Factors Affecting Students' Learning in Civil Engineering Measurement

Factors Affecting Students' Learning in Civil Engineering Measurement

P *P F TUNJI-OLAYENI[1,2]; K KAJIMO – SHAKANTU[1]; T O AYODELE[1] , and KZ EMMANUELA[2]
[1]Department of Quantity Surveying and Construction Management, University of the Free State, South Africa;
[2]Department of Building Technology, Covenant University, Nigeria;
*pat.tunji-olayeni@covenantuniversity.edu.ng

Abstract
The purpose of this study is to assess the factors affecting students' learning in civil engineering measurement, with a view to enhancing students learning experiences and outcomes. The methodology adopted for this research was quantitative with the use of questionnaires distributed to 30 civil engineering students in their 3rd year, studying at a Nigerian university. The measurement of items in the survey questionnaire was based on a 5 point Likert scale. The data from the survey were analysed using descriptive statistics such as percentages and mean scores. The data from the survey were also presented in the form of pie chart and table. Teaching style was found to be the most significant factor affecting students' learning in civil engineering measurement. Other significant factors were factors that had to do with the nature of the course which included difficulty with understanding the measurement process, measurement calculations, standard method of measurement (SMM), taking off sheet and terminology and acronyms. The findings also provided additional evidence to support a conducive learning environment and the use of teaching aids in enhancing learners' experiences. The study focused only on civil engineering students from one university in Nigeria. More empirical evidence of the factors affecting students' learning in civil engineering measurement can be obtained by considering other universities within and outside Nigeria. The findings place great responsibility on lecturers to improve their teaching styles. Moreover, the use of sufficient examples during teaching, and the use of 3D drawings such as Revit would greatly enhance the learning experiences of students in civil engineering measurement.

Keywords: affective element, epistemology, learning experiences, Nigeria, ontology, Revit, teaching style

1. Introduction

Civil engineering measurement is a fundamental skill that is required in the evaluation of the cost of proposed works and the calculation of final accounts for work executed. Moreover, civil engineering measurement is calculation based and it requires considerable skill in mensuration and a good understanding of civil engineering design and construction. However, it has been found that students generally have learning difficulties with calculation courses. For example, Williams et al. [1] reported that secondary school students believe physics is boring because it is considered a difficult subject. Moreover, Barton, [2] and O'Connor, [3] noted that students have difficulty in understanding the specialized mathematical language. Since civil engineering measurement relies on the principles of mensuration in mathematics and it is perceived as a difficult subject, this study aimed at identifying

and assessing the factors affecting students' learning in civil engineering measurement, with a view to enhancing students learning experiences and outcomes.

2. Literature Review

2.1 Learning Theories

There are five major learning theories identified in literature namely: behaviorism, cognitivism, constructivism, social learning, connectivism.

Behaviorists believe that a learner is passive and that behavior is learned by observing the environment. They also believe that behavior can be positively or negatively reinforced by the use of rewards and punishments. Major contributors to behaviorism include Ivan Pavlov, Albert Bandura, and B.F. Skinner. The cognitive theory of learning focuses on the use of the mind in the learning process. It is based on the belief that learning emanates from the internal stimuli (the learner's mind) rather than the external environment as believed by behaviorism theorists. Proponents of the cognitive theory view the learner as an active participant in the learning process who comes into the learning situation with knowledge, skills and related experiences. Foremost proponents of the cognitive theory include Jean Piaget, Jerome Bruner, and David Ausubel. Constructivism is a learner-focused paradigm on learning where learners construct their knowledge, learn by doing, actively participate in learning and make use of critical-thinking skills. Lev Vygotsky, John Dewey, Jerome Bruner, and Jean Piaget contributed significantly to constructivism. The Social Learning theory was advanced by Albert Bandura. The theory is based on the belief that learning occurs by observing and modeling the behaviors, attitudes and emotional reactions of others. George Simens and Stephen Downes introduced the connectivism theory of learning in 2005. The theory centers on the effect of technology on communication and learning. Connectivism is based on the belief that learning can also take place in a non-human environment like an online community or a database.

2.2 Factors affecting students' learning

Several factors have been identified in the literature as affecting students' learning. Luben et al. [4] identified three factors that affect students' learning. These factors are the experience of the teacher, availability of textbooks and teaching facilities available in the school like teaching aids and technology. Luben et al. [4] further revealed that factors such as family issues, financial difficulties, and academic workload also affect students' learning.

Linskie [5] identified three necessities that facilitate students' learning. These include physical needs, emotional needs, and social needs. Linskie [5] described physical needs as the physical state of the student and classroom environment. Comeaux [6] specifically noted that students with learning facilities performed better than students who do not have learning facilities. Kirmani et al. [7] found a positive relationship between students' performance and the availability of such facilities as a library and computer laboratory in the academic environment. Young [8] noted that students' performance has a positive correlation with the availability of learning facilities in the school environment.

Cox [9] highlighted three teacher-centered factors that would promote an effective learning environment. These are (1) good human relationship (2) correct motivation and (3) having good communication. Trigwell et al. [10] indicated a positive relationship between teaching approach and students' learning.

Hassan et al. [11] identified six factors affecting students' learning: They are (1) students' attitude before and after attending class, (2) the strategies adopted by students for comprehending the lecture, (3) size and condition of the class, (4) importance of the lecture, (5) extra efforts made by students outside the class and (6) convenience of the classroom and importance of listening to lecture.

Ojelabi et al. [12] noted that students' learning can be greatly influenced by the lecturer's capacity, lecturing style, and learning facilities.

Ostrowski [13] grouped the factors affecting students' learning into three categories namely: epistemological factors, ontological factors, and factors relating to the affective element. Bauer [14] describes epistemology as the fundamental assumption about the nature of knowledge and learning. Research results from university students indicate that epistemological factors affect students' learning. For example, Schommer et al. [15] carried out a survey to determine whether there is a relationship between students' epistemological beliefs and their interpretation of information and meta comprehension of written text. The findings from the research indicated that the more university students believe in simple knowledge the worse their comprehension, meta comprehension, and test performance. Moreover, Kardash and Howell [16] studied the relationship between students' epistemological beliefs, cognitive process, and strategies adopted for comprehension. The study found out that students with naïve beliefs about the speed of learning used fewer processing strategies, unlike their peers who believe that learning should take place quickly.

Ostrowski [13] highlighted the epistemological factors affecting students' learning in construction measurement including understanding the SMM (Standard method of measurement), understanding rulings in the taking-off sheet, ability to interpret AutoCAD drawings and ordinary drawings, understanding the process of measurement, understanding calculations in measurement, knowing how to use vocabulary and acronyms in measurement.
Ontology has been described as a branch of metaphysics concerned with the nature of being (existence). Foremost philosophers in the field of ontology include Aristotle, Christian Wolff, Edmund Husserl, and Martin Heidegger. These philosophers explain ontology as the essence of being. They ask the following questions to shed more light on the concept of ontology: what is being?, How it is?, How much it is? where it is? and its relation to other beings. Ostrowski [13] described ontological factors affecting students learning in construction measurement in terms of the 'howness' of being, how much it is and its relation to other beings. Ostrowski [13] highlighted the following ontological factors affecting students learning in construction measurement: conduciveness of the construction measurement classroom, availability of drawings in construction measurement class, teaching approach of the construction measurement lecturer and the availability of study groups and student tutors.
The affective element generally refers to students' attitudes and motivations towards learning [17]. Ostrowski [13] noted three affective elements influencing students' learning in construction measurement. They are the enjoyment of construction measurement classes, anxiety during construction measurement classes and the ability to retain knowledge gained after each construction measurement class.

3. Research Methodology

The methodology adopted for this research was quantitative. The study utilized a descriptive research design. The respondents comprised of all the 30 third year students of civil engineering studying at a Nigerian university. The civil engineering module is offered at the third year of the civil engineering programme. The questionnaire consisted of epistemological, ontological and affective items affecting students' learning as identified by [13].
The measurement of items in the questionnaire was based on a 5 point Likert scale with 1 representing "strongly disagree" and 5 representing "strongly agree". A mean range was used to categorize the significance level of the factors affecting students' learning in civil engineering measurement. The mean categorization was as follows:
$5.00 \geq x \geq 4.50$ = extremely significant
$4.49 \geq x \geq 3.50$ = very significant

$3.49 \geq x \geq 3.00$ = somewhat significant
$2.99 \geq x \geq 1.00$ = not significant
The data from the survey were analysed using descriptive statistics such as percentages and mean scores. The data from the survey were also presented in the form of pie chart and table.

4. Results and Discussions

4.1 Demographic Information of the Respondents

The only demographic detail considered in this study was gender. Fig 1 indicates that 27% of the respondents were females, while 73% were males. This result is typical of most construction related programmes because construction is a male dominated profession [18, 19].

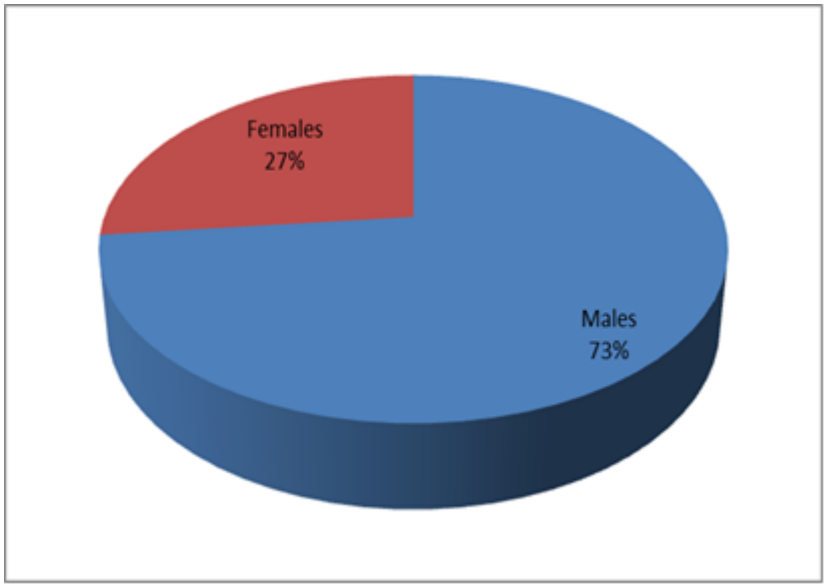

Fig 1: Gender analysis of the respondents

4.2 Factors affecting students' learning

The most important factor affecting students' learning in civil engineering measurement is lecturer's speed with a mean score of 4.60 (Table 1). This mean score lies within the range of $5.00 \geq x \geq 4.50$, indicating that lecturer's speed was an extremely significant factor affecting students' learning in civil engineering measurement. This finding is similar to the study of Tunji-Olayeni et al. [20] which indicated that lecturers' speed was one of the factors affecting students learning in building measurement. There is a need for lecturers to slow down their pace of lecture delivery particularly in calculation based courses such as civil engineering measurement, to ensure that the majority of students offering the module comprehend each topic. Even though the fast pace of delivering the civil engineering module may be due to the lecturers teaching style or the need to complete the syllabus, there should be a balance between students comprehension and the need to finish the module syllabus within a specified semester.

This will enhance students' comprehension of the module and also increase the chances of completing the module. Moreover, the factor 'lecturer's speed' is an ontological factor which relates to how the knowledge of civil engineering has been transferred to the students. Ontology in measurement modules includes the manner in which the module has been delivered [13]. Ontology also describes

the way knowledge has been communicated to facilitate knowledge comprehension and sharing [21]. The ontology of civil engineering measurement as indicated by the results of this study shows that the transfer of knowledge has been quite fast and was one of the factors affecting the learning of students in the module.

Table 1: Factors affecting students' learning

Factors	N	Mean	Rank	Remark
Lecturer's speed	30	4.60	1	extremely significant
Measurement process	30	4.30	2	very significant
Measurement calculation	30	3.87	3	very significant
Understanding SMM	30	3.77	4	very significant
Taking off sheet	30	3.70	5	very significant
Terminologies and acronyms	30	3.53	6	very significant
Retain knowledge	30	3.47	7	somewhat significant
Anxiety in class	30	3.27	8	somewhat significant
Enjoy the classes	30	3.10	9	somewhat significant
Study group	30	3.07	10	somewhat significant
Student tutors	30	3.03	11	somewhat significant
Interpret AutoCAD drawings	30	2.50	12	not significant
Interpret ordinary drawings	30	2.40	13	not significant
Conducive classes	30	2.37	14	not significant
Use of drawings during lectures	30	1.93	15	not significant

The results of the survey (table 1) further showed that comprehension of the measurement process (4.30), measurement calculations (3.87), the SMM (3.77), the taking off sheet (3.70) and terminologies and acronyms (3.53) were the subsequent factors affecting students' learning in civil engineering measurement. The mean values for these factors were > 3.50 and < 4.50, indicating that the factors were very significant in affecting students learning in civil engineering measurement.

Moreover, these factors are epistemological in nature, stemming from the content of the civil engineering module. Epistemology deals with the nature and variety of knowledge [22]. It also describes the content of the knowledge offered [23]. The difficulties associated with comprehension of the measurement process, measurement calculations, taking off sheet, terminologies and acronyms may suggest that the civil engineering module is not easy to grasp particular at the first instance, and may require that lecturers go through the concepts in the module constantly to enhance students' comprehension. The results imply that the difficulty in comprehending the contents of the civil engineering module is combined with the fast pace of lecture delivery, thereby compounding the learning difficulties of students in the module.

In addition, the findings (table 1) identified three factors of the affective element which affected students' learning in civil engineering measurement. The factors were 'retaining knowledge' (3.47), 'anxiety in class' (3.27) and 'enjoy the class' (3.10). The mean scores of these factors were > 3.50 and

< 3.00, this shows that all the three factors of the affective element had a somewhat significant effect on students' learning in civil engineering measurement.

The two least factors affecting students' learning in civil engineering measurement were conducive classes and the use of drawings during lectures, with mean values of 2.37 and 1.93 respectively. These mean values were > 1.00 and < 3.00, indicating that these factors were not significant. This finding indicates that the use of drawings during classes and a conducive classroom did not negatively affect the students learning. This also suggests that the use of teaching aids such as drawings Omuh et al. [24] and conducive learning environment [12] enhances learners' outcomes.

To improve students learning experiences in the course, much attention has to be given to both the epistemology and ontology of the course. In this case the nature of civil engineering measurement and how it is taught. As suggested by Tunji-Olayeni [20] lecturers have to use sufficient illustrations to enhance students' comprehension of the course. The use of 3D drawings such as Revit and other instructional videos can greatly improve students understanding of the course. Omuh et al. [24] also suggested the use of creative methods in the teaching of calculation based courses to improve students' interest and performance. The adoption of the aforementioned suggestions can help reduce the difficulties associated with the epistemology or nature of civil engineering measurement.

To address the ontological (lecturer's speed) issue identified in the study, it is suggested that lecturers find a balance between students' comprehension and completing the module syllabus within a specified semester. Tunji-Olayeni et al. [19] noted that lecturers play a crucial role in enhancing the learning experience of students. The seemingly difficult or complex nature of the course requires that lecturers take time to explain basic arithmetic mensuration which is the foundation for civil engineering measurement, while also attempting to complete the module syllabus.

5. Conclusion and Recommendations

Factors affecting students' learning in civil engineering measurement were assessed. Teaching style was found to be the most significant factor affecting students' learning in civil engineering measurement. Other significant factors were factors that had to do with the nature of the course.

The study recommends that lecturers of civil engineering measurement should adopt appropriate teaching styles such as a slower teaching pace. Other recommendations include the use of sufficient examples during teaching, and the use of 3D drawings such as Revit.

References

[1] Williams, C., Stainsstreet, M., Spall, K., Boyes, E and Dickson, D, 2003, Why aren't secondary school students interested in Physics. Physics Education, 38 (4), pp. 324-329.

[2] Barton, M. L., Heidema, C and Jordan, D, 2002, Teaching Reading in Mathematics and Science. Educational Leadership, 60(3), pp. 1-8

[3] O'Connor, M. M., Kanja, C. G. & Baba, T, 2000, The open-ended teaching approach in mathematics Education, Nairobi; Kenya: SMASSE PROJECT.

[4] Lubben, F. Davidowitz, B. Buffler, Allie, S and Scott, I, 2010, Factors influencing student's persistence in an undergraduate science programme: A South African case study. International Journal of Educational Development. 30, pp.351-358

[5] Linskie, R, 1977, The Learning Process: Theory and Practice, New York, Van Nostrand

[6] Comeaux, B, 2005, Environmental Predictors of Academic Achievement among Student-Athletes in the Revenue-Producing Sports of Men Basketball and Football, The Sport Journal, 8 (3)

[7] Kirmani, N.S, and Siddiquah, A, 2008, Identification and Analysis of Factors Affecting Students Achievement in Higher Education.2nd Proceeding of the 2nd International Conference on assessing quality in higher education, pp. 425-437

[9] Cox, B, 2013, Practical Pointers for University Teachers, e-book, Routledge, London, pp.1-176

[10] Trigwell, K., Prosser, M. & Waterhouse, F, 1999, Relations between teachers' approaches to teaching and students' approaches to learning. Higher Education and Research, 37, 57-70.

[12] Ojelabi, R, Afolabi, A, Tunji-Olayeni, P, Amusan, L and Omuh, I (2017). Learning adequacy of Nigerian tertiary educational system for sustainable built environmental courses. Turkish Online Journal of Educational Technology , 395-404

[13] Ostrowski, S, 2011, Solutions to the pedagogical difficulties with measurement in quantity surveying. COBRA 2011 - Proceedings of RICS Construction and Property Conference. 715-725.

[14] Bauer, J Festner, D Gruber, H, Harteis, C, Heid, H, 2004, The effects of epistemological beliefs on workplace learning. Journal of Workplace Learning, 16 (5), pp. 284 – 292

[15] Schommer, M., Crouse, A., & Rhodes, N, 1992, Epistemological beliefs and mathematical text comprehension: Believing it is simple does not make it so. Journal of Educational Psychology, 84 (4), 435-443

[16] Kardash, C. M., & Howell, K. L, 2000, Effects of epistemological beliefs and topic-specific beliefs on undergraduates' cognitive and strategic processing of dual- positional text. Journal of Educational Psychology, 92, pp. 524-535.

[17] Rowe, K.J, 1995, Literacy, teaching and learning. An International Journal of Early Literacy, 1 (2), 57-110.

[18] Afolabi, A. O., Tunji-Olayeni, P. F., Oyeyipo, O. O., and Ojelabi, R. A. (2017). The socio-economics of women inclusion in green construction. Construction Economics and Building, 17(1), 70-89.

[19] Tunji-Olayeni, P. F, Omuh, O. I., Amusan L. M., Afolabi, O. A., Ojelabi R. A. & Ogundipe, K. E. (2017). Attracting and Retaining Female Students in Construction Related Programs Turkish online journal of educational technology. Special issue for INTE 2017. 425-430

[20] Tunji-Olayeni, PF, Amusan, LM, Omuh, IO, Afolabi, AO, Ojelabi, RA. (2016) Learning difficulties in building measurement. Proceedings of INTED2016 Conference, 7th-9th March 2016, Valencia, Spain

[21] Fensel, D., Crubezy, M., van Harmelen, F and Horrocks, I, (2000): OIL & UPML: A Unifying Framework for the Knowledge Web. In Proceedings of the Workshop on Applications of Ontologies and Problem-solving Methods, 14th European Conference on Artificial Intelligence ECAI'00, Berlin, Germany August 20-25,

[22] Brown, L. (Ed.) (1993). The new shorter Oxford English dictionary on historical principles. Oxford: Clarendon Press

[23] Cunningham, JW and Fitzgerald, J (1996)Reading Research Quarterly, 31, 1 (Jan. - Feb. - Mar., 1996), pp. 36-60

[24] Omuh, I.O., Amusan, L.M., Ojelabi, R.A., Afolabi, A.O and Tunji-Olayeni, P.F.(2017). Learning difficulties in the study of structural analysis in tertiary institutions. Turkish Online Journal of Educational Technology, Special Issue for INTE 2017, November 2017, 395-403