Development and Validation of Statistics Module for Quality Educational Research

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Abstract: *This study was an attempt to develop and measure the validity of a statistical module for educational research which can be an input to sustainable quality research among student-researchers of Laguna State Polytechnic University. In this study, it was hypothesized that subjects' evaluation on the developed module is significantly correlated to their performance. It was also hypothesized the existence of significant difference between the extents of evaluation of groups of respondents on the characteristics of the developed module. Based on the result, the developed module in Statistics has very high extent of validity in terms of specific objectives, content, language used, and evaluation activities. The utilization of the developed module leads students to have a very satisfactory performance. This performance shows that they do not only know the concepts included in the subject but also they can apply statistics in real life situations. Likewise, the performance of students has increased after the utilization of the developed module which is attributed to the attainment of the specific objectives in every lesson provided in the module and the language being used. In addition, if students were given step by step procedure which is easily understood, their performance would be increased.*

Keywords: Statistics, Module, Development, Validation, Research

1. Introduction

Inadequate Statistics plays a very vital role in many aspects of life;in economy, governance, and even in entertainment. It is significant that all statistical specialists recognize their full extent potential impact on the broader society and their corresponding obligations to perform their work responsibly. A good professional citizenship is expected to the practitioners permissible to the improvement of public climate for, understanding of, and respect for the use of statistics throughout its range of applications. (ASA, 2011)

The article 3 section 32 of Republic Act No. 10625 (RA 10625), an act reorganizing the Philippine statistical system, promulgated to rationalize and promote efficiency as well as effectiveness in the conveyance of statistical services.

In the field of education, statistics is very useful particularly in doing scientific or quantitative researches as revealed by its space in the research manuscript. The lifeline of a unique research is influenced by a strong statistical analysis. However, there have been reports of statistical malpractices in studies that could arise from the insufficient understanding of the essentials of statistics (Krithikadatta and Valarmathi, 2012).

In addition to this, not all students have the competency to perform statistics in research. This below average competency in performing statistical analysis is attributed to the reason that there are some education programs that do not include statistics in the curriculum. Hence, lack of information of student-researchers in terms of statistical concepts is evident. This scenario moves student-researchers ask experts to perform statistical analysis for their research which resulting to business talks contradicting the essence of constructivism among students. As an effect, the quality of research produced by the student-researchers suffers and the reliability of the research findings becomes questionable. With this, instructional material development that will help student-researchers bridge the gap between the role of statistics in producing quality researches and use of modern technology is an imperative.

2. Objectives

This study aims to develop and measure the validity of a statistical module for research which can be an input to sustainable quality research among student-researchers of Laguna State Polytechnic University.

In particular, it aspires to:
1) Quantify the characteristics of the module in research statistics with regards to the following:
   a) characteristics of the specific objectives of the module;
   b) characteristics of the content of the module;
   c) characteristics of language used; and
   d) characteristics of evaluation of activities.
2) identify the strengths and weaknesses of the developed module in terms of the specified characteristics;
3) determine the performances of students who were subjected to pilot testing;
4) test the significant relationship between the pilot-respondents' evaluation on the developed module and their performance;
5) test the significant difference between the extent of evaluation of groups of respondents on the characteristics of the developed module.

3. Framework of the Study

The conceptual framework presented in below shows the input-process-output model of research. It shows that in the first box, the inputs were came from the major subjects of mathematics major students, and the newly implemented enhanced basic education curriculum (K to 12) of the Department of Education particularly the Probability and Statistics. Coining the inputs through developing research module is the first part of the process done by the researcher while pilot testing it to the students followed by data gathering procedure is considered as the second part of the

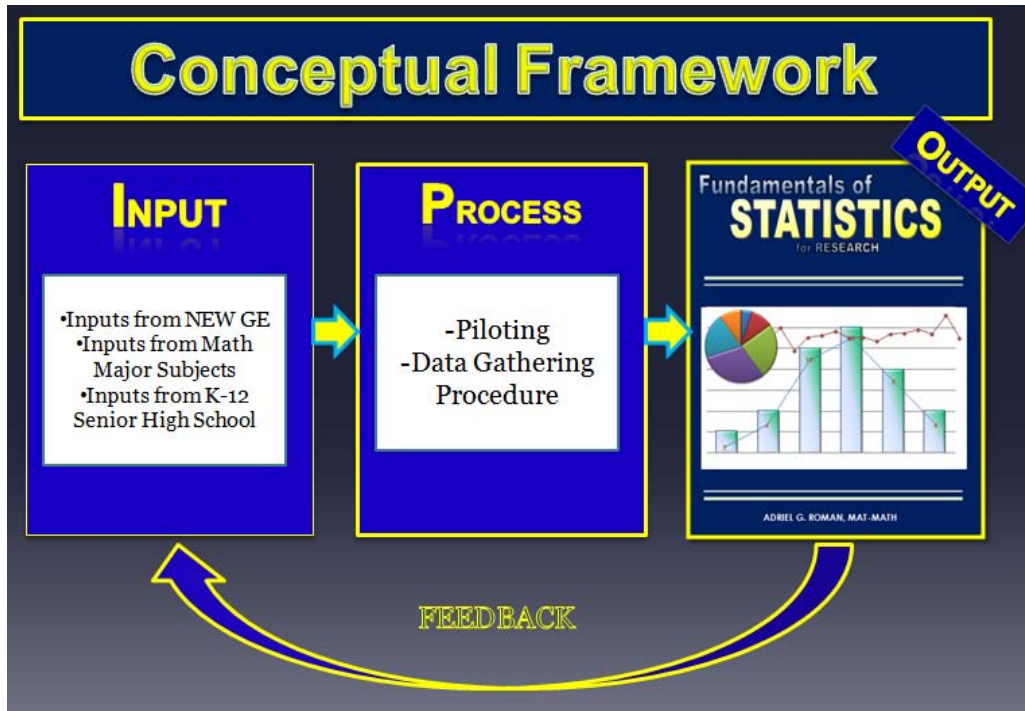processes. Lastly, as depicted on the last box, the output is the developed and validated module for research.

Figure 1: showing the input-process-output model of instructional model

4. Research Methods

The present study is adapting the instructional design theory. According to Smith (1998) instructional design theory is the study on how to design the best instruction in order learning will take place. The ADDIE model, as the well-known model used for creating instructional materials was utilized. This acronym stands for five stages of the material development; A for Analyze - analyze learner potential characteristics, and the anticipated learning, D for Design - develop learning objectives and choosing an instructional approach, D for Develop - create instructional or training materials, I for Implement - delivering or distributing the instructional materials and E for Evaluate - ensuringthat the materials achieved the desired goals.

Guided by this design, the researcher is moved to develop a module to eliminate the difficulties of students particularly researchers on statistics. After analyzing the present scenario of students when it comes to studying statistics, the researcher found out that statistics is one of the most disciplines that students do not know how to apply in research. Hence, the researcher developed a module and piloted it to 17 students during the first and second quarter of the academic year 2015-2016 who were enrolled in Statistics class. After giving them the module and having sort of discussions, students' academic performances were analyzed. In addition, the researcher utilized a validated instrument about the evaluation of proposed modules. A survey also was done among 10 Mathematics and Statistics high school teachers and University professors to further assess the validity of the module. The study also solicited responses from non-statistics professors and students to strengthen the content as well other parts of the module. Lastly, the data gathered were subjected to analysis and interpreted using suitable statistical measures such as descriptive and some inferential tools.

5. Results and Discussion

The evaluated characteristics of the developed module in terms of specific objectives, content of the module, language used, and activities are presented below. It is shown that all indicators measuring the characteristics of the specific objectives of the module are met to a very great extent having an average mean value of 4.70. This result means that the developed module is really accompanied by specific objectives that are clear and easily understood, realistic and measurable and attainable. Thus, readers are guided on the target competencies that should be achieved for every topic. As to respondents' evaluation on the content of the module, the overall mean of 4.70 shows that the developed module is acceptable to a very great extent. In particular, respondents said that the developed module is aligned to the content of the curriculum. The presentation also of the lessons is adequate (4.79). It can also be seen that the examples given in the module are accurate, defensible, current (4.74) and each lesson reflects the most important aspects of what is being taught (4.74). Though last in rank, still respondents agreed that the developed module is acceptable to a very great extent in terms of variety of supplementary activities (4.52). With this, it can be implied that the content of the module is parallel to what the curriculum sets.

Table 1: Characteristics of the Developed Module in Terms of Specific Objectives, Content, Language Utilization, and Evaluation Activities

Characteristics of the Specific Objectives of the Module	Non-Math	Math Prof	ASC (Pilot)	Math Major	WM	VI	Rank
1. Each lesson in the module is accompanied by specific objectives.	5.00	4.60	4.82	4.69	4.79	VGE	1
2. The words used in the objectives are clear and easily understood	4.63	4.60	4.82	4.69	4.72	VGE	2.5
3. The specific objectives are realistic	4.75	4.60	4.76	4.69	4.72	VGE	2.5
4. The objectives are measurable	4.50	4.40	4.76	4.54	4.60	VGE	5
5. The specific objectives are attainable within specified time limit.	4.88	4.60	4.65	4.62	4.67	VGE	4
AWM	**4.75**	**4.56**	**4.76**	**4.65**	**4.70**	**VGE**	
Characteristics of the Content of the Module	**Non-Math**	**Math Prof**	**ASC (Pilot)**	**Math Major**	**WM**	**VI**	**Rank**
1. Each lesson reflects the most important aspects of what is being taught	4.88	4.60	4.82	4.62	4.74	VGE	3.5
2. The lessons are presented at a pace that allows for reflection and review	4.50	4.40	4.65	4.77	4.63	VGE	9
3. There is adequate provision for supplementary activities/exercises.	4.88	4.60	4.76	4.46	4.67	VGE	6.5
4. The content leads to the attainment of the objectives.	5.00	4.60	4.71	4.46	4.67	VGE	6.5
5. There is adequate presentation/discussion of content	4.88	4.60	4.88	4.69	4.79	VGE	2
6. The information about the different topics is accurate and precise	4.88	4.40	4.88	4.54	4.72	VGE	5
7. There is variety of supplementary activities	4.75	4.50	4.65	4.23	4.52	VGE	10
8. The ideas, concepts and points presented are well-expressed	4.88	4.60	4.65	4.54	4.65	VGE	8
9. The examples presented are current, accurate and defensible	4.88	4.60	4.76	4.69	4.74	VGE	3.5
10. The lessons are aligned on the curriculum	5.00	4.40	4.88	4.85	4.84	VGE	1
AWM	**4.85**	**4.53**	**4.76**	**4.58**	**4.70**	**VGE**	

cont. of table 1. Characteristics of the Developed Module in Terms of Specific Objectives, Content, Language Utilization, and Evaluation Activities

Characteristics of Language Used	Non-Math	Math Prof	ASC (Pilot)	Math Major	WM	VI	Rank
1. The words used in the module are correctly used.	4.88	4.20	4.94	4.62	4.74	VGE	2
2. The module is accompanied by clear and specific directions for their use.	4.88	4.40	4.76	4.65	4.71	VGE	4
3. The vocabulary used is suitable to the reading and understanding level of students to whom the modules are intended	4.88	4.40	4.88	4.54	4.72	VGE	3
4. Instructions to students are clear, unambiguous and easy to follow.	4.63	4.40	4.76	4.54	4.63	VGE	5
5. The lessons are presented in paragraphs/sentences that are grammatically correct	4.88	4.40	4.76	4.85	4.77	VGE	1
AWM	**4.83**	**4.36**	**4.82**	**4.64**	**4.71**	**VGE**	
Characteristics of Evaluation Activities	**Non-Math**	**Math Prof**	**ASC (Pilot)**	**Math Major**	**WM**	**VI**	**Rank**
1. The module has provision for self-assessment	5.00	4.60	4.71	4.55	4.71	VGE	5
2. The items help increase understanding and retention of the content covered	4.63	4.40	4.76	4.54	4.63	VGE	9
3. The items focus on important objectives and content of the lessons	5.00	4.60	4.71	4.46	4.67	VGE	6
4. The items in the evaluation are congruent to the specific objectives	4.88	4.60	4.82	4.85	4.81	VGE	2
5. There are items which measure higher thinking skills	4.88	4.60	4.88	4.54	4.74	VGE	3
6. The items are grammatically correct.	4.75	4.40	4.88	4.62	4.72	VGE	4
7. The items are arranged from easy to difficult	4.63	4.60	4.71	4.62	4.65	VGE	7.5
8. The test items are written at a level that students can understand	4.75	4.40	4.71	4.62	4.65	VGE	7.5
9. The answer to one item furnishes or gives clue to the answer in another item.	4.63	4.00	4.88	4.46	4.60	VGE	10
10. The items cover the important competencies to be developed	4.88	4.60	4.94	4.77	4.84	VGE	1
AWM	**4.80**	**4.48**	**4.80**	**4.60**	**4.70**	**VGE**	

With respect to language utilization, the developed module gained a weighted mean of 4.71 which connotes that there is very low extent of grammatical errors, misused words, misalignment of the vocabulary used to the readers, and vague directions. Hence, it can be said that the developed module is user-friendly that it can be understood by the readers since words that being used is presented in layman term. The last portion of the evaluation pertains to the activities in which the developed module gained an average of 4.70. This shows that the activities presented after the lesson has a connection to what is expected to achieve. This also means that the activities cover what competencies should be developed to the students. The activities are also congruent to the specific objectives of each lesson and measure not only the lower order thinking skills but also the higher thinking skills of the students.

6. Statistics Performance of Pilot-students

The average performance of the pilot-students based on the table below is 89.90 for mean, 90.36 for median and 91.19 for mode which verbally analyzed as very satisfactory to outstanding. This means that the utilization of the developed module leads students to have an very satisfactory performance. This performance shows that they do not only know the concepts included in the subject but also they can apply statistics in real life situations. The standard deviation of 1.38 which statistically means lack of deviation (homogeneous) from the mean implies that majority of the students performed well in statistics. This is supported by the skewness value of -0.50 which is negative in nature signifying that the most frequent number of grades gained by the students is higher than the average performance of the

group. This implies that after utilizing the developed module, pilot-students gained advanced knowledge in Statistics. This conforms to the statement that students tended to use modules at their own convenience and these modules somewhat help them generate interests to learn and explain the concepts and methods very well. Statistics as a tool in doing research should not be a terror subject particularly to those who are making research.The given statement proves that module helps teachers meet the desired intended learning outcomes of the students by providing convenience and self-explanatory yet an accurate discussion of the topics. With this, the utilization of instructional module will give an impact to students' holistic understanding of the concepts being taught. Likewise, module facilitates the development of cognitive processes resulting in better academic performance (Deng, 2008 and Ganiron, 2015).

Table 2: Statistics Performance of Pilot-students

Descriptive Measures	Values	Interpretation
Mean	89.90	VS - Outstanding
Median	90.36	Outstanding
Mode	91.19	Outstanding
Standard Deviation	1.38	Homogeneous
Skewness	-0.50	Negatively Skewed

Significant Relationship Between the Pilot-Respondents' Evaluation on the Developed Module and their Performance

As what the findings show, there is a moderate significant relationship existed between the acceptance of the developed module in terms of its specific objectives and the academic performance of the students who undergone pilot testing as seen on the r-value of 0.590 which is supported by the p-value of 0.013. This describes that the attainment of the specific objectives present in every lesson included in the module leads students to deeply understand the concept of statistics as proved by their very satisfactory performance. In addition, the positive correlation value and its coefficient of determination imply that there are atleast 34.8% variation in the students' performance attributed to the attainment of every specific objective present in the module. Hence, as the attainment of the module's objective increases, the performance of students also increases. Parallel to this, language used in the module shows positive correlation to students' performances as revealed by the r-value of 0.498 with 24.8% coefficient of variation inferring that the more students understand the language being used in the module, the more they achieve high performance.

Table 3: Significant Relationship Between the Pilot-Respondents' Evaluation on the Developed Module and their Performance

Evaluation	Mean	Acad. Performance	r-value	r-squared	p-value	Relationship
Specific Objectives	4.76		0.590	34.8%	0.013	Significant
Content of the Module	4.76	89.900	0.447	20.0%	0.072	Not Significant
Language Used	4.82		0.498	24.8%	0.042	Significant
Evaluation Activities	4.8		0.723	52.3%	0.001	Significant

The evaluation activities provided in the module has also a significant relationship to students' performance with a probability value of 0.001 indicating very large evidence to reject the null hypothesis of no significant relationship between variables. Hence, evaluation process has something to do with the academic performance of students. The result of the study agrees to what Chuckett and Sutherland uttered that if the teacher wants to change student learning then she/he needs to change the methods of assessments.

Significant Difference Between the Extent of Evaluation of Groups of Respondents on the Characteristics of the Developed Module.

As depicted in table 4, the presence of significant difference among the extent of acceptance of different group of respondents in terms of specific objectives and evaluation activities is not evident having p-values of 0.472 and0.067. This means that the extents of acceptance of the different group of respondents to the developed module are the same. This connotes that students and teachers have the same level of acceptance with regards to the attainment of specific objectives of the developed module and the evaluation activities present.

Table 4: Significant Difference Between the Extent of Evaluation of Groups of Respondents on the Characteristics of the Developed Module

Class	Specific Objectives	H-value	Df	P-value	Difference
Pilot	4.800				
Math Major	4.600	2.52	3	0.472	Not Significant
Math Prof	4.600				
Non-Math Prof	4.800				
Class	Content	H-value	Df	P-value	Difference
Pilot	4.700				
Math Major	4.600	8.67	3	0.034	Significant
Math Prof	4.778				
Non-Math Prof	4.850				
Class	Language	H-value	Df	P-value	Difference
Pilot	4.800				
Math Major	4.600	8.71	3	0.033	Significant
Math Prof	4.000				
Non-Math Prof	5.000				
Class	Evaluation Activities	H-value	Df	P-value	Difference
Pilot	4.900				
Math Major	4.600	7.13	3	0.068	Not Significant
Math Prof	4.600				
Non-Math Prof	4.900				

On the other hand, the presence of significant difference is observed in terms of the characteristics of module in terms of its content and the language used as seen on the p-values which are all lesser than the threshold value 0.05. In particular, it is observed that non-mathematics professors have the highest extent of evaluation of the conformity of the module to its content while mathematics/statistics professors have the least evaluation which is also the case in terms of language used. The result of the study suggests that the acceptance of the developed module has still its space for further evaluation. According to Ganiron (2015), modules are effective for improving the quality of instruction if they have been developed in consistent manner, and if all gears of the module match with one another.

7. Conclusion

After thorough analysis, it was concluded that the developed module in statistics has very high extent of validity in terms of specific objectives, content, language used, and evaluation activities. More so, the performance of students has increased after the utilization of the developed module which is attributed to the attainment of the specific objectives in every lesson provided in the module and the language being used. In addition, if students were given step by step procedure which is easily understood, their performance would be increased. Finally, variety of learning activities really helps students further understand the lesson being taught.

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