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Development and Validation of a Physics Achievement Test to Identify Instructor Variables Associated with Students' Physics Academic Performance

Wilfredo T. Lacambra, Ph.D.
College of Engineering, AMA International University Bahrain

Abstract
One of the most common ways of detecting whether an improvement is achieved by an education institution is through measuring the students' achievement in a test. Testing is generally thought of as a means of assessing the knowledge and skills students have acquired through learning (Du-chastel and Nungester, 1998). Test results, besides assisting professors and administrators in making decisions concerning their students, provide vital information that could be the basis for the following: (a) assigning final course grade to a student; (b) distinguishing students' strengths and weaknesses in a particular subject; (c) assessing student performance in class as a whole; and (d) improving teaching methods or techniques in carrying out a teacher's day-to-day lessons; (e) assessing teachers' needs in a certain program or curriculum; (f) allowing a teacher to make decisions at the beginning, and at the end of instruction; (g) evaluating the effectiveness of specific teaching methods; (h) guiding the administrators on the kind of in-service, trainings, seminars, workshops and the like that would suit the teachers' needs; and (i) serving as one of the criteria upon which to evaluate a certain curriculum. Knowing the students' achievement more or less determines the kind of instructors the school has. The Physics performance of Engineering students in the test is affected and found significantly by the students' variables: age, civil status, course schedule, sponsorship, employment status, Grade Point Average (GPA) in the pre-requisite subjects in basic Mathematics courses (Algebra and Trigonometry), and high school background in Physics. University Physics is always part of the Engineering program, and this needs complete concentration, time and patience of the students. As teachers always remember the principle, which is, individual differences among the students. They are unique in abilities, interest, needs and experiences. Students should be treated according to their needs and interests, they must be assisted into developing proper attitudes towards this course and they must be grouped according to their ability and develop each group up to the optimum
Keywords: Academic Performance of Engineering Students, Achievement Test in Physics

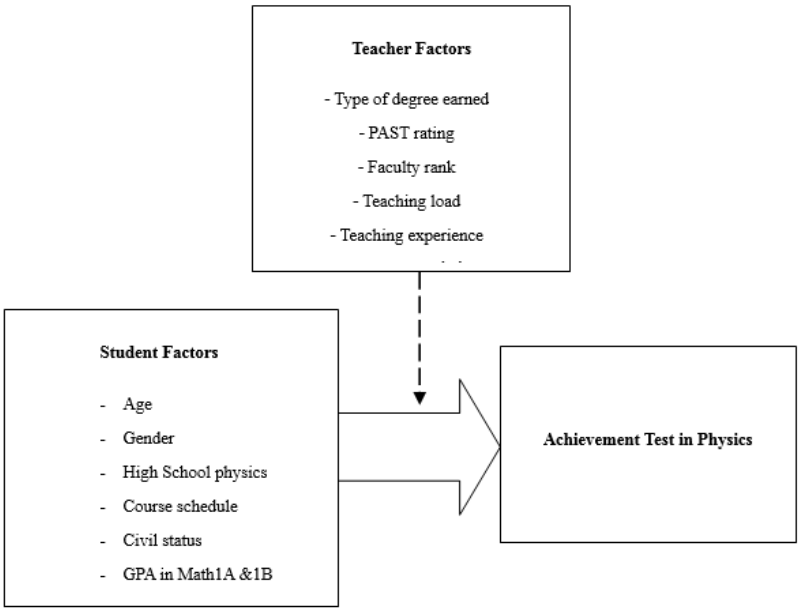
1. Introduction

Innovation is a watchword in almost all areas of endeavor. In the field of higher education, the school administrators and teachers are concerned with ways and means of improving student achievement and performance, physical facilities, curricula, and learning in general. Innovations in these areas need to be designed and applied to meet the demands upon these schools making education more responsive to the needs of a fast growing society. Schools or universities are considered one of the most delicate enterprises because they are tasked with the development of human beings. The primary goal of education is to produce excellent outputs. Programs and projects have been created as means to improve the quality of education. Nevertheless, it should be borne in mind that the achievement of a student in a certain course is affected by many factors. One of the important factors among others, is the instructor. Niflis (1993) has this to say: "Teaching is something that takes place only when learning does. No matter what the teacher is doing in his classes, if his students are not learning something significant, he is not teaching. When the student fails, the teacher has failed more." The main objective of this research was to identify factors associated with the Physics academic performance of Engineering students in AMA International University-Bahrain.

Conceptual Paradigm

Figure 1 illustrates the conceptual paradigm that guided this study. The independent variables illustrate the student factors while the intervening variables are those of the teacher factors. The dependent variable includes the achievement test items in Physics.

Fig. 1: The Research Paradigm



2. Research Design

The descriptive – correlation method of research was employed in this study. It is correlation because the study attempts to correlate some factors associated with the Physics academic performance of Engineering students in AMA International University - Bahrain.

There were two kinds of respondents in the study, Table 1: the students and the teachers teaching Physics. The study made use of fifty Engineering students who have earned eight units of University Physics 1 and University Physics 2. These class samples were subjected to the Physics achievement test. On the other hand, a total of five teachers were respondents of the study. They represent the Department of Natural Sciences of the Center for General Education.

Table 1: Kinds of respondents.

Respondents	Male	Female	Total
Students	32	18	50
Teachers	3	2	5

Data Gathering Tools

The questionnaire was used in data gathering. The 50 - item teacher-made achievement test as covered topics in Mechanics, Electromagnetism and Thermodynamics. This was used to measure the Physics academic performance of Engineering students in AMAIUB. The instrument was reviewed by other member-teachers in the Department of Natural Sciences of the Centre for General Education. The Table (2) of Specification of the test is presented. It is noted that three major topics were included in the test with the corresponding number of items, namely: Mechanics - 22 items, Thermodynamics - 6 items, and Electromagnetism - 22 items.

Table 2: Specification of the test.

Topics: Taxonomy	Mechanics	Electromagnetism	Thermodynamics	Total
Knowledge	1	1		2
Comprehension	3	3	1	7
Application	4	6	2	12
Analysis	8	7	2	17
Synthesis	4	3	1	8
Evaluation	2	2		4
Total	22	22	6	50

Data Gathering Procedures

The procedure in the research is divided into four sub-sections: Planning the test or drawing the Table of Specification; Preparing or drafting the test items; Reviewing/selecting the test items; and Evaluating the test. The final form of the test took shape after the necessary corrections were made.

3. Results and Discussion

This study utilized the descriptive-correlation statistics where the respondents were divided into three category levels: Above average performance, Average performance, and Below average performance. They were classified based on the results of the mean scores and standard deviation of the respondents. The relationship of the students' profile variables to the Physics performance in the achievement test were analyzed using Pearson Product Moment of Correlation (r) at 5 per cent level of significance, as shown in table 3.

Table 3: Significant relationship between student variables and their Physics performance in the achievement test

		Age	Gender	Civil Status	Course Schedule	HS Physics	GPA Math	Sponsor	Employed	No. of Units
Performance in Achievement Test	Pearson Correlation	-.574**	-.141	.359*	.560**	.444**	.792**	.656**	.385**	-.134
	Sig. (2-tailed)	.000	.327	.010	.000	.001	.000	.000	.006	.354
	N	50	50	50	50	50	50	50	50	50
*. Correlation is significant at the 0.05 level (2-tailed).										
**. Correlation is significant at the 0.01 level (2-tailed).										

The table 3 presents the significant relationship between student variables and their Physics performance in the achievement test. Seven student variables were rejected, which means that there is a significant relationship between the Physics performance of Engineering students in the achievement test to the following student factors: age, civil status, study of High School Physics, course schedule, Grade Point Average in Math1A and Math1B, sponsorship, and employment status. These student variables have significance as gleaned from the result of the correlation test at 0.05 level of significance. Hence, the null hypothesis is rejected.

It can be implied that the students' age, civil status, course schedule, GPA in Math1A (Algebra) and Math1B (Trigonometry), background of high school Physics, sponsorship and employment status are good predictors of Physics academic performance. Further, students who had outstanding and very satisfactory grades in both Algebra and Trigonometry; students who had background of high school Physics; students who are above 20 years old; married students; evening students; students with full sponsorship; and working students had better performance in the Physics achievement test. On the other hand, the following student variables bear no significant relationship, namely: gender and number of registered subjects. This means that the null hypothesis of no significance is accepted.

Table 4: Six teacher variables.

		Degree	PAST rating	Faculty rank	Teaching Load	Teaching Experience	Attendance to Training
Performance in Achievement Test	Pearson Correlation	.693	.626	-.707	-.283	.474	.141
	Sig. (2-tailed)	.195	.259	.182	.645	.420	.821
	N	5	5	5	5	5	5

The table 4 presents the six teacher variables selected were accepted at 5% level of significance. This means that there is no significant relationship between the Physics performance of Engineering students under teacher variables: type of degree earned, PAST rating, faculty rank, teaching load, years of teaching experience, attendance to trainings, seminars, workshops and conferences. This implies that the students' performance in the Physics achievement test does not bear significance on the identified teacher variables.

Table 5: Problems encountered.

Problems Encountered	Above Average Achievers		Average Achievers		Below Average Achievers	
	F	R	F	R	F	R
Limited Lab Apparatus	5	2	4	2	2	4
Absenteeism/Tardiness	4	3	2	4.5	5	1
Poor Health	1	5	2	4.5	3	3
Limited of Textbooks	6	1	5	1	1	5
English instructions	3	4	3	3	4	2

Table 5 shows that among the above average achievers, the problems encountered were ranked accordingly: limited textbooks and reference materials, limited laboratory apparatus, absenteeism/tardiness, English as a medium of instruction and poor health. Among the average achievers, the problems encountered

were ranked accordingly: limited textbooks and reference materials, limited laboratory apparatus, English as a medium of instruction, absenteeism/tardiness and, poor health. Among the below average achievers the problems were on absenteeism / tardiness, English as a medium of instruction, poor health, limited laboratory apparatus and limited textbooks and reference materials.

Encountered problems were ranked as follows: limited textbooks/reference materials, limited laboratory apparatus, absenteeism/ tardiness, English as a medium of instruction and poor health.

4. Conclusions

In light of the facts revealed by this research, the study came up with the following conclusions:

1. The correlation analysis revealed that the Physics performance of Engineering students in the test is affected and found significantly by the students' variables: age, civil status, course schedule, sponsorship, employment status, Grade Point Average (GPA) in the pre-requisite subjects in basic Mathematics courses (Algebra and Trigonometry), and high school background in Physics.
2. There were problems encountered by the student-respondents that had affected their performance in the Physics achievement test. The students prioritized the problems accordingly to their rank: classroom instruction was English; lack of textbooks and other reference materials; limited laboratory apparatus and materials; and students' absenteeism and tardiness.

5. Recommendations

On the basis of the findings and conclusions, the following are the recommendations:

1. University Physics is always part of the Engineering program, and this needs complete concentration, time and patience of the students. As teachers always remember the principle, which is, individual differences among the students. They are unique in abilities, interest, needs and experiences. Students should be treated according to their needs and interests, they must be assisted into developing proper attitudes towards this course and they must be grouped according to their ability and develop each group up to the optimum.
2. Remedial instructions should be undertaken to help students overcome their difficulties especially in the application of Physics laws, theories, concepts and principles through problem solving.
3. Students should be encouraged to avail of the opportunity to read more books and join to some university contested events like science-math quiz bee.
4. Physics and Mathematics instructions should be related to everyday activities of students to help them develop the proper attitude towards these two courses.
5. Teachers of Physics should be motivated to attend trainings, seminars, workshops and conferences to grow professionally and academically to keep abreast with the modern methods and strategies in the teaching of physical sciences.
6. Teachers should follow the guides in the course specification, the objectives and the course intended learning outcomes (CILOs) to have uniformity in coverage and contents of test questions for the whole college.
7. Teachers must provide more visual aids / power point presentations to equip the students more power of understanding of the lessons and to make teaching learning more meaningful.
8. Similar studies should be conducted to other disciplines like Chemistry and Mathematics because the researcher strongly believes that this type of study is beneficial to the teachers and administrators.
9. Physics program for Engineering should be given more time allotment to respond to the needs of students in doing problem solving drills, exercises, assessment works and the like.

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