

## **Development and Validation of Tenth Grade Physics Modules Based on Selected Least Mastered Competencies**

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### *Abstract –*

The main purpose of the study was to develop and validate modules in physics based on selected least mastered competencies for tenth-graders. Hence, the researcher developed a set of modules which covered six major areas of physics (i.e. motion, force, energy, momentum and impulse, and heat and thermodynamics). Specifically, it sought to answer the following questions: (1) Were the developed modules appropriate in terms of its objectives, content, design characteristics, learning activities, adaptability, clarity, and evaluation as perceived by the pool of experts, teachers, and students? (2) Was there a significant difference among the perceptions of the students, teachers, and experts with respect to acceptability of the developed modules? (3) Would the developed modules enhance student's performance in terms of knowledge acquisition? The development and validation was anchored to the ADDIE model which involved four stages: preparation, development, validation, and try-Out. Select physics experts from Philippine Normal University, and teachers from Tibagan High School in the Philippines were the sample used for the validation of the modules which were further tried out on 96 students of Tibagan High School. Moreover, this study utilized the quasi-experimental design, as such, a pretest and posttest were administered to the student users to determine the knowledge acquisition performance of the two groups of respondents (i.e. experimental and control groups). Likert scale data collected and test results were analyzed using descriptive and inferential data analysis procedures. The result of the study showed that the developed modules were found acceptable for the 10<sup>th</sup> grade physics students. There was no statistically significant difference between the evaluation of the students, peers, and experts on the module's acceptability. Also, the developed set of modules was found to be effective in terms of knowledge acquisition. Therefore, this study suggests that the developed module can be a useful tool for teaching and learning basic physics.

*Keywords - development; validation; physics module; knowledge acquisition*

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## 1. Introduction

Based on the results of 2012 National Achievement Test (NAT), the fourth year students from National Capital Region (NCR) obtained a mean percentage score (MPS) of 48.90. In the given achievement results of the five (5) subjects, science got the lowest MPS for the past school year. As such, the Department of Education (DepEd) issued a memo that recommends to enhance the competencies needed to improve the performance of all students across the country. One recommendation states that “provide supplementary materials (modular form) to enhance the competencies of those in schools with more than one shift as an enabling mechanism to extend time.” (“NAT overview and 2012 test results”, p 28). The National Science Education standards require science teachers to make use of science tools and instructional materials, media and technological resources accessible to the students and for the effective teaching of the subject matter. Furthermore, the development of the instructional materials must be in the interests, knowledge, understanding, abilities, needs and experiences of students. In providing quality education, one should not underscore the role of instructional materials in effective instruction. Aside from the basic textbook, the use of instructional materials is essential for meaningful and effective teaching (“Selecting and Developing Teaching/Learning Materials,” 1997).

It is a fact that most high school students find physics difficult to understand. This may be accounted to the use of mathematics as its language which requires skills in computation. Misunderstandings and misconceptions among students arises when physics concepts are not properly explained. An instructional material will help learners to understand the lesson better, especially when a classroom has a great number of students, learning is difficult to achieve and individual differences are hardly monitored (“What Makes Physics Difficult?” 2008).

In learning specific skill or acquire knowledge, teacher can help student’s individualized instruction through the use of modules. Modular learning is becoming popular because of the concrete application of principle of individual differences in which student can proceed at a pace suited to his abilities. An educational authority stated that development of production of textbooks and other instructional materials are necessary in order to achieve the objectives of education. It is evident that instructional materials have been effective instruments for answering quality education (Dizon, 1998).

Almario (2002) in his study concluded that the students who used her developed materials obtained higher scores in the posttest than in the pretest. The manual she developed in Elementary Mathematics V proved to be an effective tool in teaching Mathematics. Her study also stressed the importance of the content organization of topics, mechanics and language used appropriateness of presentation, illustrations and pedagogical approaches in the development of instructional materials. She further recommended the development of manuals in other Mathematics subject to aid instruction of the teachers.

The achievement test given to the drafting third year high school students in the Division of Muntinlupa, Vega (2004) had significantly identified the most difficult topics in drafting. He made a study on how developed instructional modules in drafting affect the student’s performance. He found that there is a mastery level in the performance of the students using his developed modules.

In the study conducted by Gagarin (2003) she found that her developed modules in physics proved to be effective tool in teaching physics to the students of Samson College of Science and Technology. The modules found to be valid and acceptable as assessed by the Science instructors and sophomore college students in her school. Moreover, the findings of her study reveal that her developed modules in physics really enhance the learning experiences of the students. For this reason, she recommends the adoption of her modules for classroom instruction and be a pattern for developing instructional materials in other Science subjects in the different year levels.

Bayle (2004) specified the low performance of the fourth year students in Science and Technology IV (Physics) in the Division of Taguig and Pateros for the school year 2003-2004. There were reviews and revisions made in the Science curriculum yet students get low scores. She perceived the need of teaching-learning materials so that students can learn to manipulate and do hands-on activities. For this reason, she conducted her study on how the activity manual she developed affects the student’s performance. She then concluded that the manual effectively increased the performance level of the students and was highly acceptable instructional materials as regard to its usability, adequacy, clarity, and relevance.

The study conducted by Hermosisima (1999) showed that her developed modules in Physics 112 (Magnetism) were an effective tool in teaching the subject rather than the lecture method. She made use of the identified student’s difficulty in Physics 112 and arrived at her findings indicating that the use of modules had increased student’s performance.

Sadsad’s (2000) study on validity of the resource book in Science and Technology I in the Division of Quezon City revealed that there was high significant relationship between the assessments of the pilot and non-pilot science teachers as to level of validity and acceptability of the resource book in terms of contents, organization of topics, utility, mechanic or language used, appropriateness of presentation, illustration, pedagogical approaches and physical makeup of the test.

## **2. Methods**

### *2.1 Research Design*

The development and validation of the modules focused on the ADDIE Model. It involved four stages: Stage I- Preparation; Stage II- Development; Stage III- Validation; and Stage IV- Try-Out. And to determine the student's performance in knowledge acquisition, this study utilized the quasi-experimental design, as such, a pretest and posttest were administered to the student users to determine the knowledge acquisition performance of the two groups of respondents (i.e. experimental and control groups).

### *2.2 Subjects*

The study took place in a public school in Makati City, Philippines. Ten [10] physics experts from Philippine Normal University, and ten [10] teachers from Tibagan High School in the Philippines were the sample used for the validation of the modules which were further tried out on 96 students of Tibagan High School. Ninety-six [96] students participated in the study which has lasted for almost five [5] months. All participants for the try-out were physics students, who were taking the course as part of their basic education program for the school year 2012 to 2013. They were selected on the basis of class membership. Prior to the study, they were grouped into two (Experimental group and control group) according to their first quarter grades in Physics. Only scores of students who had completed both the pretest and posttest physics content exam were included in the data analysis.

### *2.3 Instruments*

The data were collected through the following instruments: the California Physics Standard Test [CPST], and a survey questionnaire. The tests were administered in the paper-and-pencil mode.

To determine the proficiency level of the participants in specified Physics skills or concepts, the researcher administered the California Physics Standard Test [Released Test Questions]. The released test questions were taken from the Physics Standard Test. Initially, the test questionnaire consisted of eighty-nine [89] questions which represent various topics in Physics. However, to ensure its appropriateness for measuring the desired skills and concepts that have been covered within the research period, the teacher-researcher chose forty-two [42] questions from the test, which included motion, forces, conservation of energy, momentum, and heat and thermodynamics. These items were in multiple-choice format taken within a 60- minute period. Each item has four choices and one keyed answer.

To evaluate the level of acceptability of the module in terms of objectives, contents, design characteristics, learning activities, adaptability, clarity and evaluation, the researcher had utilized student, teacher and physics expert satisfaction survey results.

### *2.4 Procedures*

The development and validation of the modules was carried out based on the ADDIE Model's stages. Stage I- Preparation; Stage II- Development; Stage III- Validation; and Stage IV- Try-Out. Each stage is composed of different phases.

The preparation stage involved administering the pretest using California Standards Test. It was used to determine the least mastered skills of the students. The identified contents and components of the module were based on the result of the pretest.

The development stage involved the following phases; deciding on the format of the module, the process of writing the module and the initial revisions needed to improve the first draft of the module.

In the validation stage, physics teachers (peers and experts) were asked to assess the module in terms of its objectives, content, design characteristics, learning activities, adaptability, clarity and evaluation. Final revisions made by peers and experts were incorporated in the printing of the final copy of the modules.

In the try-out stage, pilot testing of the modules were conducted using the quasi-experimental design. In this

design there is an experimental and control group but there is absence of randomization.

### 2.5 Data Analysis

The data obtained from the survey were analyzed by utilizing both descriptive and inferential data analysis procedure.

Item analysis was used to establish the least mastered skills of the student. This was the basis of the content of the modules.

The median was computed to measure the respondents' perceptions on the developed modules with regard to its objectives, content, and design characteristics, learning activities, adaptability, clarity and evaluation.

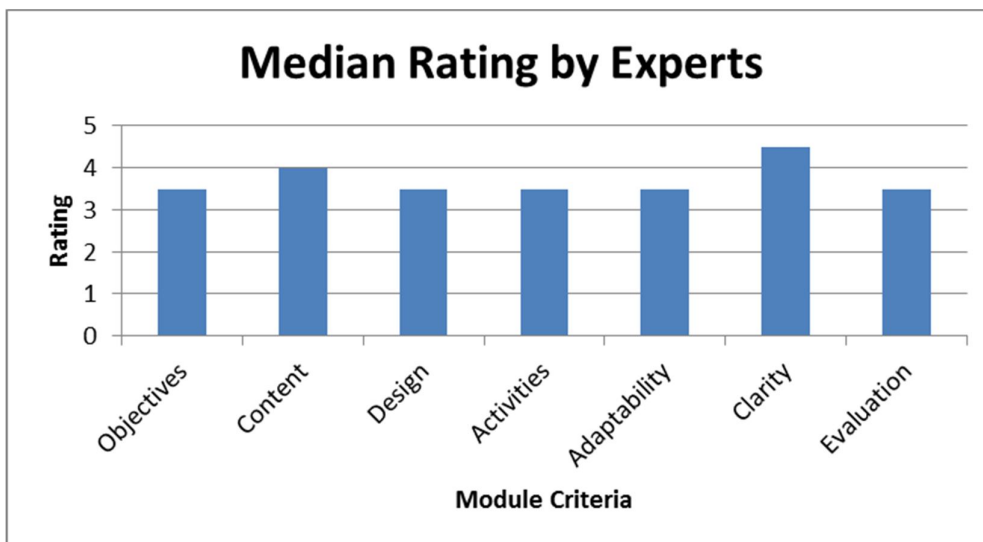
To determine if there are significant differences on the perceptions of the students, peers and experts on the developed modules, the Kruskal-Wallis H test was computed.

To test if there is a significant difference in the pre/posttest mean gain of students in the experimental group (modular instruction) and the control group (traditional instruction), the t-test for dependent samples was computed.

To determine if there is a significant difference between mean assessments of the experimental group (modular instruction) and the control group (traditional instruction), the t-test for independent samples was computed.

## 3. Results and discussion

Research Question 1: *Are the developed modules appropriate in terms of its: Objectives, Content, Design characteristics, Learning activities, Adaptability, Clarity, Evaluation as perceived by the pool of experts (select physics professors and teachers) and students?*



Rating: 5 (Very Strongly Acceptable) 4 (Strongly Acceptable) 3 (Acceptable) 2 (Moderately Acceptable) 1 (Least Acceptable)

Figure 1. Median rating by experts

Based on the figure above, the developed modules are rated from 'acceptable to 'strongly acceptable' by the experts in terms of the different criteria: objectives, content, design characteristics, learning activities, adaptability, clarity and evaluation.

Research Question 2: *Is there a significant difference among the perceptions of the students, teachers, and experts with respect to the acceptability of the developed modules?*

To determine if there are significant differences among the assessments of the students, peers, and experts on the acceptability of the developed modules, the Kruskal-Wallis H Test was utilized.

**Table 1**  
*Kruskal-Wallis H test*

	Score
Chi-Square	15.963
Df	2
Asymp. Sig.	.000

Group	N	Median
A	10	5.0000
B	10	4.0000
C	10	3.0000
Total	30	

A Kruskal-Wallis H test showed that there was no statistically significant difference in among the assessments of the students, peers, and experts on the acceptability of the developed modules,  $\chi^2(2) = 15.963$ ,  $p = 0.000$ , with a median rank score of 5.00 for A, 4.00 for B and 3.00 for C.

Research Question 3: *3. Will the developed modules enhance students' performance in basic physics?*

Computed mean of the pretest and posttest in the experimental group (modular instruction) and the control group (traditional instruction) are shown in table.

**Table 2:**  
*Result of pretest and posttest of experimental and control group*

CST	Mean		Std. Deviation		Std. Error Mean	
	Experimental	Control	Experimental	Control	Experimental	Control
<b>Pretest</b>	16.7083	15.1042	3.6259	3.47171	0.52335	0.5011
<b>Posttest</b>	36.1458	18.9167	7.62412	5.83034	1.10045	0.84154

To test if there was a significant difference in the mean gain of the two groups, a t-test for dependent samples was computed.

**Table 3a**  
*Mean Gain of the groups*

CST	Mean	N	Std. Deviation	Std. Error Mean
Pretest-Posttest Experimental	-19.4375	48	9.00805	1.3002
Pretest-posttest Control	-3.8125	48	6.75610	0.97516

**Table 3b**  
Significance Level of CST Pre-Post Test Score

CST	Mean Difference	95% Confidence Interval of the Difference		Std. Deviation	T	df	p-value
		Lower	Upper				
Pretest-Posttest Experimental	-19.4375	-22.05316	-16.82184	9.00805	-14.95	47	0.000
Pretest-posttest Control	-3.8125	-5.77427	-1.85073	6.75610	-3.91	47	0.000

Content –knowledge acquisition was determined by the score on the California Physics Standard Test [CPST]. It was administered before and after implementing the developed modules. The test comprised of 42 selected response items and the score was determined by summing the number of correct items [maximum possible score is 42]. Pretest and posttest content knowledge scores were summarized in Table 2. Pretest mean score for the experimental group was 16.7 with standard deviation of 3.6. While pretest the mean score of the control group was 15.1 with a standard deviation of 3.4. These data only shows that the level of homogeneity of the two groups (experimental and control) is high. The data also showed that after the use of the modules, the posttest mean of experimental group is 36.14 with a standard deviation of 7.6. On the other hand, the posttest mean of the control group is 18.91 with a standard deviation of 7.6. A t-test for dependent samples (experimental) indicates that there was a significant difference [M= -19.43, SD=9.00] conditions; t [47] =-14.95, p was less than 0.0001[Table 3b]. It can be perceived that students perform better using the developed modules

#### 4. Conclusion

This study addressed three research questions and showed the following findings:

- (i) The developed modules are rated from ‘acceptable to ‘strongly acceptable’ by the experts in terms of the different criteria: objectives, content, design characteristics, learning activities, adaptability, clarity and evaluation.
- (ii) There was no statistically significant difference in among the assessments of the students, peers, and experts on the acceptability of the developed modules.
- (iii) The developed modules promoted students’ performance in content-knowledge acquisition.

#### 5. Recommendations

The main purpose of this study was to develop and validate physics modules based on the least mastered competencies and assess the impact of the developed modules on students’ knowledge acquisition. The data suggest that the developed modules are acceptable and have a positive impact on students’ performance [i.e. knowledge acquisition]. However, carefully conducted research should be done at different grade levels and in a variety of disciplines. Furthermore, a reproduced of this study which the sample is large enough and is conducted over a much longer period of time in between the pretest and posttest could also reveal additional insight of the impact of the developed materials.

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