Evaluation of the Effects of Independent Data Assignment (IDA) Method as a mean of Enhancing the Competence of Nigerian Engineering Students

*[1]Christopher Fapohunda, [2]Bolatito Akinbile
[1]Department of Civil Engineering, Federal University Oye Ekiti, Nigeria
[2]Department of Building, The Polytechnic Ibadan, Nigeria.
christopher.fapohunda@fuoye.edu.ng

Abstract— Understanding basic principles of engineering by students requires practise by hand calculation of simple problems which is usually accomplished through assignments. This paper reports the results of a method called Independent Data Assignment (IDA) which enables the teacher to generate multi-variables independent data for every student, many times in a teaching period, irrespective of the student population, in such a way that no two students have the same data set for any given assignment, by using the MS-Excel software package. Structural engineering was used as case study. The responses from the questionnaire administered were analysed from which it was found that 91.7% of the students agreed that it helped them in doing independent work and 95% said the method encouraged learning. It can thus be concluded that IDA is an effective tool for effective course delivery, and a model for teachers of courses in engineering with large class.

Keywords— Civil Engineering, Examinations, Evaluations, Hands-on-Experience, Structural Engineering

———————————— ◆ ————————————

1   INTRODUCTION

Computer has become the most important technological invention of the present human civilization that has fundamentally changed the way we do things (Sidelinger and Ayash, 2006 and[1] Judge, 2014). Computers have simplified, and are simplifying many complications in all the fields of human endeavours: at offices, schools, home, industries, educational and research institutions, just to mention but few. In the field of engineering profession – in teaching, research, manufacturing, and practice - its applications have been robust creating new applications and new ways to make existing applications more responsive (Johnson, 2007). In the area of teaching engineering, computer is improving and enhancing efficient course delivery. Nevertheless, in the teaching of most engineering courses, at the lower level stage, understanding of basic principles of involved in engineering requires practise by hand calculation – not by computer - of simple problems. In the process, the students developed analytical skills, gained confidence, and nurture the ability to work independently, that are preparatory for the use of computer (Roy and Chakrabarty, 2009).

This is usually accomplished by giving students assignments. In giving students assignment, two approaches are currently adopted. The first one is to give students separate assignment to encourage independent work. This method is sustainable when the class is small. But when the class is large, typical of developing countries for common engineering courses like mechanics, strength of materials, introduction to design, etc., this method is not sustainable for the lecturer. Thus impartation of engineering knowledge may be hampered. The second approach is to give group assignment. But experience in Nigeria has shown that only one student will do the assignment. The rest will simply copy it, without inducement to develop his/her own logic and engineering judgment. Again, just like the first method, this approach does not encourage individual learning and work, especially at the present state of Nigerian development when her prospective engineers ought to have expanded capacity for acquisition of developmental resources and also

be able to demonstrate same, for national development. The effect of this inability to ensure that students pass through rigorous hand-on training before introduction to computer at later stages results in engineers that are ill-trained and timid to face challenges in practise. This paper presents the result of a study aimed at solving this problem, using a method called independent data assignment (IDA) module, with structural engineering as a case study.

Much computer software have been developed for structural analysis and design (Aktan, et a., 1987). Many software have also been developed as a teaching and learning aids (Oreta, 2005, and Li, et al., 2012). Some textbooks in structural analysis also contain CD-ROM with software (Kassimali, 1999 and Hibbeler, 2002). However, all these do not take the place of hand-practise assignments and projects which are integral parts of teaching structural engineering at the University level. Assignments are not just a means to prepare students for examinations but also to help the students develop and nurture a sense of independent problem-solving skills which is to add to their overall readiness to take on challenges as they come. This is more so in Structural Engineering, where a high degree of analytical and numerical skills are required to make sure that buildings and indeed structures are correctly analysed without any error. Mistakes in analysis and design of structures, usually numerical in nature (Seward, 1998) can cause building or structural failure and collapse which can result in loss of lives and wastage of scarce economic resources (Sadiq, 2014)).

Development of an error-free and a proficiency in structural analysis is product of continuous practice, in which assignments play an important role. But in the situation where students escaped this training, especially in developing nations where classes are large in addition to paucity of equipments, journals, textbooks; he/she may not be able to display the necessary competence to handle structural analysis and design while in practice, thereby endangering the lives of people. The advent of computer does not replace the intelligence of the structural engineer though computer can

*Corresponding Author

make analysis and design faster and easier. Computer is no use for engineer with a flawed logic. Use of computer assumes mastery of procedures and techniques for solving problems which are supposed to be acquired through constant hand practice. It also helps to nurture in the students the ability to make sound judgment based on results obtained from the software (Oreta 2001), if eventually they are introduced to them.

The understanding of basic principles of structures, which requires practise by hand calculation of simple problems (Marshall and Nelson, 1982), can simply not be subordinated to computer. Students must be aided to go through this. Thus the purpose of this work is to demonstrate how students can be aided to develop independent analytical skills by making it difficult and impossible for a student to copy the assignments of another student through a method called independent data assignment (IDA) module. This method makes use of the data generation facilities offered by MS-Excel spreadsheet package. The use of MS-Excel spreadsheet software, as a tool for scientific and engineering calculations is not new because of its availability and accessibility (Billo, 2007). It has been used by professional structural engineers for design purposes (Davies, 1995 and Craig, 2006). The present usage is for the generation of independent data for students' assignment modules for as many students as possible. Thus the aim of this investigation is to find out whether independent data assignment (IDA) module enhances the numerical competence of engineering students.

2 METHODOLOGY

The students selected for this project, 60 in number, are about to complete a 5-year course of study and have done structural courses with the author, in at least four semesters during the course of their programme, with scores of 50 percent and above to minimise frivolous response as much as possible. These students have also offered structural-related courses from other lecturers. For this study, a structural scheme was conceived as shown in Fig. 1.
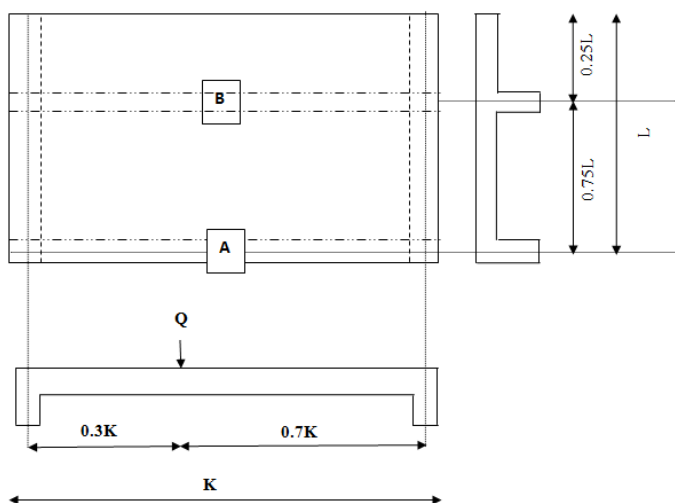

Fig. 1. A Typical Student Project

This structure was to be analysed and design according to BS 8110 (or any other relevant code used to train the stu-

dents) by all the students. A cantilever slab supported by two beams. Each student is required to analyse and design the slab and any one of the beams (A or B). However, the data used for this project was generated by MS-Excel software package, through the Fill, Series, Vertical, Step value, and Stop value icons on the Menu bar, so that no two students will have the same set of data to solve the problem, irrespective of the number of students in the class. Every student has independent data for the assignment (IDA). The data for each of the student was different. This data was configured as shown in Table 1 in few minutes (This is for 200 students. It can be more). The design data have been given variable letters so that it can assume any number. For example, the length has been represented as "l". In this way, numbers like 1, 2, etc. can be assigned to it and varied – either consecutively or in steps using MS Excel - to cater for as many students as possible. Except in some cases, all other parameters are also given in terms of letters. The span of the slab is "l", the span of the beam is "k", "Q" is the point load on the Beams, "q" is the imposed load, and "g" is the dead load. The characteristic strengths of concrete and reinforcement are respectively "F_{cu}" and "F_y".

Table 1. A Typical Data Configuration

S/No	L (m)	K (m)	Q (KN)	Q (KN/m²)	G (KN/m²)	F_{cu} (N/mm²)	F_y (N/mm²)	Exposure Condition	Fire Resist	Force on Beam
1	6	6	50	4	4	30	250	Mild	1	A
2	8	7	60	5	6	35	425	Moderate	2	B
3	10	8	70	6	8	40	460	Severe	3	A
,	,	,	,	,	,	,	,	,	,	,
,	,	,	,	,	,	,	,	,	,	,
200	8	9	40	5	5	55	250	mild	2	B

A student will use a set of data that corresponds to, say, his/her matriculation number. The number of set of data that the computer can generate is not limited, so that no two students will have the same set of data. This will ensure that students do independent work. During each semester, many assignments of this nature are expected to be given to the students. So that a student going through this method during his/her course of study is expected to have developed sound independent and analytical skill, competence and confidence in solving problems, and high level of preparation for examinations. In order to investigate the efficiency of this method, a questionnaire was provided for the students to fill. Analysis was subsequently carried out on the data collected.

3 RESULTS AND DISCUSSION

3.1 The Background of the Respondents

For dependability of responses which will subsequently make the result credible and reliable, demography analysis of the students is essential. Figure 2 shows the total number of structural related courses taken by each of the students. It was assumed in the study that each course is a 2-unit course. From the figure, it can be observed that about 90% of the students have taken between 6 and 8 courses in structures, while 10% have taken at least 9 courses in structural courses.
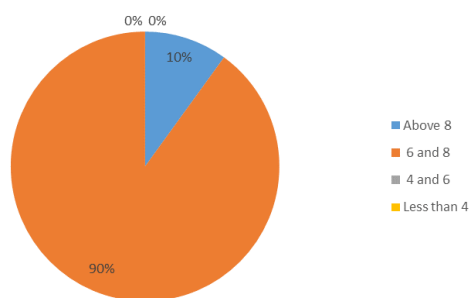
Fig. 2. The Number of Courses in Taken Structures Courses

The data showed that no student had taken less than 6 structural related courses. This result is consistent with the nature of students considered for the project. They are all civil engineering students with structural related courses forming a significant portion of the curriculum. Table 2 shows a comparison of structural courses taken by the students with (and by inference without) IDA modules. Out of the 60 students, 55 respondents, representing 91.66% have taken between 6 and 8 courses in which IDA formed an integral part of those courses. What this suggests is that the majority of the students are in the domain of the course delivery system of the author.

TABLE 2
THE NUMBER OF COURSES IN STRUCTURES TAKEN WITH IDA

Structures Courses	Above 8	6 and 8	3 and 6	Less than 4
With IDA	0	55	4	1

As engineering students are expected to take courses outside their department, Table 3 shows the number of mathematical/analytical courses taken by each of the students in addition to the structural courses. Out of the 60 respondents, 53 students, representing 88.33 % offered between 6 and 8 courses in other mathematical/analytical courses and no students offered less than 4 courses.

TABLE 3
COMPARISON WITH OTHER NON-STRUCTURAL BUT MATHEMATICAL COURSES

Numerical Courses	Above 8	6 and 8	4 and 6	Less than 4
Non-Structures	2	53	5	0

The above analysis of the data obtained from the respondents' shows that the students are equipped with background, intelligence, and the understanding that are capable of enabling them to give responses that are credible and reliable to questions asked during the course of the study.

3.2 Evaluation of Effects of IDA
The results of the administration of the questionnaire for students are presented in Table 4. Did the method helped

students to prepare for examinations? From this Table 4, 45 students representing 75% of the respondent said the IDA method was very good as a help in preparing for the examination, while the rest said to was good. Thus there is overwhelming evidence that it method helps the students to prepare for the examinations. The same percentage of the respondent also said that it helped them develop confidence in solving problems. About 95% representing 57 respondents agreed that the method encouraged learning. In relation to other courses, especially mathematical/analytical in nature, in which this method was not employed, 55 students, representing 91.67% said it encouraged individual work than those courses. The major thrust of this study is to encourage independent work that makes it difficult from students from copying another work verbatim. To what extent has the scheme achieved this aim. All the students agreed that it prevented them from copying the works of one another. That the method of assigning independent data seemed to make it difficult from such venture.

TABLE 4
RESULTS OF QUESTIONNAIRE TO EVALUATE THE EFFICIENCY OF IDA METHOD

The Questions	Very Good	Good	Average	Not Helpful
Help in Preparation for Examinations	45	15	0	0
Help to develop confidence in solving problems	45	15	0	0
	YES		**NO**	
Encourages learning	57		3	
Encourages individual work than other courses without independent assignment module	55		5	
Prevention of copying other students	60		-	
Would have copied my friend if data were the same	55		5	
Beneficial	55		5	
Should it continue	54		6	
	IDA Courses		**Others Courses**	
Courses where student had Higher scores	44		16	
Can you recommend it for other courses	58		2	

They would have loved to do so, because 55 students, representing 91.67% said they would have copied other student (s), had it not been that each student had his/her own data set. Also 55 students representing 91.67% agreed that the method was beneficial, and hence should continue. Comparing the scores a student had in IDA method with other courses was used as a way to assess how beneficial the method had been. About 73.33% of the students represent-

ing 44 students said that they had higher scores in IDA method courses than in other courses in which no independent data was given. 54 students, representing 90% of the students want the continuation of the method, as against 10% who want it to be discontinued. An overwhelming number of students, about 96.67% suggested that the use of the IDA method be extended to other courses.

4   CONCLUSIONS

From the analysis of the data collected from the Independent Data Assignment (IDA) method questionnaire, it can be concluded that the method has the potential to help students studying structural engineering develop their analytical skill and also the Teacher to be efficient in the art of teaching structural engineering, especially at the undergraduate level. Also, the fact that overwhelming majority of the students wants the continuation of the method, and even extension to other courses, is an evidence of the usefulness of the method. The method is also sustainable for the teachers, since the same module can be reuse over again for another set of student. Although the method used structural engineering to illustrate the method, the principles involved are applicable to other discipline in engineering when dealing with large class. It is hereby recommended for all teachers in the field of any of the branches of engineering, especially in Nigeria.

REFERENCES

Aktan, H., Khasnabis, S. and Gupta, A. (1987). The Use of Microcomputers for Self-Teaching of Civil Engineering Principles. *Proceedings of the Third International Conference on Civil and Structural Engineering Computing,* Civil-Comp Press, Edinburgh, UK, 279-285.

Billo, E. J. (2007). *Excel for Scientists and Engineers*. New Jersey, John Wiley and Sons.

Craig, T. C. (2006). *Engineering with the Spreadsheet: Structural Engineering Templates using Excel*. Washington, ASCE Press.

Davies, S. R. (1995). *Spreadsheets in Structural Design*. London, Longman Scientific and Technical.

Hibbeler, R.C. (2002). *Structural Analysis*. Singapore, Pearson Education Asia Pte. Ltd.

Judge, K. (2014). *Online Safety: Technology has changed our world.* Retrieved from http://www.heritage.com/2014/08/articles

Johnson, B. W. (2007). Engineering Advances in Information Technology: Engineering the Information Age. *University of Virginia School of Engineering and Applied Science: Impact*, 8 (1), 1 – 8.

Kassimali, A. (1999). *Structural Analysis.* 2nd Ed., California, Brooks/Cole Publishing Company, USA.

Li, D., Qi, H. and Liu, L. (2012). Application of CDIO Model for Microcomputer Principle at Technology University. *International Journal of Education and Management Engineering*, 9, 66 - 69.

Marshall, W. T. and Nelson, H. M. (1982). *Structures*. London, ELBS.

Oreta, A. W. C. (2005). Developing Learning Modules On Structural Engineering Using Commercial Software. *11th ASEP International Convention (11AIC)*.

Oreta, A.W.C. (2001). Role of Computer Technology in Civil Engineering Education. *Proc. 4th National Civil Engineering Education Congress,* DLSU-Manila.

Roy, S. K. and Chakrabarty, S. (2009). *Fundamentals of Structural Analysis – With Computer Analysis and Applications*. New Delhi, S. Chand and Company.

Sadiq, M. S. (2014). *Structural Analysis: The Panacea for Collapse of Structures and Infrastructure*. Lagos, University of Lagos Press Inaugural Lecture Series.

Seward, D. (1998). *Understanding Structures: Analysis, Materials, and Design*. London, Macmillan Press Ltd.

Sidelinger, R. J. and Ayash, G. (2006). Couples Go Online: Relational Maintenance Behaviors and Relational Characteristics Use in Dating Relationships. Human Communication. *A Publication of the Pacific and Asian Communication Association*. 11 (3), 333 – 348.