Development and Validation of Module Presentation of Selected Topics in Physics for Architecture Students

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INTRODUCTION

Physics has the capability of playing a major role in finding solutions too many of the problems facing the human race. Of course it does not have all the answers but the science is developed enough to have created nuclear weapons which remain a global threat, then surely it can be used for the betterment of all people around the globe. It generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world.

Physics contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries. It plays an important element in the education of chemists, engineers and computer scientists, as well as practitioners of the other physical and biomedical sciences.

Physics extends and enhances the understanding of other disciplines, such as the earth, agricultural, chemical, biological, and environmental sciences, plus astrophysics and cosmology - subjects of substantial importance to all peoples of the world. Moreover, physics improves the quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery.

The method that focus on self-learning and individualized instruction is not applied in the classroom. In this respect, module based learning resource has been used successfully at elementary, secondary and higher level of education in the European as well as in the developing countries of the world. Modules were also recommended for the training of educational personnel in the five years plan of ASEAN countries. Module is defined as a self-contained, self-instructional package that allows the learner to proceed in his studies in accordance with his own capacities and abilities. It can be used in any social setting suitable in the learner. The education scholars and researchers of the developed and developing countries of the world have been recognized module as the most beneficial and effective learning resource. It is a

specific type of learning resource. There is a group of contents or single subject matter content covered in the module. It ensures active participation of students to make the learning process alive and dynamic.

School records of Qassim University in the Preparatory Year Program (PYP) on the test achievement results in the School Year 2012-2013 showed that students performed about 50% proficiency level in Physics. About 42% of 110 students got grades from 60% to 79% [2.3]. These students were identified as slow learners by the university and most of them will take up Bachelor of Architecture program in the university.

During interviews conducted, the students pointed to the difficulty in understanding the language of Physics textbook series.

A considerable amount of research has been done on the difficulty level of textbooks which include physics, mathematics and high school literature anthropologies. In many instances, the readability level was found to be inappropriate to the needs of the students. A study of [1,4] revealed that students' performance is affected by the availability of appropriate materials used in teaching.

Researches on Module Presentation have found that these materials help in vocabulary building, stimulate a liking for reading, and help students with limited reading abilities to experience significant literary works in a largely visual medium.

This action research addressed the need to improve achievement of slow learners in the College of Architecture of level 3 by developing and validating a module presentation on selected topics on physics for their use.

The study hypothesized that the use of module presentation improves the achievement of architecture students.

1 BACHELOR OF ARCHITECTURE IN QASSIM UNIVERSITY

The Bachelor of Architecture degree program in Qassim University is a 4 year course consisting of 139 credit-hours. The educational system in the college is based on two semesters per educational year. Each semester is (15) week length. In addition, an optional eight week summer maybe offered. All architecture students may complete any of the architecture programs in 8 semesters after the Preparatory Year Program (PYP). A successful architecture student may complete the full requirements of the selected program if he completed (after the PYP) a total of 139 credit-hours.

1.1 Physics

One of the basic course s in Architecture is Physics, a 3 unit course offered in level 3 of fall semester. Physics is the capstone course in basic architecture since it integrates almost all the knowledge a student has learned in 4 years of high school education. This course has traditionally been delivered through classroom multimedia instruction to architecture students. One semester leaning period is insufficient to fully discuss all the topics for this course.

In Qassim University under the College of Architecture, Physics course focuses the following areas of study: the foundations of mechanics that are related to the field of architecture [5]. Topics consist of vectors and scalars, kinematics, newton's laws, fundamentals of statics: trusses and bridges, work, energy, power and momentum, equilibrium and elasticity, light, vision and colours, and optics.

Table 1 shows the coverage and requirements for the course. The total number of hours needed to finish the course syllabus is 52 hours for the whole semester. This does not include the times when faculty members are not able to attend their class

because they participate in faculty development activities such as seminars and conferences [2, 6].

Table 1. Course outline and course requirements for Physics

TOPICS	NUMBER OF HOURS
Course Introduction Measurement, Vectors and Scalars	4
Motion Along a Straight line	6
Motions in Two or Three Dimensions	6
Long Quiz	2
Force, Friction and Laws of Motion	6
Kinetic Energy and Work	6
Power and Potential Energy	5
Equilibrium and Elasticity	5
Midterm Examination	2
Light, Vision and Colors	3
Optics	3
Final Examination	3
Total	52
COURSE REQUIREMENTS	
1. Long Quiz	15
2. Home works/Reports	8
3. Midterm Exam	25
4. Final Exam	50
5. Attendance	2
Total	100
Passing Grade : Between 59 and 60	

2 RELATED WORKS

The main function of the educational institution is to impart instruction to the students. The pattern of imparting instructions varies from institution to institution. Many changes have been occurred from time to time in the process of instruction. The development in the filled of instructional technology and modern researchers in the filled of education have contributed in the organization of the learning model.

2.1 Concurrent Modules

According to [1,7], concurrent modules follow the pattern of semester system in which students have to attend the classes, write the research paper, and appear in the Midterm and Final examinations. Students try to meet their entire academic obligations during the semester term. They are under heavy workload. The faculty convenes three or four class meetings of 50 minutes each per week for 15 or 16 weeks term. The whole emphasis of the programme is on input and output format. In addition to being segmental and impressionistic, the learning process has the characteristics of lack of commitment and cool restraint on the part of students

2.2 Difference between Modular Teaching and Lecture Method

One may point out that all the principles of modular teaching match with the principles of lecture method. Lecture method also includes reading by the students,

completing the homework, writing the papers, and taking the exam etc. These all activities require active participation of the students [8,9]. Textbook always provides rationale for their content in an introductory chapter and lectures frequently supplement test objectives with their own statements of course objectives. Textbooks and “Readers” are always divided into units and chapters, and typical Lecture covers a series of well-defined topics. The typical lecture course has at least a midterm, a final examinations, home assignments and papers. They all provide feedback to students. Finally, the students are permitted with in the limit imposed by the length of a course and examination dates to do the course work at their own pace [9].

2.3 Purposes of Modular Instruction

One purpose of modular instruction is the provision of the opportunity to student to proceed at his own pace. The beliefs that the students are different from one and other as far as their mental and intellectual abilities are concerned. As a result, it is recognized that learners do not achieve at the same rate and are not ready to learn at the same time [11].

The second purpose is the freedom to choose the learning mode for the study of different topics and subjects. Choice among different learning modes is desirable, if we assume that learners solve problems and learn using different techniques based on unique behavior patterns. Modular Instruction (MI) may include a large variety of instructional activities, such as reading textbooks and additional reading material, examining pictures and diagrams, viewing films and videos, listening to audiotapes, supervising, demonstration of materials, participating in projects and experiments, and participating in relevant extra-curricular activities [10,11].

The third purpose is to provide a choice among a large variety of topics within any given course or discipline. It is very useful when the students do not possess the same level of interest and are not motivated to achieve the same goals.

The fourth purpose is the provision of opportunity for the student to identify his strengths and weaknesses, and to "recycle" through remedial modules. Repetition or a change in learning mode, if we assume that it is desirable to save student time (frequent evaluation permits early diagnosis) and to allow as many students as possible to attain the stated objectives

2.4 Advantages of Modular Instructions for the Students

[1] Listed the importance and advantages of modular teaching. Among them are the following:

(a) Modular instruction lessens the tension of competition and threat of failure. As a result, cooperation is increased: Students and teachers both share the responsibility for learning.

(b) Modules have their own built-in assessment of progress. They provide the student with immediate and continuing feedback.

(c) Modular instruction adapts to individual learner differences by providing flexibility with respect to the pacing, format, and content of instruction.

(d) Modular Instruction does not follow the artificial procedure of grading/scoring on a normal curve. The nature of the learning process in Modular Instruction focuses on mastery learning. It is expected from all of the students to achieve the entire objectives of the modular programme that are presented in behavioural form.

(e) Modules provide choice to students for the selection of learning material. The deficiency on the part of students has been made up through deficiency module that provides greater motivation to students.

(f) Modules are designed so that the student may easily recognize the objectives of the topic or the lesson and, therefore, proceed directly and put efforts to achieve them.

(g) Modular scheduling allows the students to think deep on his/her studies and to reflect on it. The individual learning technique is an effective method for developing reflective thinking and creativity in the students.

(h) Independent study in modular teaching promotes the self-confidence of the students and paves the way for life-long learning process.

2.5 Validation of Module

According to [4,12], modules are effective for improving the quality of instruction if they have been developed in consistent way, and if all components of the module match with one another. It can be validated in following ways. It must start with the aims of module. This describes what the module wants to achieve, the broad content addressed by it, and any motivation or aspirations that it will provide for the learners.

3 PHASE 1: DEVELOPMENT OF THE MODULE

The researcher worked in developing the module strips on the identified topics.

The concepts and topics included in developing the module material shown in table 2

Table 1. Concepts and topics for Physics module

CONCEPTS	TOPICS
Measurement	Distance and Length
Vectors and Scalars	Introduction to Tip to Tail Vector Addition, Vectors and Scalars
Motion Along a Straight line	Straight Line Motion
Freely Falling Bodies	Freely Falling Objects and Acceleration due to Gravity
Projectile Motion	Strobe Freezes Water Drops in Mid-Air
Force	Equilibrium of Force x y components
Friction	Static and Kinetic Friction
Laws of Motion	Exploring the Laws of Motion
Kinetic Energy	The Physics of Starship Battles
Work	The Work Done
Power	The Power of Resonance
Potential Energy	Potential Energy Stored in A Spring
Equilibrium	Forces acting on an Object in Equilibrium
Elasticity	Hooke's Law and Young's Modulus
Light, Vision and Colors	The Human Eye
Optics	Lenses and Mirrors

Physics instructors were asked to validate the content of the module. The instructors were asked to judge the appropriateness of the structure of the illustrations to the learning skills to be developed: knowledge. Comprehension, application and analysis.

4 PHASE2: DEVELOPMENT THE READABILITY OF THE MODULE

The readability of the module material was established through instructor's judgement and through the cloze procedure for testing comprehension. The cloze procedure consists of deleting every 4th word in a reading passage; and asking the students to fill in the blank spaces with appropriate words derived from reading the context of the selection. A 100 item cloze procedure was used. The material was tried out among ten (10) students selected from a class of slow learners but who were not part of the sample.

5 PHASE 3: TESTING THE EFFECTIVENESS OF THE MODULE

To test the use effectiveness of the module in improving the achievement of the architecture students, students with overall grade average of 80 and below were randomly selected through lottery technique during enrolment. Fifty-five (55) students were assigned to the control group and fifty-five (55) to the experimental group. The experimental group was taught in the first period in the morning while the control group was taught in the first period in the afternoon.

Other measures to determine the effectiveness of the material included quizzes, midterm examinations, classroom activities, midterm examination and final examination. The data were collated and were subjected to statistical tests of comparison of the t-test.

6 RESULTS AND FINDINGS

The results of the test on the readability of the module material given to ten (10) respondents shows that the weighted percentage scores range from 45%-71% as shown in table 2. On the basis of Barmuth interpretation of scores, the module was at the students' instructional and dependent level of reading.

Table 2 shows the results of the test on the readability of the module material,

Table 2. Results of the Pilot test on the readability of the module material

	Physics Concepts																	
	Measurement	Vectors and Scalars	Motion Along a Straight line	Freely Falling Bodies	Projectile Motion	Force	Friction	Laws of Motion	Kinetic Energy	Work	Power	Potential Energy	Equilibrium	Elasticity	Light, Vision and Colors	Optics	Total Score	Weighted Percentage
	Number of Items																	
Student ID	5	6	7	8	6	5	6	7	6	7	5	5	7	7	6	7	100	%
A	4	3	5	6	6	3	5	6	6	6	4	3	5	5	4	4	75	*75
B	2	3	4	4	5	4	5	4	4	5	2	2	4	4	3	6	61	*61
C	4	5	6	7	6	5	4	6	6	6	4	3	5	5	4	4	80	*80
D	4	3	5	6	6	3	5	2	5	5	4	3	2	2	4	4	63	*63
E	2	3	4	4	5	4	5	4	4	7	5	5	7	7	6	7	79	*79
F	4	5	6	7	6	5	4	6	6	7	5	5	7	7	6	7	93	*93
G	5	6	7	8	6	5	6	6	6	6	4	3	5	5	4	6	88	*88
H	2	3	4	4	5	4	5	4	4	6	4	3	5	5	4	4	66	*66
I	2	3	4	4	5	4	5	4	4	4	4	5	5	6	6	2	63	*63
J	4	4	4	4	4	4	5	4	4	5	2	2	4	4	6	6	66	*66

Barmuth Cloze Test Interpretation of Score

*A score greater show 58% of the total score indicates that the material is on the student's independent level

** A score of 44% to 57% indicates that the material is on the student's instructional level

*** A score below 44% indicates that the material is on the student's frustration level

The weighted percentage scores from 63%-93%. On the basis of Barmuth interpretation of scores, the module material was at the student's independent level.

Table 3 compares the mean achievement post-test and gain scores of the experimental groups at the end of study.

Table 3. Test of difference between Pre-test and Post-test mean scores of the experimental and control groups

Group	N	Mean score			t-ratio
		Pre-test	Post-test	Different	
Experimental	51	14.34	19.22	4.88	2.23*
Control	44	14.39	17.67	3.28	

*significant at 0.05 level

The pre-test mean scores in the achievement test showed that before the study, the two groups did not differ significantly as shown in table 3. The students' initial achievement mean scores differed only by 0.05 point (14.39 versus 14.34). The t-test of difference was applied on the post-test mean scores of the two groups. The computed t-value of 2.23 is significant at the 0.05 probability level. The comparison of gains was also in favour of the experimental group. These results indicate that, at the end of the study, the group will use module material had significantly higher scores that the control group.

Table 4 shows the comparison of the mean scores on quizzes, midterm examination, class room activities and final examination of the experimental and control groups.

Table 4. Test of differences between mean scores on quizzes, midterm examination, classroom activities and final examination of the experimental and control groups

Measure	Mean score		Differences between means	t-ratio
	Experimental N = 51	Control N = 44		
Quizzes	39.67	22.78	16.89	6.51*
Classroom activities	22.23	13.45	8.78	4.98*
Midterm Exam	34.23	28.11	6.12	2.43*
Final Exam	14.56	10.29	4.27	3.76*

*significant at 0.05 level

The difference between means in all test types were 16.89, 8.78, 6.12 and 4.12, respectively, in favour of the experimental group beyond the 0.05 level. This provides evidence of the effectiveness of the module as instructional material over the conventional method of teaching.

In regard to attitude shown in table 5, the experimental group perceived less difficulty leaning physics and had significantly higher mean improvement ratings along interest in physics than the control group.

The computed t-values of 2.12 and 1.84 indicate significance of the post-test mean difference between the two groups in interest in physics and difficulty learning physics (statistically significant at 0.025. df. = 93). These findings favour the experimental group.

Table 5. Test of difference between Experimental and Control groups' post-test mean score in aspects of attitude toward Physics

Attitude aspect	Group	Post-test	Differences between post-test means	t-ratio
A. Beneficial aspects of Physics	Experimental	4.12	0.13	0.63(ns)
	Control	3.99		
B. Interest in Physics	Experimental	2.01	0.46	2.12*
	Control	1.55		
C. Harmful aspects of Physics	Experimental	1.98	0.10	1.37(ns)
	Control	1.88		
D. Career interest in Physics	Experimental	3.09	0.12	0.41(ns)
	Control	2.97		
E. Difficulty learning Physics	Experimental	1.45	0.37	1.84*
	Control	1.82		

*significant at 0.025 level

No significant difference was found between the two group ratings on the beneficial aspects of Physics, harmful aspects of Physics and career interest in Physics

7 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings, it can be concluded that module materials can serve as effective teaching aids in helping slow learners acquire scientific knowledge. Moreover, the results also suggest that the material could enhance students' interest in Physics and may lessen difficulty in learning the course.

However, the material cannot as yet be considered the sole, contributing factor to the improved achievement of the slow learners. This is because scheduling of Physics classes in the afternoon appeared to have been disadvantageous to the control group.

Difficulty in teaching Physics, specifically highly abstract concepts to slow learners has been struggle in the past.

The results of this study suggest that module strips facilitate the development of cognitive processes resulting in better academic performance as shown by higher scores in Physics achievement test by those who used these materials. Instructors should try using this material and similar ones in their lessons

REFERENCES

[1] Banta, T. W. (2001), Comparing the Impacts of a Problem-Based Computer Assisted Instruction and the Direct-Interactive Teaching Method on Student Science Achievement, *Journal of Science Education and Technology,* Vol. 10, No. 2, pp. 147-153.

[2] Ganiron, T. U. Jr.(2013), Application of Accelerated Learning in Teaching Environmental Control System in Qassim University, *International Journal of Education and Learning*, Vol. 2, No. 2, pp. 27-38.

[3] Duch B. (2001), The Power of Problem Based Learning, *A Practical for Teaching Undergraduate Courses in Any Discipline*, Vol. 1.

[4] Copland, M.A.(2000), Problem Based Learning and Prospective Principals, Problem Framing Ability, *Educational Administrative Quarterly*, Vol.36, No. 4, pp. 585-607.

[5] Ganiron, T.U. Jr.(2013), Accelerated Learning Techniques: Teaching Critical Thinking in Qassim University, *Journal of Proceedings of the 41st Annual Conference of the European Society for Engineering Education*, September 16-20, Belgium.

[6] Ganiron, T. U. Jr. (2014), The Effect of Study Group Activity Guide in Expository reading and Writing Course at the College of Architecture in Qassim University, *International Journal of Education and Learning*, Vol.3, No. 1, pp.23-34.

[7] Greewald, N.L.(2000), Learning from Problems, *The Science Teacher*, Vol. 67, No. 4, pp. 28-32.

[8] Ganiron, T. U. Jr. (2014), The Impact of Higher Level Thinking on Students' Achievement toward Project Management Course, *International Journal of u-and e- Service*, Vol. 7, No. 3, pp. 217-226.

[9] Martinez, D.T., T.U. Ganiron Jr and H. S. Taylor (2014), Multimedia Tools for Teaching Basic Electronics, *International Journal of Education and Learning*, Vol. 3, No. 2, pp. 23-34.

[10] Ganiron, T. U. Jr. (2014), The Effects of the Mentoring System on the Achievement of Students in Project Management Course, *Journal of Proceedings of the 42nd Annual Conference of the European Society for Engineering Education (SEFI)*, Birmingham, United Kingdom

[11] Martinez, D.T., T.U. Ganiron Jr and H. S. Taylor (2014), Curriculum Development of Hardware Interfacing System for Visual C++ in Computer Engineering Course, *Journal of Proceedings of the 42nd Annual Conference of the European Society for Engineering Education (SEFI)*, Birmingham, United Kingdom

[12] Ganiron, T.U. Jr. (2014), Enhancing the CE Project Course in the BSCE Curriculum of FEATI University, *Journal of Proceedings of the 42nd Annual Conference of the European Society for Engineering Education (SEFI)*, Birmingham, United Kingdom