

# Investigation of Learning Challenges in Building Measurement Unit

Argaw T. Gurm, Muhammad N. Mahmood

## II. LITERATURE REVIEW

**Abstract**—The objective of this research is to identify the architecture and construction management students' learning challenges of the building measurement. This research used the survey data obtained collected from the students who completed the building measurement unit. NVivo qualitative data analysis software was used to identify relevant themes. The analysis of the qualitative data revealed the major learning difficulties such as inadequacy of practice questions for the examination, inability to work as a team, lack of detailed understanding of the prerequisite units, insufficiency of the time allocated for tutorials and incompatibility of lecture and tutorial schedules. The output of this research can be used as a basis for improving the teaching and learning activities in construction measurement units.

**Keywords**—Building measurement, construction management, learning challenges, evaluate survey.

## I. INTRODUCTION

**B**UILDING measurement, estimating and cost planning are some of the challenging quantity surveying units which are delivered to architecture and construction management students at the School of Architecture and Built Environment, Deakin University. Over the last few years, review of students' grades for the building measurement unit showed poor performance (lower grades) as compared to other units. Further, the feedback provided by the students indicated that they have difficulty in understanding most principles and practices of building measurement and estimating.

Previous research conducted in the UK, Malaysia and Nigeria has also pointed out some of the challenges associated with teaching and learning processes of building measurement units [1]-[3]. Because of differences in teaching and learning practices, the standard methods of measurement, measurement principles and practices, the challenges identified in the international context might not be applicable to Australian students. Thus, it is essential to explore context-specific difficulties which could be encountered by students in Australian universities, in this study at Deakin University. Further, to develop appropriate solutions which help to enhance the understanding of the measurement practices and principles, the teaching and learning difficulties should be thoroughly investigated. Hence, the objective of this research is to identify the key challenges in learning Building Measurement unit at Deakin University.

Gurm T. Argaw is with the Construction Management at Deakin University, Australia (corresponding author, e-mail: argaw.gurm@deakin.edu.au).

Mohamoud M. Nateque with the Construction at Deakin University, Australia (e-mail: n.mahmood@deakin.edu.au).

### A. Difficulties in Learning Building Measurement

Tunji-Olayeni et al. [2] explored the learning difficulties associated with the delivery of building measurement unit in Nigeria. The study concluded that the main sources of the learning difficulties were related to the lecture, lecturer, and learning facilities. Furthermore, [2] found that lecturers assumed that students already possessed knowledge about construction technology and rush over the lecture. Additionally, the interviewees (students) involved in the study revealed that the teaching style adopted by lecturers was one of the major barriers to comprehend the contents of the unit. Also, the availability of insufficient exercises or examples, the adoption of non-interactive lectures and lack of exposure to software and country-specific textbooks on building measurement were identified as some of the causes of the learning difficulties. In Australia, context-specific problems related to the teaching and learning of the unit Building Measurement should be explored so that appropriate solutions could be proposed.

In the Australian context, [4] investigated the difficulties in construction disciplines which include quantity surveying, building surveying and construction management. According to the study, the major challenges are related to the curriculum and the fragmentation of the teaching and learning in the disciplines. Similarly, [5] analyzed quantity surveying education system in Ghana and found that the major deficiencies include lack of skills development, unavailability of teaching and learning resources, shortage of qualified and experienced teachers and the dearth of linkages between the different levels of education.

In the UK, [6] identified six categories of difficulties which are related to building measurement teaching and learning. These challenges were categorized under (1) process, (2) calculations, (3) technology, (4) the rulings, (5) the standard method of measurement (SMM) and (6) speed. According to the author, 'process' was defined as the difficulty in knowing what to do next. The 'calculations' denoted not understanding how to carry out the numerical calculations. The term 'technology' was used to represent problems relate to the inability to understand the building processes. The difficulties associated with the use of a book comprising of rules of measurement were classified under 'Standard Method of Measurement' (SMM). The 'rulings' was the failure to know how to use the specialist paper used for measurement purpose. The 'speed' was defined as the ability of the lecturer to teach either too fast or too slow [6].

### *B. Teaching Approaches of Building Measurement*

Wong et al. [3] assessed the video-based e-learning approach in building measurement unit in Hong Kong. The findings of the study indicated that students were not satisfied with the design as well as the content of the instruction videos. However, the students suggested that e-learning approach helps to enhance the teaching and learning process of the building measurement since the approach allows students to access the resources outside of the lecture or seminar rooms. The study also indicated that the blended learning method, which is the combination of face-to-face and e-learning, is an important approach to deliver building measurement unit. Similarly, [7] investigated the use of video and interactive PowerPoint as a teaching method to aid learning and to enable students to acquire the skills for measuring construction works. The author used questionnaires as an instrument for collecting the opinions of the students regarding the use of video and interactive PowerPoint as a tool to support students' learning. The findings of the research indicated that the teaching methods helped the unit to be delivered efficiently. Furthermore, the study opined that the students' learning experience was enriched and they were able to understand the unit better. Nonetheless, the author suggested that the teaching method which aids to improve the skills required for interpreting construction drawings should be developed separately. Additionally, [8] argued the significance of adopting the traditional building measurement teaching methods which help to develop the reading and interpretation of the construction drawings. The author opined that manual building measurement must be used to achieve the required learning objectives; however, it should be supplemented but not substituted by the software. Likewise, [1] developed e-learning measurement packages utilizing 3D images. The authors blended construction technology while teaching building measurement. They used software packages such as Camtasia Studio and Google SketchUp to develop the quantity surveying (QS) teaching materials. To evaluate the suitability of the teaching materials, a follow-up survey was conducted and the finding indicated that the materials were useful. Also, [9] compared the instructional pedagogies which can be applied in teaching math-related units in construction management. The authors compared traditional lecture, problem-based learning, and flipped classroom instructional models and found a problem-based learning approach as the most suitable model.

### III. RESEARCH METHODOLOGY

The three main approaches used in educational research include qualitative, quantitative and mixed research [10]. The quantitative research approach primarily follows the confirmatory scientific method as it mainly emphasizes on hypothesis testing, whereas qualitative research approach is used to provide detailed explanations for phenomena and to generate a new hypothesis [10]. Similarly, [11] mentioned that the qualitative research approach explores the reason why certain phenomena occur. According to the authors, this

approach helps to understand the meanings which people ascribe to events and processes. In this research, the qualitative approach is adopted to explore why some students fail to understand the principles and practices of measurement which are delivered in Building Measurement unit.

#### *A. Methods of Data Collection and Analysis*

Interviews and focus group are the two most common methods deployed to collect qualitative data [12]. Furthermore, desk research can also be adopted when secondary data is available for analysis [13]. According to [13], desk research is quick, cheap and makes a good starting point for any research. This research used secondary data (eVALUate survey data) since student's opinions on the unit site is readily available and the analysis of the eVALUate data can also be used as a starting point for future similar studies which attempt to develop tools that help to enhance the teaching and learning process in Building Measurement unit. The qualitative data (eVALUate survey data), which was used to identify the key challenges related to the delivery of the Building Measurement unit, was obtained from the unit's library from 2015 to 2019. To arrive at valid conclusions, data from one year may not be sufficient. Hence, eVALUate survey data from the last five years was chosen for analysis.

Dey [14] mentioned that qualitative data analysis involves the description of phenomena, classification, and observation of how the concepts might interconnect. According to the author, during the analysis, progress is made from the initial description of the data, through the decomposition of the data, and finally observing how the ideas could interconnect to form a new theme. Additionally, [15] described that qualitative data analysis can be carried out in three stages which include data reduction, data display, and drawing conclusions. On the other hand, [16] described that data reduction is a process of sorting, discarding and organizing the data. Further, [16] proposed methods of data reduction such as clustering, coding and summarizing.

To reduce data obtained from the eVALUate surveys, this study adopted data summarizing technique since it helps to recapitulate students' opinion about the Building Measurement unit. After the data is reduced, alternative methods of data displaying such as matrix, network, graph and chart can be adopted [15]. The eVALUate surveys data were summarized and presented in a matrix format since it is convenient to display the summary of the students' feedback in a table format. After displaying the data, conclusion can be drawn using various techniques such as observing patterns of differences and/or similarities between categories or processes; clustering the themes; making contrasts and comparisons; or noticing relationships among ideas [15]. NVivo qualitative data analysis software was used to identify the themes which arise from the students' feedback regarding the delivery and the contents of the Building Measurement unit. Hence, the key challenges in the delivering of the unit were identified by analyzing the patterns of the students' feedback and formulating themes which arose during the analysis of the eVALUate survey data.

#### IV. FINDINGS AND DISCUSSIONS

The eVALUate survey questionnaire comprises two major parts. In the first part, students were asked to provide their opinion using five response scales: strongly disagree (SD), disagree (D), Agree (A), strongly agree (SA) and unable to judge (UJ). This section of the survey was not used in the analysis since it does not provide an opportunity for the students to express their views. In the second part of the questionnaire, the students were requested to provide their opinion using open-ended question such as ‘how do you think this unit might be improved?’ Hence, this study used the second part of the questionnaire.

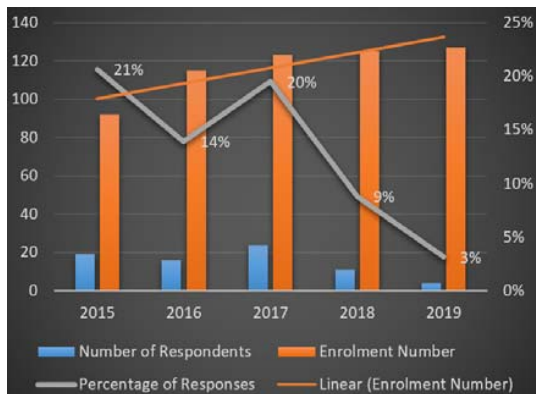


Fig 1 Enrolment number and Percentage of Responses

Fig. 1 shows the total enrolment in a unit, the number of respondents, the percentage of responses and the trend of enrolment. Accordingly, the trend for the response rate is declining from 2015 to 2019. The percentage of response was 21% in 2015 whereas the response rate is only 3% in 2019. Nonetheless, the trend in the enrolment number has increased. This shows that students enrolled in the building measurement unit are reluctant to evaluate the unit. Thus, some incentive mechanisms should be proposed to increase the response rate. For instance, filling the eVALUate questionnaires could be made mandatory by the university.

The results of the longitudinal data analysis from 2015 to 2019 are presented in the subsequent section. In Fig. 2, the word cloud of the eVALUate survey data for 2015 is presented. The finding shows that ‘unit’, ‘understand’, ‘content’, ‘class’, and ‘questions’ are found to be the most frequent words. The weighted percentages of these words are 3.03%, 1.82%, 1.52%, 1.52% and 1.21%, respectively.

The in-depth text query for the most frequent words was also carried out to understand the underlying challenges. However, for the sake of brevity, the word tree for the node “unit” is presented in Fig. 3. Accordingly, the difficulties associated with the unit in 2015 are found to be the lack of sufficient resources in the unit site. This finding is similar to what [2] found in the context of Nigeria in which the authors identified the availability of insufficient exercises or examples as learning difficulties.



Fig. 2 Word cloud for 2015 Survey Data

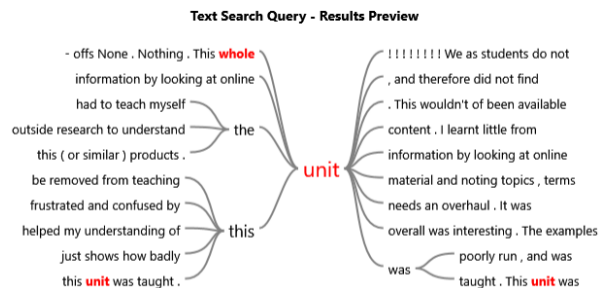


Fig. 3 Word Tree for the Node ‘Unit’ in 2015 Survey Data

The results of the analyses of the 2016 eVALUate survey data are presented in Figs. 4 and. 5. Based on the word cloud indicated in Fig. 4, the most frequent word is found to be ‘assignment’ with a weighted percentage of 4.19%. This is followed by ‘unit’, ‘understand’, and ‘calculations’ having weighted percentages of 2.22%, 1.85% and 1.72%, respectively.

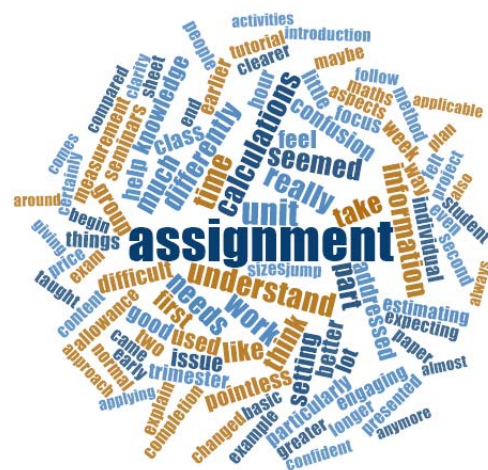


Fig. 4 Word Cloud for 2016 Survey data

To further understand the issues underlying the word 'assignment', the word tree which was obtained using the text search query is presented in Fig. 5. Accordingly, difficulty to work as a group on the assessment task was identified as the main challenges of the unit in 2016. Some students mentioned that they do not want to work as a group as some of the group members were unwilling to contribute to the assignment. On the other hand, if the students do not work on the group assignments, the chance of learning from their peers could be low. Further, if the students do not practice the measurement exercises included in the group assignment, they could fail the unit due to the hurdle requirement in the exam. Hence, the unit learning outcome might not be achieved. This finding is different from the findings obtained in other countries in which the issues related to the assignment were not identified as the main learning difficulties [6], [2].

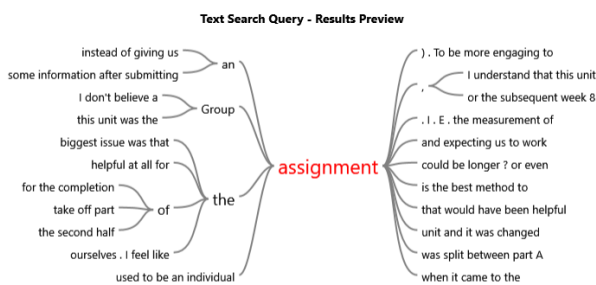


Fig. 5 Word Tree for the Node 'Assignment' in 2016 Data

In Fig. 6, the word cloud of the eVALUate survey data for 2017 is presented. Accordingly, the words such as 'exam',

'assignment', 'unit', 'students' and 'group' with the weighted percentages of 2.83%, 2.46%, 1.72%, 1.35%, and 1.23%, respectively are found to be the most frequent nodes.

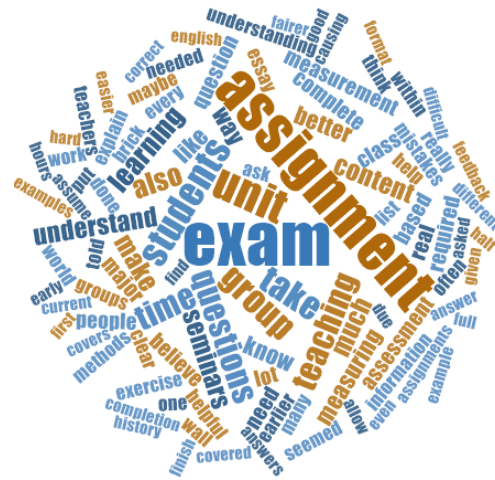


Fig. 6 Word Cloud for 2017 Survey data

The text query result for the word 'exam' is provided in Fig. 7. The result shows that some students were frustrated before sitting for the exam. Further, other students mentioned that they could not finish the exam within the allocated time frame. Thus, the inadequacy of the time allotted for the exams is identified as the main challenge of the unit in 2017.

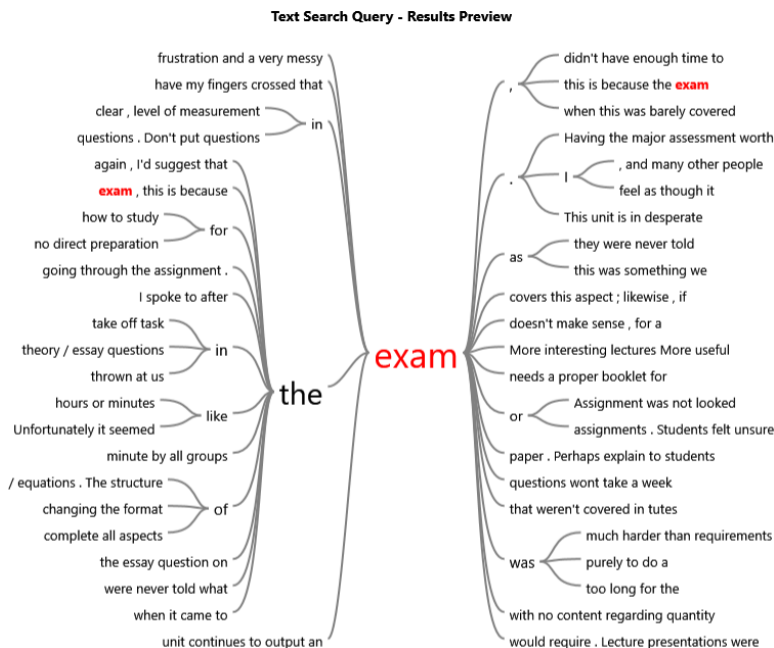


Fig. 7 Word Tree for the Node 'Exam' in 2017 Data

Similar to 2016, the issues related to the group assignment is also found as one of the challenges in 2017. The



respondents mentioned that students completing some part of the group assignment will be disadvantaged during the examination. For instance, if the exam covers substructure and students who have done superstructure in the assignment will be disadvantaged. However, in a group assignment, the students are expected to understand all aspects of the assignment which are executed by other group members. The result suggested that some students could fail to achieve one of the graduate learning outcomes, which is teamwork.

The outputs of the analysis of the 2018 survey data are shown in Figs. 8 and 9. Accordingly, 'exam', 'unit', 'class', and 'seminar' are found to be the most frequent keywords with the weighted percentage of 3.11%, 2.67%, 2.22% and 1.78%, respectively. The main finding of 2018 is similar to that of 2017 in which exam was also found to be the key learning challenge of the unit.

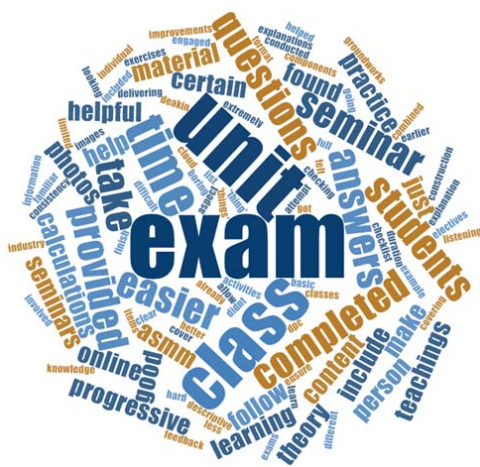


Fig. 8 Word Cloud for 2018 Survey data

In Fig. 9, the word tree for the keyword with the highest weighted percentage or 'exam' is shown. Accordingly, the lack of sufficient questions for exam preparation is found to be the main learning difficulties. Some students also mentioned that exclusion of theory question from the exam was one of the challenges. However, this finding contradicts with the opinions of students in 2017 in which some students suggested that essay or theory questions should not be included in the exam.

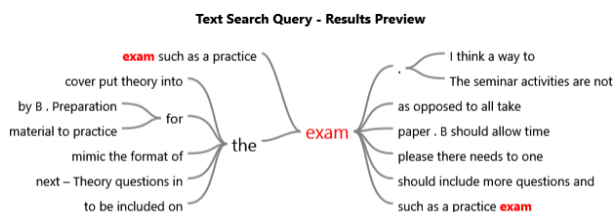


Fig. 9 Word Tree for the Node 'Exam' in 2018 Data

In 2019, the analysis of the data revealed that the keywords 'seminars' and 'classes' with the weighted percentage of 4.50% and 3.60%, respectively, are found to be the most

frequent nodes (refer Fig. 10). Likewise, in 2018, the word 'class' was found to be a frequent word. However, the issues associated with the class in 2018 are related to the scheduling of classes prior to seminars and the inclusion of more calculations in classes. On the other hand, in 2019, the challenge associated with the class is the need to schedule class and seminar on the same day. Some students suggested that it would be hard for them to come to the university since they have work commitments. In other words, they prefer to attend the seminar and class on the same day.



Fig. 10 Word Cloud for the 2019 Survey data

In Fig. 11, the text search query for the word 'seminars' is presented. Accordingly, the main difficulty of the unit in 2019 is found to the inadequacy of the time allocated to some seminar sessions.



Fig. 11 Word Tree for the Node 'Seminars' in 2019 Data

To understand the overall challenges of the building measurement unit, the data from 2015 to 2019 were combined and feed into the Nvivo software for further analysis and the output is presented in Fig. 12.

Overall, the keywords such as unit, assignment, exam, time and class with the weighted percentages of 2.09%, 1.72%, 1.72%, 1.15% and 1.04% are found to be the most frequently mentioned words. After analyzing the word tree of these keywords, the following learning difficulties for the building measurement unit are obtained.

#### A. Difficulty in Managing Group Assignment

Some respondents mentioned that the group assignments will not provide the students with an opportunity to learn some aspects of the measurement unit. Other students opined that

the students learned some information after submitting an assignment that would have been helpful for the completion of the assignment. Some respondents suggested that the major assignment should be submitted as an individual, not as a group.



Fig. 12 Word Cloud for Survey data from 2015 to 2019

#### *B. Inadequate Knowledge of Mathematics and Construction Technology*

Some students responded that the maths involved in the unit was formatted and laid out very differently from what they were taught in secondary schools. Other respondents stated that the teaching staff assumes that students had a thorough understanding of the construction materials and methods and rushed while discussing these parts. They also proposed a slower pace of teaching with progressive learning to cover individual components thoroughly before moving onto the next section. Prior to undertaking building measurement unit, students are required to complete the pre-requisite units which helps them to understand the drawings and construction methods. However, the finding suggests that some students might fail to acquire fundamental knowledge in other units. Consequently, the building measurement was found to be a challenging unit for them.

#### *C. Lack of Sufficient Time to Practice Seminar Questions*

Some respondents suggested that it would be wise to run numerous seminars with multiple tutors to help each group, in two-hour seminar sessions, not in one-hour seminars. Other students described that seminars always feel very rushed, even with small class sizes. This shows that additional hours might be required for some of the seminars or the seminar activities which should be completed in one hour should be re-designed.

#### *D. The Inflexibility of the Class and Seminar Timetables*

Some respondents recommended that seminars should be scheduled after the classes. They preferred to have a class and seminar on the same as they have work commitments. This finding showed that the students were unable to attend seminars and classes regularly, and this could affect the

learning experience of the unit. Construction measurement usually requires practicing numerous exercises with the help of a tutor or lecturer. However, if the students do not attend the seminars and lectures on a regular basis, they might not get a deeper understanding of the measurement principles and practices. Though the recordings of seminars and lectures could be available online, getting one on one support can enhance the students' knowledge.

#### V. CONCLUSION

The purpose of this research is to explore the learning difficulties associated with the building measurement unit at the School of Architecture and Built Environment, Deakin University. The findings of longitudinal data analysis from 2015 to 2019 revealed the following learning difficulties. In 2015, the main challenge is found to be the lack of sufficient learning resources. However, in 2016, the inability to manage the group assignments is identified as the key learning deterrent. On the other hand, in 2017, the inadequacy of time allocated during the exam is identified as a critical problem. In 2018, the lack of sufficient questions for exam preparation is found to be the major learning difficulty. In 2019, the major issue is the inadequacy of the time allocated to some seminar sessions. The above findings showed that the learning challenges vary from year to year. This could be due to the variations in the characteristics of the students who are enrolled in the unit in a particular year.

Overall, the analysis of the five years of data revealed that, 'insufficient resources for exam preparation', 'difficulty in managing group assignment', 'inadequate knowledge of mathematics and construction technology', 'lack of sufficient time to practice seminar questions', and 'inflexibility of the class and seminar timetables' are found to be the major learning challenges of the building measurement unit.

The output of this research can be used as a basis for improving the unit. The school of Architecture and Built Environment can propose practical solutions to the identified learning difficulties. For instance, the timetable for seminars and classes can be adjusted on the basis of students' feedback. This study has some limitations. First, the response rates in 2018 and 2019 are very low and this could affect the validity of some of the conclusions of this research. Second, the opinions of the teaching staff were not analyzed and this could also affect the findings of this study. Therefore, future researchers can collect additional data and validate the findings of this research. Moreover, they can seek the opinions of the teaching staff and conduct further analysis.

#### REFERENCES

- [1] G. Hodgson, W. Sher, and M. Mak, "An e-learning approach to quantity surveying measurement," *CIB W89 International Conference on Building Education and Research: Building Resilience (BEAR 2008)*, Heritage Kandalama, Sri Lanka, 2008, pp. 1639-1649.
- [2] P. F. Tunji-Olayeni, L. M. Amusan, I. O. Omuh, A. O. Afolabi and R. A. Ojelabi, 2016, "Learning difficulties in building measurement," *International Technology, Education and Development Conference (INTED)*, Valencia, Spain, pp.6013-6016, 2016.
- [3] J. K. Wong, O. T. Olatinrin, C. M. Ho, E. Guilbert and R. Kam, 2018. "Assessment of video-based e-learning in a construction measurement

- course," *International Journal of Construction Management*, 1-7, DOI <https://doi.org/10.1080/15623599.2018.1435152>.
- [4] A. Williams, W. Sher, C. Simmons, A. Dosen and B. Pitt, *Construction education in Australia: a review of learning and teaching challenges and opportunities*, Sydney, Australia, Australian Learning and Teaching Council, 2009.
  - [5] E. Badu and P. Amoah, *Quantity surveying education in Ghana* (Online), 2004, Available: [www.icoste.org/GhanaEdu.pdf](http://www.icoste.org/GhanaEdu.pdf) (Accessed 23 July 2019).
  - [6] S. Ostrowski, "Solutions to the pedagogical difficulties with measurement in quantity surveying," *RICS Construction and Property Conference*, Salford, UK, 2011.
  - [7] C. Lee, "An Interactive Approach To Teaching Quantity Surveying Measurement," *International Conference of Education, Research and Innovation (ICERI2013)*, Seville, Spain, 2013.
  - [8] F. P. McDonnell, *The Relevance of Teaching Traditional Measurement Techniques to Undergraduate Quantity Surveying Students* (Online), 2010, Available: <https://arrow.dit.ie/cgi/viewcontent.cgi?article=1024&context=beschreart> (Accessed 23 July 2019).
  - [9] N. Lee, L. W. Lee and J. Kovel, "An experimental study of instructional pedagogies to teach math-related content knowledge in construction management education," *International Journal of Construction Education and Research*, 12(4), 255-269. 2016.
  - [10] B. Johnson and L. B. Christensen, *Educational research: quantitative, qualitative, and mixed approaches*, California, SAGE Publications, 2014.
  - [11] R. Fellows and A. Liu, *Research methods for construction*, Oxford, Blackwell, 2015.
  - [12] P. Gill, K. Stewart, E. Treasure, and B. Chadwick, "Methods of data collection in qualitative research: interviews and focus groups," *British dental journal*, 204(6), pp. 291-295, 2008.
  - [13] S. Crouch and M. Housden, *Marketing research for managers*, Oxford, Routledge, 2012.
  - [14] I. Dey, *Qualitative data analysis: a user-friendly guide for social scientists*, New York, Routledge, 1993.
  - [15] S. Rose, N. Spinks and A. I. Canhoto, *Management research: Applying the principles*, London, Routledge, 2014.
  - [16] M. B. Miles, A. M. Huberman, M. A. Huberman and M. Huberman, *Qualitative data analysis: An expanded sourcebook*, California, Sage, 1994.