site visit to HVAC installations offers students practical insights into real-world applications of these systems. With such a holistic approach, civil engineering students are provided with a solid foundation for mastering the complexities of ACS, contributing to the development of energy-efficient and environmentally friendly buildings in the future.

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Furthermore, site visit or collaboration with industry professionals may be integrated to expose students to real-world applications and challenges (Foo & Foo, 2022). Collaborative learning can foster active student engagement while enhancing their critical thinking abilities (Khusaini et al., 2024). Lecturers have used field trips as a tool to involve students in active learning, complement traditional lessons, and achieve more stronger and profound student learning experiences (Sun et al., 2022). By combining theoretical knowledge with practical experiences, the conventional teaching approach aims to equip civil engineering students with a comprehensive understanding of ACS, enabling them to contribute effectively to the design and implementation of climate control solutions in diverse built environments (Pikas et al., 2020). On the other hand, integrating experience-based methods in higher education can support Sustainable Development Goal 4 (SDG4) by bridging theory with practical application to achieve good quality of learners (Gani & Ramalingam, 2024).

In developing the practical understanding and technical skills of civil engineering students regarding ACS, a site visit method has been implemented. This hands-on approach allows students to directly observe and analyse the components, installation techniques, and operational mechanisms of ACS in real-world settings (Mesuwini & Mokoena, 2023). By visiting a selected site that comprises HVAC facilities, students can witness the entire process of installing, operating, and maintaining the ACS, thus providing them with invaluable experiential knowledge. Moreover, students could interact with industry professionals, gaining insights into emerging technologies and industry practices. This site visit method not only fosters a deeper understanding of ACS but also equips civil engineering students with the practical skills necessary for their future careers in the field.

Materials and Methods

Student's Participation Information

This study involved two batches of second-year Diploma of Civil Engineering students, from the Civil Engineering Studies, College of Engineering, UiTM Johor Branch, Pasir Gudang Campus. The students were enrolled in the Building Services subject, code course ECM346 for the academic year of March - August 2022 (20222) and March - August 2023 (20232). Table 1 depicts the details of each respective semester.

Table 1: Details of Semester

Semester	March –August 2022 (20222)	March –August 2023 (20232)
Nos. of team-teaching lecturer	7	6
Nos. of groups of students	14 groups	22 groups
Site visit	Week 11	-
Nos. of total student	125	185
Nos. of student participant in this study	89	140
Percentage of Student participate	71.2%	80.6%

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Location of Site Visit

The location of a site visit is the chiller room, cooling tower, and pump room which is located within the area of UiTM Johor Branch, Pasir Gudang Campus. All the areas are located nearby the facility management department and students only have to walk to the site area from the building service laboratory which located at the Civil Engineering building. Since the session has been conducted during the lab session of each group, this approach is cost saving and does not require any extra time to be allocated out of student face-to-face learning time as designated for the course. In addition, the concession (Damai Abadi Sdn Bhd) was willing to accept the academic visit and offer to assist in explaining the operation and maintenance of the air conditioning system to the students during the session. The representatives of the concession involved in this site visit session were the Manager of Damai Abadi, Safety Officer, Mechanical and Electrical Supervisor and technician.

Before the commencement of the site visit, management of the site organized a full briefing on the administration, operation, and maintenance aspects of the air conditioning system installed on the premises. This proactive effort helped visiting students understand the technical components of the system and ensured visiting students were adequately knowledgeable about the complexities of the facility. Furthermore, safety and health were prioritized during the briefing, emphasizing the commitment to a safe learning environment. Students' mandatory use of Personal Protective Equipment (PPE) protocols, including safety helmets and shoes, showed a commitment to their well-being and promoted safety awareness during the on-site visiting session. This comprehensive approach to technical knowledge and safety requirements shows a commendable dedication to the holistic education and well-being of the students engaged in the practical learning experience.

The site visit offered a highly useful experiential learning opportunity for students. The concession granted students the clearance to thoroughly investigate all aspects of the site with the assistance and supervision of authorised technical specialists. The immersive method provided a practical counterpart to the theoretical knowledge obtained in the classroom, enabling students to develop a comprehensive comprehension of the complexities of the ACS in real-world situations. The practical experience provided them with an opportunity to observe the real-life functioning of the system within the premises, strengthening the link between theoretical principles and their practical implementation. Furthermore, the students were afforded a distinct opportunity to actively participate in and closely examine the core functions of the system while also witnessing the complexities of maintenance processes conducted by the concession. The comprehensive exposure offered to the students not only enhanced their understanding of the subject matter but also provided them with vital insights into the practical issues and considerations associated with operating and maintaining complex systems in a real-world context. The time allocated for the visiting activity was two hours. Students can observe the operation process of a centralized ACS. Figures 1(a), 1(b), 1(c), and 1(d) show the basis system and main components of the chiller, comprising the compressor, condenser, expansion valve, and evaporator, which are located in the chiller room. In conjunction with this, students gained experience by observing the operation process of an ACS.

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Figure 1(a): Pipework For Centralized ACS

Figure 1(b): Main Components of Chiller

Figure 1(c): Cooling Tower

Figure 1 (d): Chiller Pump Room

Summative Assessment

In this course, a summative assessment is being conducted after week 14, which is during the final examination week. A series of subjective questions was formulated to gauge students' understanding of the particular topic as comprised in the course information. The questions were primarily developed in alignment with the Examination Specific Table (EST) which was checked by the course Resource Person appointed by the Civil Engineering Centre of Studies and endorsed by the appointed panel during the Examination Question Preparation Workshop arranged by the Centre of Studies.

However, for this study, only questions related to Mechanical Engineering topics, focussing on ACS were selected as an instrument to indicate students' understanding and performance. Table 2 shows the details of the questions that served as a tool for gauging the students' understanding and knowledge. These questions were created to test students' knowledge of the ACS with respect to mechanical engineering learning.

Table 2: Details of Instrument's Question
(Summative Assessment - Final Exam Question)

Semester	March –August 2022 (20222)	March –August 2023 (20232)

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Approach of Teaching	Conventional Method with Site Visit	Conventional Method without Site Visit
Lecture on Topic	Week 8	Week 8
Site Visit Week	Week 11	-
Type of Assessment	Final Exam (Summative Assessment)	Final Exam (Summative Assessment)
Assessment Week	After Week 14 (final examination week)	After Week 14 (final examination week)
Level of Difficulties	(CO1-PO1) (C4)	(CO1-PO1) (C3)
Question	Q3b) Heating, ventilation and air conditioning (HVAC) systems have become the required industry standard for construction of new buildings. Analyse the most suitable type of air conditioning system to be installed in a new single storey terrace house.	Q4a) The process of air conditioning system regulates the air temperature in a building to the level that it is comfortable for the occupants. Illustrate with the explanation the air conditioning process of a four-story building that uses a centralized air conditioning system.
Time Allocation to answer specify question	30-40 minutes	30-40 minutes

Each student who participated in the study was required to submit their written responses to the predetermined questions within the allocated time frame. According to their understanding and knowledge, the students must respond to the questions. The students were required to turn in written answers to every question at the end of the class. Lecturer was chosen specifically to assess the students' written response scripts. Based on each student's responses, the lecturer was in charge of assigning grades. This is crucial to keep track of the evaluation process' consistency.

The scores of each student could reflect their comprehension regarding the basic concept of ACS. This is consistent with Wrenn & Wrenn (2009) findings, which state that an experience should be accompanied by reflective thinking and internal processing, which links the experience to previous knowledge and adjusts the learner's prior understanding in some manner. In this study, the scoring marks are adopted from a study conducted by Ismail et al., (2021), which were categorised into four; (1) good understanding, (2) better understanding, (3) moderate understanding, and (4) poor understanding as shown in Table 3. All graded marks of each participating student were recorded for data analysis purposes.

Table 3: Category of Marks

Category	Marks
Good Understanding	16-20
Better Understanding	11-15

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Moderate Understanding	6-10
Poor Understanding	<5

Data Analysis Method

The students' scoring scores for the summative assessment were documented. The results were structured and analysed by a particular statistical methodology that complemented the aim of the study. Statistical analysis was integrated based on the recorded marks of each group of students by using Microsoft Excel software. In this study, the p-value was calculated, followed by additional analysis including descriptive statistics and box plot analysis.

Students' Demographic

Two groups of students were selected as participants in this study. The students registered for code course ECM346 of the respective semester; March - August 2022 (20222) and March - August 2023 (20232). Students who were involved in the site visit that was arranged by the Centre of Studies were enrolled in the course during March - August 2022 semester and students who were not involved in any site visit were enrolled in the course during March - August 2023 semester. The demographic feature of the groups is shown in Table 4 and Table 5.

Table 4: Number of Students According to the Gender (Semester 20222)

Demographic aspect	Gender	Freq ((N)	Percentage
Students with Site visit	Female	39	43.8
	Male	50	56.2%
	Total	89	100%

Table 5: Number of Students According to the Gender (Semester 20232)

Demographic aspect	Gender	Freq (N)	Percentage
Students without Site visit	Female	53	37.9%
	Male	87	62.1%
	Total	140	100%

Score Marks Distribution

Table 6 displays the categories of marks and the number of students with site visit. The data analysis of the mark's frequency score assigned by the site visit students indicates that 60 students acquired good understanding, 17 students acquired better understanding, and 9 students acquired moderate understanding. This indicates that 86.5% of students attained more than 10 marks and above for ACS topic in the summative assessment.

Table 6: Semester 20222 (Students with Site Visit)

Category	Marks	Number of Students		Total	Percentage (%)
		Male	Female		
Good Understanding	16-20	36	24	60	67.4
Better Understanding	11-15	9	8	17	19.1
Moderate Understanding	6-10	2	7	9	10.1
Poor Understanding	<5	3	0	3	3.4

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On the other hand, the categories of marks and the number of students without site visit is depicted in Table 7. The highest mark frequency score recorded by 25 students from without site visit group was 6-10 marks. The result confirms that most of the students in this group acquired moderate understanding and most of the students with a percentage of 66.4% acquired a poor understanding of learning ACS basic concept.

Table 7: Semester 20232 (Students without Site Visit)

Category	Marks	Number of Students		Total	Percentage (%)
		Male	Female		
Good Understanding	16-20	4	6	10	7.1
Better Understanding	11-15	5	7	12	9.6
Moderate Understanding	6-10	14	11	25	18.9
Poor Understanding	<5	63	30	93	66.4

Comparison of Scoring Marks Group of Students with Site Visit (Semester 20222) and Students without Site Visit (Semester 20232)

Overall, findings show that 77 students in semester 20222 attained a better understanding of the basic concept of air conditioning systems compared to 22 students in semester 20232. Hence, it proves that students who participated in one site visit exhibited better performance on this topic compared to those who had no site visit experience. This is in line with the research done by Eiris Pereira & Gheisari, (2019), which found that students benefit greatly from observing and interacting with surroundings and the professionals working on a construction site.

Differences in Score Marks Based on Students with Site Visit and Students without Site Visit

The statistical analysis was employed to explore and compare the significant differences between the groups with site visit and those without site visit. Thus, a t-test is conducted to determine whether there was a significant difference in the score marks for both groups. The hypothesis formulated in this study suggested that participation in and experiencing with site visit might enhance students' comprehension of the subject matter, particularly the principles of air conditioning systems.

From the results, the mean (M), standard deviation (SD), t-value, and p-value for students' semester 20222 and 20232 are shown in Table 8. The t-test in this study yielded a p-value of 0.000, indicating statistical significance at the 0.05 level. Thus, it suggests a notable disparity in the understanding of the topic's content between the two student groups.

Table 8: T- Test Value of Students with Site Visit (Semester 20222) and Students without Site Visit (Semester 20232)

Demographic aspect	Freq (N)	Mean (M)	Std. Deviation (SD)	t	p- value
Students with Site visit	89	15.60	4.7	15.85	0.000
Students without Site Visit	140	5.49	4.7		

Box Plot Analysis

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Furthermore, the students' marks in this study were evaluated using the boxplot technique as illustrated in Figure 2. The exploratory box plot data analysis provides a concise and efficient way to visualize the distribution of marks obtained. Meanwhile, this technique has been selected due to its ability to provide the distribution of any data, including samples from the statistical population, without making any assumptions about the underlying statistical distribution.

The range, which encompasses both outliers and the whisker, clearly displays the distance between the smallest and largest values. The mean, median, and Inter Quartile Range (IQR) were determined for each statement consistently. The statements were arranged in descending order based on the magnitude of the mean, with the highest mean at the top and the lowest mean at the bottom. This study does not involve any outliers in the gathered data.

In semester 20222, the total number of participants was 89. Of the total participants, 39 were female, while 50 were male. From the analysis obtained, 3 students recorded marks between 0-5 (poor understanding), 9 students recorded 6-10 marks (moderate understanding), 17 students recorded 11-15 marks (better understanding) and 60 students recorded 16-20 marks (good understanding). It is revealed that most of the students scored marks within the range of 16-20 which specify the students had good understanding. It was found that students demonstrated the highest scores from this group (semester 20222) (Mean: 15.6, Median: 16, IQR Low Bound:12, IQR High Bound: 20).

Meanwhile, in semester 20232, there were a total of 140 participants, consisting of 53 females and 87 males. Out of the total, 93 students scored marks between 0-5 (poor understanding), 25 students scored 6-10 marks (moderate understanding), 12 students scored 11-15 marks (better understanding), and 10 students scored 16-20 marks (good understanding). Most of the students in this group scored marks within the range of 0-5 which represents the students had poor understanding. This analysis found that the students from Sem 20232 (Mean: 5.49, Median: 4, IQR Low Bound: 2, IQR High Bound: 8) had a lower score in comparison with the students in semester 20222.

It is evident that the median of the data for the students with site visit group is higher compared to the median for the students without site visit group. This indicates that engaging in activities and gaining experience through observing the operation and maintenance of air conditioning systems can enhance students' comprehension of construction site safety aspects.

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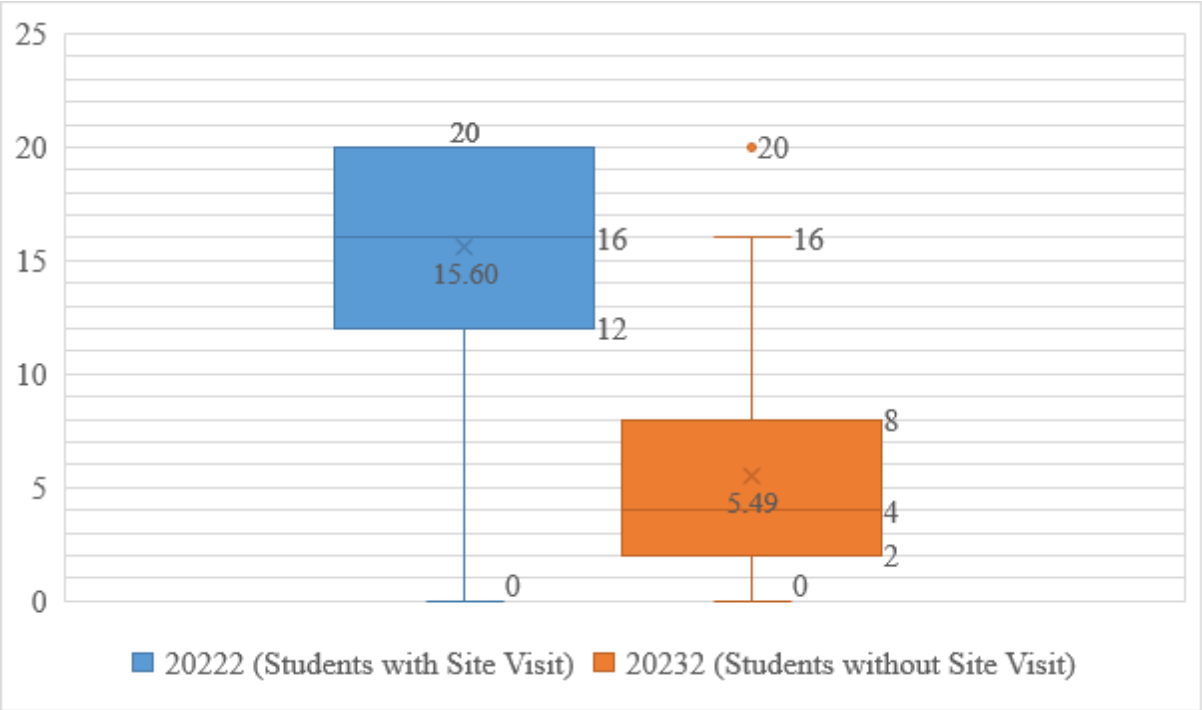

Figure 2: The Box Plot of Total Score for Students Semester 20222 and 20232

Comparison of Scoring Marks Between Gender Group of Students with Site Visit (Semester 20222)

The mean (M), standard deviation (SD), t-value, and p-value for students in semester 20222 according to gender are shown in Table 9. Figure 3 demonstrates the Box Plot of the total score for students in semester 20222. From the findings, it shows that the p-value of the t-test in this study is 0.274, which is higher than 0.05. Thus, it indicates that there is no notable difference in the understanding of the topic's content between female and male students in this group of students (semester 20222).

Table 9: T- Test Value of Students with Site Visit (Semester 20222)

Demographic aspect	Freq (N)	Mean (M)	Std. Deviation (SD)	t	p- value
Female	39	15.0	4.37	-1.100	0.274
Male	50	16.1	4.95		

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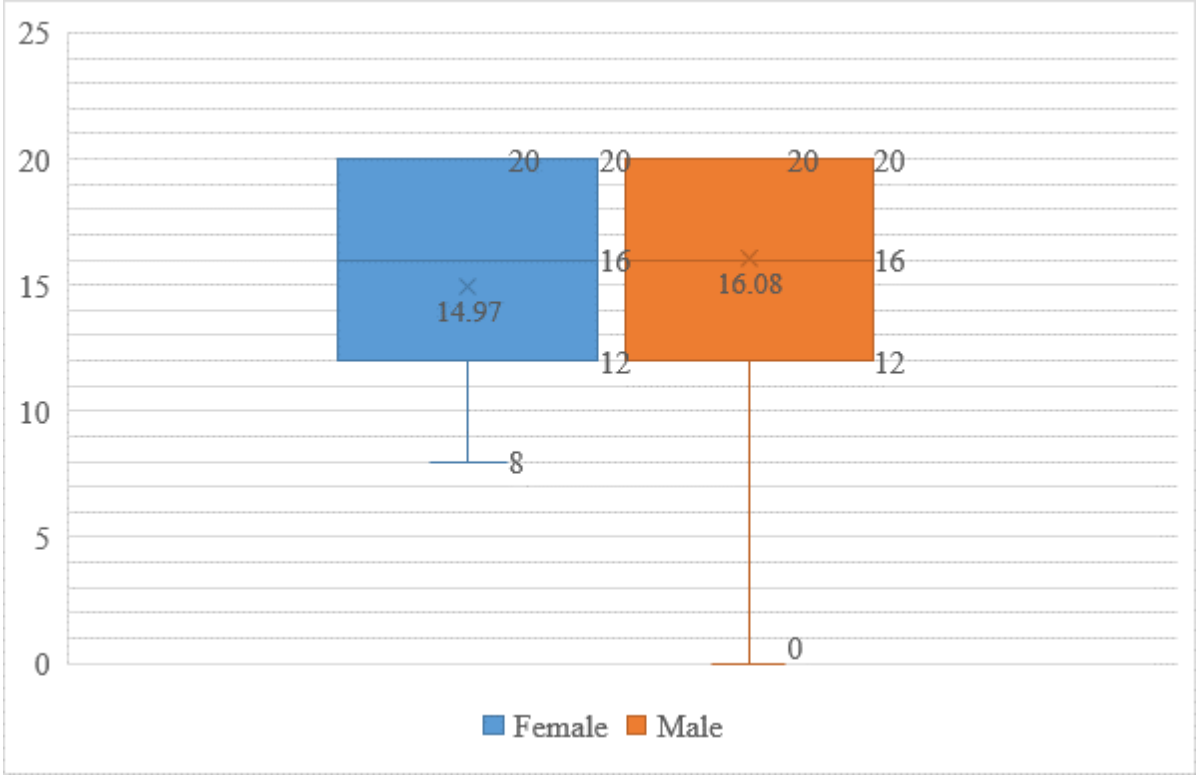

Figure 3: The Box Plot of Total Score for Students Semester 20222

Comparison of Scoring Marks between Gender Group of Students without Site Visit (semester 20232)

The mean (M), standard deviation (SD), t-value, and p-value for students in semester 20232 based on gender are depicted in Table 10. It revealed that the p-value of the t-test in this study is 0.000, which is less than 0.05. Therefore, it indicates that there is a substantial difference with respect to understanding the content of the topic within female and male students in this group of students (semester 20232). Additionally, Figure 4 represents the Box Plot of total score for students in semester 20232.

Table 10: T- Test Value of Students without Site Visit (Semester 20232)

Demographic aspect	Freq (N)	Mean (M)	Std. Deviation (SD)	t	p- value
Female	53	6.9	5.00	2.863	0.000
Male	87	4.6	4.31		

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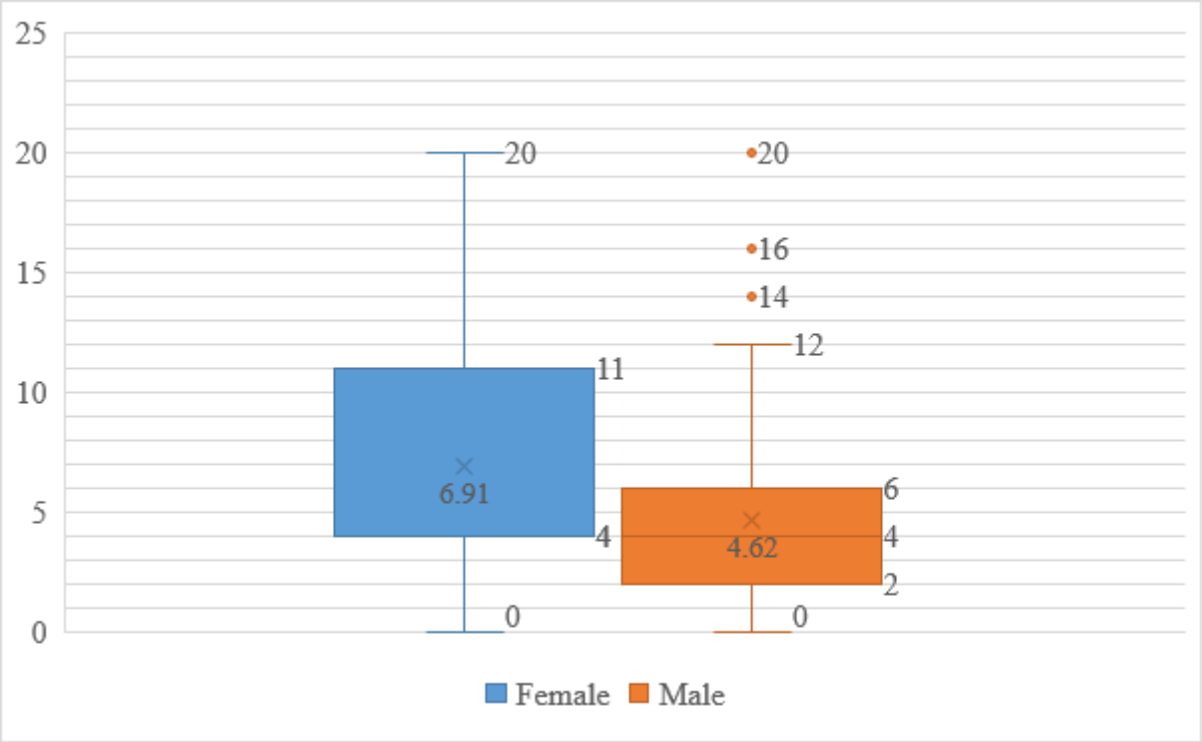

Figure 4: The Box Plot of Total Score for Students Semester 20232

Conclusion

In conclusion, this study aims to compare the performance of civil engineering students in learning the Air Conditioning Systems (ACS) through two different teaching methods: conventional teaching with site visit and conventional teaching without site visit. The results of the study provide valuable insights into the effectiveness of incorporating practical experiences, such as site visits, in enhancing students' understanding of complex engineering topics. The findings indicate that students who participated in a site visit demonstrated significantly better performance in understanding the principles of ACS compared to those who did not have the site visit experience. Most students with a site visit achieved good and better understanding, while a significant percentage of those without a site visit demonstrated only moderate to poor understanding. The statistical analysis, including t-tests and box plot analysis, further supported the conclusion that the students with site visit group outperformed the students without site visit group. The p-value obtained from the analysis was significant, suggesting that the site visit had a positive impact on students' comprehension of the ACS. On the other hand, the analysis based on gender indicated that there was no noteworthy distinction in the performance of male and female students within the students in the semester 20222, demonstrating that the benefits of the site visit were consistent across genders. However, in the semester 20232, a significant distinction was observed among male and female students, with male students performing better on average.

These results underscore the importance of incorporating experiential learning, such as site visits, into the teaching of complex engineering topics like air conditioning systems. Practical experiences not only enhance theoretical knowledge but also offer students with a deeper understanding of real-world applications and challenges in the field of building services. The study suggests that educational institutions should consider integrating more hands-on

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experiences into their curricula to better prepare students for the dynamic and interdisciplinary nature of the civil engineering profession, particularly in the field of building services.

The findings of this study offer valuable understanding and more information to the lecturer in charge of planning the teaching approach of the course. Experience-based learning can be considered an alternative teaching approach that exposes students to real-life situations. Moreover, this could offer students a chance to enhance their lifelong learning abilities to prepare themselves to become a technical person in the future. This may add value to the students and enrich them with technical experience, which may be useful for them as civil engineering students.

As a civil engineering student, the mechanical and electrical (M&E) aspects of a building are also important to them besides the theoretical concept. Students need to be exposed to the M&E system so that they can get a better and clearer picture of how the system is installed, operated, and maintained throughout the building's lifespan. In addition, they also need to be exposed to the managerial aspect of the M&E system so that they know how the technical person in charge conducts their work. In summary, the findings of this study emphasize the effectiveness of experiential learning methods in improving students' performance and understanding of building service systems, with the potential for broader implications in civil engineering education.

Suggestions for Future Research

The study will be replicated to indicate the understanding of students towards other topics included in the course syllabus, such as electrical wiring, firefighting systems and building utilities. This is to indicate the significant difference in students' understanding of answering any assessment between students with site visit and students without site visit experiences related to the respective topic. In addition, by having large numbers of participants, advanced statistical analysis may be conducted to explore more of the different perspectives between male and female students.

Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Author[1] wrote the research methodology, did the data entry and carried out the statistical analysis with interpretation of the results. Author[2] carried out the fieldwork, prepared the background of study and data collection. Author[3] and Author[4] checked the write-up of the whole article including the plagiarism. Author[5], Author[6] and Author[7] prepared the literature reviews.

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