

VALIDATION, EFFECTIVENESS AND ACCEPTABILITY OF WORKTEXT IN ANALYTIC GEOMETRY

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ABSTRACT

The study used descriptive research design utilizing adapted questionnaire-checklist to determine the level of acceptability of the worktext; experimental research design to test the work text's effectiveness with two groups of student respondents equated in terms of sex and final grade in College Algebra gathered through documentary analysis; and, Spearman rho, mean and t-test to statistically treat gathered data. Content-validated pretest/posttest underwent item analysis to determine difficulty and discrimination index; and, the test-retest method for its reliability index. The study found the pretest/posttest valid and reliable; there's a significant difference on the performance level of respondents in all learning areas as revealed by their pretest and posttest mean; no significant difference on their performance level as revealed by their posttest mean; in the seven learning areas of the work text, it is more effective in three areas; equally effective in one area as revealed by the mean increments; and, the work text as an instructional material of exemplary acceptability.

Keywords: validation, acceptability, effectiveness, pretest/posttest, performance level

INTRODUCTION

It is a universal belief that the success of a society is determined not only by the quality of teachers but also by the quality of instructional materials used to attain quality, functional and relevant education. It is the role of a teacher to prepare instructional materials that would enhance the effectiveness of the learning process (Bustos, 1997). Teachers have to keep themselves abreast with the continuous changes and innovations in classroom teaching and one way to realize this is through exposure of the students to new or innovative instructional materials to further enhance their knowledge and skills, thus, delivering an education that is of quality and relevance (Ramos, 1996). In addition, the use of instructional materials in teaching is really a great factor to catch the interest and understanding of the students (Bitong, 2002).

The researcher, having the thought of how she can contribute to the academic community in facilitating the teaching-learning process and how she can give her share in significantly developing independent learning among the students, was prompted to undertake this study that aimed to develop and validate the effectiveness and acceptability of a worktext in Analytic Geometry. Having been in the teaching profession for almost three decades, she had embraced the profession as a vocation and had wanted to serve as an agent of change towards improved

teaching of Mathematics. With her research-oriented output, a validated worktext in Analytic Geometry, it is the conviction of the researcher that the use of it will speed-up the learning process, and therefore, help improve students' mathematical skills and competencies.
Geometry

Statement of the Problem

The study was conducted during the SY 2011-2012 aiming to develop a worktext in Analytic Geometry and to validate its effectiveness and acceptability.

Specifically, it sought answers to the following questions:

1. What are the indices of difficulty and discrimination; and, the reliability index of the researcher-made pretest/posttest?
2. What is the level of performance of the experimental and control group of student respondents as revealed by the pretest and posttest mean with respect to the following learning areas:
 - 2.1 Basic Concepts;
 - 2.2 Angle of Inclination and Slope of Line;
 - 2.3 Locus and Equation of a Line;
 - 2.4 Conic Sections and Circle;

- 2.5 Parabola;
- 2.6 Ellipse; and
- 2.7 Hyperbola?

3. Is there a significant difference on the level of performance of the experimental group and control group of student respondents in the pretest and posttest with respect to the different learning areas?
4. Is there a significant difference on the level of performance of the experimental group and control group in the posttest with respect to the different learning areas?
5. Which learning areas of the developed worktext are more effective than the existing book in Analytic Geometry as revealed by the mean increments of their performance in the pretest and posttest?
6. What is the level of acceptability of the developed worktext in Analytic Geometry as evaluated by Mathematics experts with respect to the following aspects?
 - 6.1 Content;
 - 6.2 Language/Grammar;
 - 6.3 Organization and Presentation; and
 - 6.4 Usefulness

METHODOLOGY

Research Design

The study employed, first, developmental research defined as the systematic study of designing, developing and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness (<http://www.aect.org/edtech/41.pdf>).

Second, descriptive research design which concerns with finding new truth or a new method, material or instruction that will uplift production of any kind, a new generation or a new law, the discovery of new causal relationship, and, a more accurate formulation of the problem to be solved (Padua, 2000).

And third, experimental research design which sought to determine whether a program

or intervention had the intended causal effect on program participants. A pre-post test design requires that data be collected on the study participants' level of performance before the intervention took place, and that same data will be collected on where study participants are after the intervention took place (<http://www.nationaltechcenter.org/index.php/products/at-researchmatters/experimental-study-design/>).

Participants of the Study

To test the effectiveness of the worktext, the study used the experimental and control group, each composed of ten (10) freshmen civil and ten (10) electrical engineering students, respectively, equated in terms of gender and their final grade in College Algebra gathered through documentary analysis.

To evaluate the level of acceptability of the worktext, the study got the perceptions of the Mathematics instructors as respondents.

Data Gathering Instrument

1. A valid and reliable 60- item multiple choice type of test in Analytic Geometry was used to determine the level of performance of the two groups of respondents. Results of student performance on the pretest and posttest were interpreted using the formulated range for different test items.
2. The study utilized an adapted questionnaire-checklist to evaluate the level of acceptability of the worktext as instructional material. To interpret the results, the scale, range and verbal interpretation is shown on the next page were used.

Statistical Treatment

The statistics used in the analysis of results are as follows:

1. Test Item Analysis and Spearman rho to determine, respectively, the indices of difficulty and discrimination; and, the reliability index of the researcher-made test.
2. Mean to determine the level of performance of the experimental and control group as revealed

by the pretest and posttest results with respect to the different learning areas. The same statistical tool was used to evaluate the level of acceptability of the developed worktext in Analytic Geometry as an instructional material with respect to content, language/grammar, organization and presentation, and usefulness.

3. T-Test to determine the significant difference on the level of performance of the student respondents in the pretest and posttest before and after exposure to the developed worktext in Analytic Geometry with respect to the different learning areas.

Procedure in Data Gathering

The research procedure consisted of the following:

1. Development of the worktext was done the 1st semester of SY 2011-2012. After developing the worktext using the approved syllabus and other books in Analytic Geometry as references, it underwent content-validation by mathematics experts whose comments and suggestions were all incorporated in its final copy. Then, it was evaluated by mathematics experts for its level of acceptability with respect to the selected aspects using adapted questionnaire checklist.
2. Based on the constructed Table of Specifications, the researcher-made pretest/posttest was content-validated by mathematics instructors. Then, it was subjected to Item Analysis to determine the indices of difficulty and discrimination using 48 third-year civil engineering students; and, the test-retest method for its reliability coefficient utilizing 21 fourth year civil engineering students.
3. To determine the effectiveness of the worktext, both groups were given a pretest at the start of the 2nd semester of the school year. During the experimentation phase of the study, the experimental group was exposed to the worktext while the control group to a long existing book in Analytic Geometry. At the end of the semester, the two groups were given a posttest.
4. Statistical treatment and interpretation of the results followed.

RESULTS AND DISCUSSIONS

The Validity and Reliability of the Researcher-Made Test

To ensure that the 60 items of the researcher-made pretest/posttest are of average difficulty, the very easy and very difficult items and those items with an index of discrimination less than 0.16 were rejected. Item Analysis resulted to 32 items needing minor revisions and 67 were accepted items.

Table 1 reveals that of the 60 items, 10 or 16.7% were easy items, 20 or 33.3% average items, and 30 or 50% difficult items. To have a good quality test, there should be a balance of difficulty, average and easy items (Abarro, 2004).

Table 1 likewise shows 18 items or 30% of the pretest/posttest were taken from the 32 revised items while 42 items or 70% lifted from the 67 accepted items. The validity of the individual test item is determined by the index of discrimination. The validity of a test concerns what the test measures and how well it does so. (Calmorin, 1994). Relative to this, results of the study implied that the researcher-made test was valid enough to which the content of the test is truly a representative of the content of the course.

The reliability of the 60-item instructor-made test was determined using the Test-Retest method. The computed Spearman rho is 0.85, interpreted as one with a marked relationship, revealing that the scores of the 21 fourth year civil engineering student respondents on the first and second administration of the test are highly correlated and there is consistency in their responses even if they took the same test twice. The test, in other words, agrees with itself, is dependable, self-consistent and stable (Calmorin, 1994). Therefore, the 60-item pretest/posttest is valid and reliable, hence, can be used as data gathering instrument to determine the level of performance of the two groups of student respondents.

Level of Performance of the Experimental Group and Control Group as Revealed by the Pretest and Posttest Results with Respect to the Different Learning Areas

With respect to the Different Learning Areas, there is a marked increase in the mean performance of both experimental and control groups in all learning

areas. This could be a positive effect of the instructional materials they used in the study of Analytic Geometry and the finding connotes that, in general, the developed worktext and the existing book in Analytic Geometry are both effective materials. This finding is supported by the study of Robles (2004) which found that students acquired knowledge and skills after they were exposed to the developed instructional modules.

The present findings are strengthened by the study of Catolos et al., (2009) when they exposed the students to the developed worktext in Plane and Spherical Trigonometry and their findings revealed that there is an increase in the mean performance of the students which could be attributed to their exposure to the developed worktext. Moreover, Marino (2005) supports the present findings when he found instructional materials like worktext used in the teaching of a subject resulted to better performance among the students.

Significant Difference on the Level of Performance of the Experimental and Control Group as Revealed by the Pretest and Posttest Results with Respect to the Different Learning Areas

The level of performance of the experimental group at the t-values of 6.86, 6.47, 8.06, 8.45, 7.33, 9.07, and 6.09, has p-values ranging from 0.000 to 0.002 which are all less than the 0.05 level of significance. Hence, the null hypothesis stating that there is no significant difference in the performance of the experimental group in the pretest and posttest is rejected; and the result is significant.

Significant Difference on the Level of Performance of the Experimental and Control Group as Revealed by the Posttest Mean with Respect to the Different Learning Areas

There is no significant difference on the performance in the posttest of both experimental and control group in all the learning areas at t-values of 1.72, 0.45, 1.19, 0.19, 0.29, 0.19, and 1.25; and with the p-values of 0.103, 0.658, 0.251, 0.850, 0.773, 0.851, and 0.229 which are all greater than the 0.05 level of significance. The study failed to reject the null hypothesis stating there is no significant difference on the performance of the experimental and control groups as revealed by the posttest means.

This finding implies that the instructional materials used by both the experimental and control group contributed positively and provided them with an effective learning tool in their study of Analytic Geometry.

Level of Effectiveness of the Developed Worktext on the Different Learning Areas as Revealed by the Mean Increments

The experimental group got higher mean increments of 3.3, 3.9 and 4.5 than those of the control group in learning areas Basic Concepts, Angle of Inclination and Slope of Line and Conic Section and Circle, respectively. However, in learning areas, Locus and Equation of a Line, Parabola and Ellipse, the control group got higher mean increments of 5.4, 3.5 and 5.2, respectively. In learning area hyperbola, the two groups of respondents equally performed with 3.9 (9) mean increment.

The findings connote that in learning areas the worktext was found less effective, improvements or modifications are still needed to further increase its level of effectiveness over the existing book in Analytic Geometry used by the control group of respondents.

Level of Acceptability of the Worktext in Analytic Geometry as an Instructional Material as Evaluated by Mathematics Experts with Respect to the Different Aspects

The participants perceived it is an Exemplary acceptable instructional material as revealed by the over-all general mean of 3.84. The mathematics experts' evaluation on the contents of the worktext shows that on the five (5) items under content, they perceived it as exemplary acceptable instructional material as revealed by the obtained general mean of 3.84. The indicators in this aspect are the following: the contents of the worktext are comprehensive and cover the complete scope of the course ($\bar{x} = 4.00$); the competencies and skills expected to be learned are contained in the different learning areas ($\bar{x} = 3.77$); facts, figures and other information in the worktext are accurate and updated ($\bar{x} = 3.66$); a variety of exercises, tasks or activities for reinforcement and mastery of concepts and skills is provided ($\bar{x} = 3.88$); and, the contents and illustrations/examples provided in the worktext are appropriate to the intellectual

level of the users as well as their needs and interests ($\bar{x} = 3.88$).

These findings imply that the content of the developed worktext met the content requirement of the approved syllabus of the course.

Language/Grammar. The worktext was evaluated as an instructional material of exemplary acceptability with respect to the used language/grammar as evidenced by the general mean of 3.75. Specifically, the respondents assessed the developed instructional material as exemplary acceptable on the following items: the worktext uses simple and appropriate vocabularies and grammar that is easy to comprehend by the users ($\bar{x} = 4.00$); the worktext contains statements that are free of grammatical errors and inconsistencies ($\bar{x} = 3.66$); the language used is appealing to the readers ($\bar{x} = 3.55$); The language presents detailed information ($\bar{x} = 3.66$); and the language structure used prevents or avoids misinterpretations ($\bar{x} = 3.88$).

The findings imply that the significance of the language/grammar used in the developed worktext cannot be ignored and it plays a vital role in providing motivation and enjoyment to the student users of the developed instructional material.

Organization and Presentation. The evaluators assessed the worktext as exemplary acceptable with respect to organization and presentation as confirmed by the general mean of 3.82. The indicators in this aspect include the following: the topics in the worktext are organized and show inter-relationship ($\bar{x} = 3.77$); the presentations of the topics are made interesting through various techniques such as figures, illustrations, tables and other graphic arts ($\bar{x} = 3.88$); the sequence of topics is presented logically from simple to complex ($\bar{x} = 3.66$); the objectives of every learning area are started in behavioral terms ($\bar{x} = 3.88$); and, the varied exercises are sufficient enough to realize the objectives ($\bar{x} = 3.88$).

It could be deduced from the results that the respondents viewed the presentation of the topics as well-organized. Furthermore, this implies that the organization and presentation of the topics made answered and met the needs of the students in their study of the Analytic Geometry and will be beneficial to the instructors in their teaching of the course.

Usefulness. The developed worktext with regard to usefulness got a general mean of 3.93, verbally interpreted Exemplary acceptable. The indicators that registered to the evaluators of the worktext as one of exemplary acceptability with respect to usefulness are as follows: the worktext can be very useful to the teachers in teaching the learning competencies ($\bar{x} = 4.00$); students can learn from the worktext independently or even with minimal/without the supervision of the teacher ($\bar{x} = 3.66$); the worktext is suited to the expected users ($\bar{x} = 4.00$); the worktext can also serve as a reference material to other related subjects ($\bar{x} = 4.00$); and, the worktext includes illustrative examples and enhancement exercises that might be given in the licensure examinations. ($\bar{x} = 4.00$).

The results imply that the developed worktext in Analytic Geometry is very useful in the teaching and learning of the course. Furthermore, these suggest that the activities in the developed worktext are beneficial to the students in motivating and challenging them to learn.

All the above findings evidently manifest that the developed worktext will significantly contribute to the teaching and learning of Analytic Geometry. In addition, the findings imply that the worktext possesses the characteristics of instructional material that would help enhance the performance of the students in Analytic Geometry and will facilitate the teaching-learning process.

CONCLUSIONS

Based on the summary of findings, the following conclusions were drawn.

1. The developed worktext in Analytic Geometry helped increase the mathematical performance of the experimental group of student respondents after they were exposed to it.
2. The developed worktext can be used as an instructional material in the study and teaching of Analytic Geometry.
3. The worktext further needs revisions/modifications to make it better effective in all learning areas.

4. The developed worktext is an instructional material of exemplary acceptability in the teaching and learning of Analytic Geometry

RECOMMENDATIONS

In the light of the conclusions made, the following are recommended:

1. The developed worktext be adopted for use by the college students and instructors, respectively, in the study and teaching of Analytic Geometry.
2. The developed worktext be continuously assessed every after use to further improvement to make it better effective in all learning areas.
3. For the administration to evaluate the worktext and recommend funding for its publication to help augment the university's financial resource and efficiency.

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