

The Effectiveness of Site Visit Approach in Teaching and Learning of Construction Site Safety: A Case Study in Civil Engineering Faculty, Universiti Teknologi MARA, Johor Branch, Pasir Gudang Campus

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<https://doi.org/10.24191/ajue.v17i4.16218>

Received: 23 June 2021

Accepted: 25 September 2021

Date Published Online: 31 October 2021

Published: 31 October 2021

Abstract: Learning from experience approach has been widely adopted in the academic cluster of Built Environment including Civil Engineering field. To further strengthen this aspect, a study in exploring construction site visit as an aid to educational component in teaching and learning method is significant. This provide a platform which helps civil engineering students to enhance their safety knowledge and understanding by experiencing the real time situation at the construction site. The objectives of this study are to: (1) determine the effectiveness of site visit approach in teaching and learning of construction site safety (2) measure the performance between students who acquire knowledge related to safety by experiencing one site visit compared to students with zero site visit; and (3) compare the achievement and understanding between male and female students if site visit is adopted in the teaching and learning process. A set of questions is designed as an instrument and participating students are required to answer the questions nonverbally to show their knowledge on the construction site safety. Based on the scoring marks, a statistical analysis has been conducted. The result indicates that students with one site visit have better achievement and understanding compared to students with zero site visit. In addition, the result also shows that with one site visit, female students have better performance in the score marks compared to male students.

Keywords: construction site, experience-based learning, site safety, site visit

1. Introduction

Experience-based learning is a learning model which describes the cycle that learners undertake throughout the experiential learning process. The cycle begins with immediate or concrete experience, which serves as the basis to observe and reflect on the occurrences. After this period of reflective observation, these reflections are assimilated into abstract concepts about what happened, which in turn will supply additional information for future actions. With the new gathered information processed, the

learners actively test the recent findings leading to new experiences and the renewing of the learning cycle (Baker et al., 2002).

A number of previous researchers found that site visit contributed to many benefits towards the students. The study by Blinn et al. (2015) showed that by visiting construction site, it helps in providing opportunities for engineering students to have time and space information (spatiotemporal) experience of the dynamic and complex construction atmosphere. This is aligned with previous discoveries by Mills et al. (2006) and Kajewski (1999) which found that learning through visiting construction projects could provide students with spatiotemporal awareness through unique opportunities for observing a real construction context. In addition, site visit exercise also promotes experiential learning processes which provide an opportunity for the students to observe, reflect, process, assimilate, evaluate, communicate and comprehend real world situations and contexts associated to construction practices (Mills et al., 2006) as findings discovered by Baba et al. (2021) that shows most of the students spend some time reading academically and leisurely daily for educational purpose and pleasure.

According to Janovy & Major (2009) and Manzanal et al. (1999), field based learning has been found to be a powerful tool in helping students to better understand the core concepts and raising their enthusiasm. This can be achieved because site visit provides an interactive learning environment for students which can enhance their understanding of real construction site safety practices. Students have the opportunity to perceive the real safety practices by observing the behaviour of workers on the construction site. In addition, students also have opportunities to interact and communicate directly in a professional setting with all groups involved in a construction project. Furthermore, site visit helps to give an exposure and enhance the students towards the topics that have been covered in the class (Bonderup, 2011; Nadelson & Jordan 2012). Besides, this approach was also supported by Bamberger & Tal (2008) which reported that site visit has improved students in terms of recalled facts and details of the experience that students have gained during the site visit.

1.1 Construction Safety Education

In general, construction site safety is one of the important content covered in any of construction and project management course. It is important to stimulate a safe and healthful thinking of working environment throughout the construction lifecycle among the students. Beside the content, the course also covers the managerial aspects, roles and responsibilities of the stakeholders, the key personnel, the procurement as well as the resources involved in a project such as manpower, material and machinery. Pisaniello et al. (2013) noticed that teaching of occupational safety in schools is an essential role of the schools in preparing students for workplace challenges. This is important as the construction industry is a complex environment and dangerous workplace. This is supported by Hallowell (2012) and Liao et al. (2013) which discovered that a construction site is still one of the most dangerous workplaces, with a large amount of injuries and accidents. Besides, Marks & Teizer (2013) addressed that most accidents on-site are regarded as the result of contact collisions mainly caused by low awareness and blind spots. Meanwhile the findings by Kunle et al. (2018) concluded that lack of depth knowledge on safety education can limit the students' ability to coordinate safety practices and develop safety policy when they are employed in construction industry as well as reduce their employability as safety manager. Therefore, it is important to equip students with construction site safety knowledge.

However current pedagogical methods and tools at the tertiary level are unable to provide students with real practical and safety experiences. In order to enhance students' understanding, there is an effort to bring the students for an academic site visit so that they can practically explore and expose themselves on the physical activities executed on the construction site thus enhance their understanding on the theoretical lesson content which has been delivered in the classroom. This is an alternative of teaching method which can be integrated in the course information document to make students appreciate the lesson learnt and internalize their thoughts by experiencing the real situation themselves on the construction site. In addition, this may stimulate the student's interest to discover more on the construction site safety issues and other aspects of construction knowledge.

1.2 Teaching and Learning Approach

Project and Construction Management is one of compulsory courses which needs to be enrolled and passed by each student of Diploma in Civil Engineering, Universiti Teknologi MARA. This course is designed to provide basic knowledge on the management of construction projects prior to lifecycle including pre construction phase, construction phase and post construction phase which consist of the construction site safety aspects. According to the course information, site visit activity is not necessary to be adopted as one of the teaching methods. However, it is an initiative of the lecturer or instructor to bring the students to the construction site. This is an approach to help students in gaining better insight and understanding of construction field including site safety. In addition, the students are not yet attending the safety courses as one of the requirements before they embark themselves for the industrial training. This is because the students are scheduled to attend the safety course during the third year and required to engage themselves with industrial training during final semester of their study. Therefore, the students are lack of experience and technical knowledge related with the construction industry and construction site safety.

In general, the course consists of four main topics which cover the aspects of management, project lifecycle, procurement, contract and safety aspect. The traditional teaching method adopted for this course is as per stated in the course information. The face-to-face interaction among students and lecturer has been conducted as per designed in the lesson plan and complying to the course information guidelines. During the semester, students are required to attend the lecture class according to the timetable. The designated contact hours for this course is three hours per week. Therefore, for one semester which comprises of 14 weeks, the total hours students need to attend face-to-face classes are 42 hours. This is aligned with Tadesse et al. (2020) which reported that academic staff focus more on lecturing than using the time for other active and collaborative learning activities. Thus, students do not have any direct exposure to the physical activities on the construction site.

In a way to cultivate the safety knowledge and practice among these students, an alternative approach needs to be considered in the students' teaching and learning process. According to Belel & Muhmud (2012), it is utmost important to ensure that a very new employee on project site is given an appropriate orientation regarding safety and safety inspections. Therefore, site visit has become an alternative approach which provides a platform for the students to polish their interpersonal skills by communicating directly with the technical personnel who are involved directly in the construction industry. Students also can acquire primary technical information related to the project by asking the site engineer, site supervisor and construction workers. This is in line with the study by Blinn et al. (2015) which reported that the benefits gained from site visit is communicating with professionals about those challenges on a real jobsite.

In order to determine the effectiveness of site visit approach in teaching and learning towards the students whom undertaking the Project and Construction Management course, this study has been conducted. In addition, the findings also assist to measure the students' understanding prior to construction site safety aspect between students with zero site visit and those with one site visit experience. To extend the discussion, the comparison of achievement and performance between male and female students have also been explored if the site visit approach is integrated in the teaching and learning process.

2. Materials and Methods

There were two stages of methodology involved in this study. The first stage was data collection method, and the second stage was data analysis. The data collection method involved the preparation of site visit activity and designated questions which were used as instruments to indicate the level of understanding and knowledge of participating students on the construction site safety aspects.

Then, the scoring marks gathered by the students were recorded and analyzed by using relevant statistical software. The output were tabulated in a proper format and interpreted according to the type of statistical analysis aligned with the objective.

2.1 Students' Demographic Information

This study involved the group of second year Diploma of Civil Engineering students, Faculty of Civil Engineering UiTM Johor Branch Campus Pasir Gudang for March-July 2019 semester academic year. The students were enrolled in the Project and Construction Management course. There were six groups of students selected to participate in this study with the total number of 138. From these six groups, the participants were classified into two main groups which were the zero site visit and one site visit. The three groups namely 4B, 4E and 4F were categorized as zero site visit where the students of these groups did not involve with any site visit. The other three groups namely 4A, 4I and 4J were selected to involve in one site visit activity during the semester.

2.2 Site Visit Activity

In general, all participating students were required to attend the face to face class starting on week 1 until week 14. However, on week 12, only students of one site visit group were required to attend site visit arranged by the faculty. Two construction sites were chosen located in Johor Bahru District. The main purpose of choosing a nearby construction site was to lessen travelling time and save cost. Thus, students had the opportunity to spend more time at the construction sites. In addition, the criteria when choosing the construction site to visit were: (1) the site had ongoing construction activity with about 30-40% of project progress; (2) the selected project was also based on the willingness of the project's stakeholder to accept the visit. In this context of study, both sites of building construction projects involved the construction of blocks of quarters and a wholesale market respectively. Both clients were from public and private sectors.

Before the site visit started, the site management conducted a briefing session about the management and background of project construction including the project details. The students were also exposed to the safety and health aspects of the respective sites. It was compulsory for the students to equip themselves with the Personal Protective Equipment (PPE) such as safety helmets and safety shoes.

During the site visit, the contractor granted an approval for the students to explore all areas of the on-going construction site with the guidance and supervision of appointed technical persons namely the site engineer and site supervisor. This was an alternative experience-based learning approach to increase students' understanding on what had been taught theoretically in the classroom. Students had the opportunity to expose themselves with the real-time construction site operation. In addition, the students were able to personally discover and observe the construction activities executed by the workers. The time allocated for the visiting activity at each construction site was four hours.

2.3 Data Collection Method

A set of subjective questions was designed to be used as an instrument in this study to indicate student's understanding on particular topic. The questions were developed based on the Examination Specific Table (EST) which was endorsed by the faculty and covered the topic of construction site safety as comprised in the course information. The total marks of these questions were 20 marks.

On week 14, all students of both groups (zero site visit and one site visit) participated in this study were required to answer the designated questions in written form during specific time set. The allocation time to answer all questions were 20 minutes. Students must answer all the questions based on their knowledge and understanding. At the end of the session, the students were compulsory to submit their written answer scripts of all questions.

In order to evaluate the student's written answer scripts, a syndicated marking approach was implemented. An evaluator was appointed for this purpose. The evaluator was responsible to award marks based on the answers provided by each student. This is important to monitor the consistency of the evaluation process. The scoring marks of each student may determine their understanding related to the construction site safety aspects. This is aligned with Jan & Bruce (2009) which reported that experience must be followed by reflective thought and an internal processing which links the experience with previous learning, transforming the learner's previous understanding in some manner. In this study, the scoring marks were categorised into four namely (1) good understanding (2) better understanding

(3) moderate understanding (4) poor understanding as shown in Table 4. All graded marks of each participating students were recorded for the data analysis purposes.

2.4 Data Analysis Method

Statistical data analysis was carried out based on the recorded marks scored by each student. A t-test analysis was adopted to indicate the significant difference of student's understanding between group of zero site visit and one site visit. The p-value compute from this analysis is important before any further interpretation is carried out such as descriptive and box plot analysis.

3. Results and Discussions

3.1 Respondent demographics

Table 1 shows the demographic of students involved in this study. In general, there were six groups of students involved. The groups were divided into two main groups of students with zero site visit and students with one site visit. The total numbers of participating students were 138 where 74 students comprised in zero site visit group and 64 for one site visit group. Besides, each group of zero site visit and one site visit comprises of both gender, female and male students.

Table 1. Number of students according to the group and gender

Group	Gender		Total	
	Female	Male		
Zero site visit	4B	14	11	25
	4E	13	11	24
	4F	16	9	25
One site visit	4A	13	11	24
	4I	17	7	24
	4J	7	9	16

Table 2 shows the percentages of the students' gender for both group of zero site visit and one site visit. The participating students involved for zero site visit were 53.6% and 46.4% for one site visit. For gender distribution, in one site visit group, 58.1% of student in zero site visit were female and 41.9% were male. In addition, for one site visit group, 57.8% of the students were female and 42.2% were male. Overall, there was a difference in total numbers of students and genders between both groups.

Table 2. Percentage of students according to the group and gender

Group		Gender	
Zero Site Visit	One Site Visit	Female	Male
74	64	80	58
53.6%	46.4%	58.0%	42.0%
Zero Site Visit		One Site Visit	
Female	Male	Female	Male
43	31	37	27
58.1%	41.9%	57.8%	42.2%

3.2 Differences in Score Marks based on zero visit and one visit

A statistical analysis was adopted to determine the significant differences between zero site visit and one site visit groups. Therefore, t-test is conducted to determine whether there was a significant

difference in the score marks based on both groups. The hypothesis derived in this study was either by involving and experiencing with one site visit may help to improve the level of students understanding towards the subject's content specifically on the construction site safety.

From the findings, the mean, standard deviation and p value for zero site visit and one site visit group is shown in Table 3. It shows that the p value of t-test in this study is 0.00005 which is less than 0.05. Therefore, it indicates that there is significant difference in the context of understanding construction site safety between students and between both groups.

Table 3. T- Test value of zero site visit and one site visit

	n	Mean	Std. Deviation	t	p-value
Zero Site Visit	74	9.5	3.41	4.215	0.00005
One Site Visit	64	12.0	3.59		

3.3 Score Marks Distribution

Table 4 shows the categories of marks and number of students. From the analysis of the marks frequency score by the student from one site visit group, it shows that 14 students acquired good understanding, 31 students acquired better understanding and 16 students acquired moderate understanding. Overall, this shows that 48 students from one site visit group acquired better and good understanding of the construction site safety knowledge compared to students from zero site visit group which was only 28 students. Therefore, this shows that the participating students from one site visit group has higher performance compared to the participating students from zero site visit group. This is in line with the study conducted by Ricardo & Masoud (2017) which indicates that the benefits of observing and interacting with the environment and the professionals present in a construction site are exceptionally important for the students. On the other hand, the highest mark's frequency score obtained by 39 students from the zero site visit group was 6-10 marks. It indicates that most of the students of this group acquired moderate understanding only.

Table 4. Category of marks

Category	Marks	No of student	
		Zero Site Visit	One Site Visit
Good Understanding	16-20	4	14
Better Understanding	11-15	24	31
Moderate Understanding	6-10	39	16
Poor Understanding	<5	7	3

3.4 Box Plot Analysis

In addition, the marks attained by the students in this study were also analyzed and reported by using boxplots technique. This exploratory box plot data analysis allows to visualize the distribution for the marks obtained in a simple and compact manner. Besides, this technique has been chosen because the spread of all data which involves as samples of the statistical population is displayed without making any assumptions of the underlying statistical distribution.

The distance between the smallest value and the largest value is shown clearly including the outliers and the whisker. The mean, median, and Inter Quartile Range (IQR) were calculated for each statement correspondently. The statements were organized from top to bottom depending on the magnitude of the mean; that is, the highest mean on the top and the lowest mean at the bottom. In this study, there is no outliers involves in the data obtained.

For the one site visit group, the total participants were 64 where 37 students were female, and 27 students were male. Amongst all, 3 students attained marks between 0-5 (poor understanding), 16 students attained 6-10 marks (moderate understanding), 31 students attained 11-15 marks (better understanding) and only 14 students attained 16-20 marks (good understanding). It is shown that most of the students scored marks in the range of 11-15 which indicate the students had better understanding. From **Fig.1**, it was found that students from this group (Mean: 12.02, Median: 12, IQR Low Bound: 10, IQR High Bound: 15) was the highest scored marks attained.

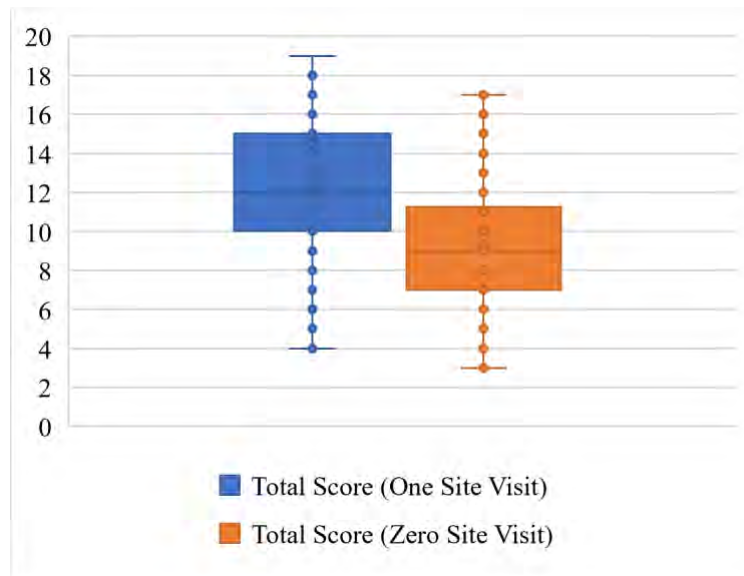


Fig. 1 The box plot of total score for zero site visit and one site visit

On the other hand, it was found that the students from zero site visit group (Mean: 9.5, Median: 9, IQR Low Bound: 7, IQR High Bound: 11) had the highest scored marks attained. It is quite apparent that the distribution for the one site visit data has a higher median than the median for zero visit. This implies that the activity and the experience of observing the construction environment can help in improving the students' understanding regarding to the construction site safety aspect.

3.5 Comparison on Students' Understanding Between Gender for One Visit Group

To extend the scope of this study, the comparison of the students' understanding towards construction site safety based on gender aspect was also investigated. Table 5 shows the number of students who attained the marks according to gender.

Table 5. Total Score of Students According to Gender of Sample group

Category	Marks	No of Student	
		Female	Male
Good Understanding	16-20	10	4
Better Understanding	11-15	21	10
Moderate Understanding	6-10	7	9
Poor Understanding	<5	2	1

From the frequency analysis of good understanding category, 10 female students attained 16-20 marks compared to male students that was only 4 marks. For the category of better understanding, there were 21 female students attained 11-15 marks compared to male student which was 10. For moderate understanding, 7 female students attained 6-10 marks compared to male students that was 9.

And for poor understanding, there were 2 female students attained less than 5 marks compared to only 1 male student. Overall, it shows that, female students acquired good and better understanding compared to male student in which 31 out of 40 female students attained minimum of 11 marks. Besides, out of 24 males' students, only 14 of them attained minimum of 11 marks.

In addition, In **Fig. 2**, it was found that female students who experienced one site visit (Mean: 12.61, Median: 13, IQR Low Bound: 11, IQR High Bound: 15.25) had the highest scored marks attained. Besides, male students who experienced one site visit (Mean: 11.04, Median: 11, IQR Low Bound: 8.75, IQR High Bound: 13) was the highest scored marks attained. It is quite apparent that the distribution for the female data has a higher median than the median for male. Tunji-Olayeni et al. (2017) opined that enticing females into built environment programs could bridge the skill gaps through adequate career counselling, a gender inclusive learning environment, students' self-motivation and subjection to female role models.

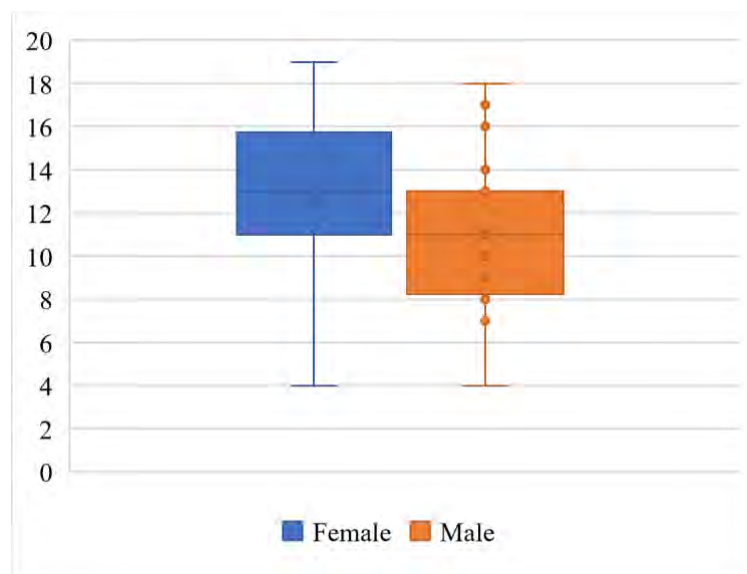


Fig. 2 The gender comparison for one site visit group

4. Conclusion

In general, the aim of this study is to determine the effectiveness of adopting site visit as one of teaching and learning methods for students who enrolled in Project and Construction Management course of diploma programme, Faculty of Civil Engineering, University Technology of MARA. From the findings, it shows that the students with one site visit acquired good and better understanding as compared to the students with zero site visit activity. Furthermore, female students showed higher performance by acquiring good and better understanding in construction site safety knowledge as compared to male students. Therefore, this indicates that site visit activity contributes positive impacts toward student's achievement and performance in understanding the concept and practice of construction site safety. Meanwhile, it also indicates the effectiveness of site visit approach due to the higher scoring marks by group of students with one site visit.

The results of this study also provide better insight for the resource person and have the potential to influence the decision made in recommending site visit as one of compulsory teaching and learning method which can be integrated in the course information due to its benefits and practicality beside the existing lecture and e-learning approaches. This also shows that the financial implication faced by the management which may arise by adopting this approach brings significant impacts to the students as this may enhance the students' understanding and self-awareness in identifying the potential hazard or risk at construction site. This is important as to prevent any accident which may contribute to injuries or fatalities so as to improve the occupational safety and health performance of the local construction industry.

The research was an explorative study that involved such a limited number of samples in terms of students and was only conducted in Pasir Gudang branch. Therefore, it could not be generalized as the Diploma of Civil Engineering also operated in few other University Teknologi MARA campuses in Malaysia. In addition, there are also vast and diverse areas can be considered in further research that involves other topic, field and area in order to get a better picture and perspective on this teaching and learning approach.

5. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Author1 carried out the fieldwork, prepared the literature review and wrote the research methodology. Author2 did the data entry and carried out the statistical analysis and interpretation of the results. Author3 overlook the write up of the whole article.

6. Acknowledgements

The authors would like to thank the top management of Universiti Teknologi MARA, Johor Branch, Pasir Gudang Campus for approving the paperwork with some allocation of budget to support the expenses of the student's activity. Furthermore, the authors would also like to recognize collaborators from the public sector, Public Work Department (PWD), Johor Bahru District and Meriah Industries Sdn. Bhd. which represented the private sector that willing to accept the site visit.

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