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Development and Validation of a Worktext in Statistics for Nursing Students

EDELYN ALICAR-CADORNA
delcadphd@yahoo.com

ERWIN F. CADORNA
wincadphd@yahoo.com
University of Northern Philippines

Abstract - This study was conducted to develop and validate a Worktext in Statistics for Nursing Students. The topics covered in the worktext include basic concepts in statistics; collection and presentation of data; measures of central tendency; measures of dispersion; measures of position; probability; vital statistics; nature, scope and significance of demography, and fundamentals of inferential statistics. After the construction of the worktext, it was content validated by the Instructional Materials Development Committee (IMDC) of the university. Said worktext was evaluated in terms of content characteristics and instructional characteristics. The degree of agreement of the evaluators was likewise determined. Comments and suggestions of the evaluators in the improvement of the worktext were also solicited and incorporated. Findings of the study revealed that the developed worktext was rated excellent by the experts indicating that it is very much valid as an instructional material. Likewise, the experts were consistent in their evaluation of the worktext. As regards the pilot testing

part of the study, no significant difference was found between the mean pretest scores of the experimental and control groups. However, the students exposed to the worktext (experimental group) had a significantly higher mean posttest score in Statistics than the those who did not use the worktext (control group). This is an indication that the students in the experimental group learned better than those in the control group.

Keywords - worktext, statistics performance, instructional material

INTRODUCTION

Statistics is one of the mandatory subjects in the curriculum. Students in all types of discipline, including nursing, have to study statistics to be able to handle the enormous data available in the field. These data are needed to solve problems occurring in the discipline. To be able to solve these problems using the available data, statistical methods have to be employed. This is because statistics enables data to be organized and analyzed properly to make it valid and meaningful.

In the nursing profession, statistical tools are used to gather information on the incidence and prevalence of diseases. These are significantly needed for the prevention and good management of the disease. Statistical procedures and techniques are used to study data dealing with birth rates, death rates, marriages, etc. Discoveries of new medicines and medical technologies are made possible through scientific experiments. The cause and effect of various experiments are best analyzed by means of statistical techniques.

One of the main tasks of nurses is to plan and take necessary actions to prevent or solve health problems of the population. To be able to perform such responsibilities, they should not only be equipped with the different health care but also be able to maintain an accurate and updated statistical records and reports.

However, statistics is considered as one of the most difficult subjects, not only at the graduate level, but also at the undergraduate level. The statistics worktext is presented using the simplest language possible to make teaching easy. The concepts and principles were discussed briefly but the essential elements are all included. The

worktext is accessible even to students with limited background in mathematics. Most of the examples and exercises were taken from actual health researches, journals and books.

This statistics worktext is intended for the students in health-related courses to equip them with the fundamental concepts and principles of statistics they need to prepare statistical records. Further, this worktext will enable them to understand results of studies found in health journals and can even provide them the skills in making their own research study.

FRAMEWORK

Presidential Decree No. 6-A, known as the Educational Development Act of 1972, explicitly stated one of the objectives of tertiary education in the following statement: "Develop the high level professions that will provide leadership for the nation, enhance knowledge through research, and apply new knowledge for improving the quality of instruction." This objective shall be attained through the design, utilization and improvement of instructional technology and development/production of textbooks and other instructional materials (http://www.lawphil.net/statutes/presdecs/pd1972/pd_6_a_1972.html).

Ornstein (1997) stated that developing your own instructional material is unique and an important ingredient of good teaching. In developing instructional materials, needs or problems must be addressed, objectives developed, methods and materials determined, tests and evaluation conducted, and parts of the program and materials revised.

Ornstein also devised the following guide questions for the development of instructional materials:

1. Do the materials fit the objectives? Materials should fit the objectives of the course as well as unit plan and lesson plan.
2. Are the materials well organized? Good instructional materials will relate facts to a few basic ideas in a logical manner.
3. Do the materials prepare the students for the presentation? The materials should include instructional objectives or advance organizers.

4. Are the materials well designed? The materials should be attractive, the size should be appropriate for the intended use, print should be readable with adequate margins, legible typeface and comfortable type size.
5. Have the materials been presented in a technically appropriate manner? The materials should not be "over-presented" with too much emphasis on decorative but uninformative illustrations or unnecessary type elements. Visual presentations, side notes in margins, appropriate headings, graphics and color should be incorporated into the material.
6. Do the materials provide sufficient repetition through examples, illustrations, questions and summaries to enhance understanding of content? Young students and low-achieving students need more repetition, overviews and internal summaries, but for all students, the materials should be paced properly, and they should have sufficient time to digest and reflect on it.
7. Is the material suitable to the reading level of the students? Many teachers can make his type of judgment intuitively by reading through the material, and others can make the judgment after the students experience the materials.
8. Does the difficulty of the materials match the abilities of the students?

Lardizabal (1999) illustrated the following sound principles of learning which are best exemplified by instructional materials like modules and work texts:

1. Learning is best practice by doing.
2. Learning is best facilitated through the psychological feedback afforded to learner.
3. Learning experiences provide many opportunities for the learners to progress at their own rate.
4. Learning experiences simulate the learner's immediate environment, hence, carry over the learning experiences from the school to the home is assured.
5. Learning situations being utilized provide for the needs of both the slow and fast learners. Consequently, less frustrations are

experienced particularly by the slow learners who are given chances to beat their own records.

According to Gregorio (1976), the following are outstanding characteristics of programmed instruction:

1. It requires clearly defined objectives in terms of student behavior. What is worth teaching must be considered by the teacher.
2. It represents the materials to the students in an organized and logical sequence.
3. It requires from the student overt response to the materials presented. In other words, an active response to the stimuli is required on the part of the learner.
4. It provides feedback to the student so that he knows whether or not his response is correct. Immediate knowledge of correct response must be made available to the learner.

Lopez (1998) developed modules for student nurses at the Region I Medical Center, Dagupan City. She claimed that enrichment modules are necessary to assist the students in their clinical practices along orientation, clinical teaching, instructional facilities, records keeping, supervision, and guidance and evaluation. After the content validation of the enrichment modules, the researcher concluded that the modules are adequate since it met the specified criteria such as clarity, functionality, conciseness and objectiveness.

The study of Dela Cruz (1999) aimed to reinforce the practice in community health extension services of midwifery students through learning activity modules. The study found out that the midwifery students lack sufficient knowledge and skills along pre-natal care, intranatal care, post-partum care, health care for infants and children, and family planning. After the development and validation of her learning activity modules, she concluded that the practice of community health by midwifery students can be reinforced by the enhancement of their knowledge and skills through the use of learning activity modules that are based on their needs.

Ilaga (1999) developed and validated Biodiversimusements for the Teaching of Systematics. The instructional material primarily aimed

to make the topic on Systematics interesting by incorporating sets of activities into the material. The enrichment material was evaluated to be valid by the pool of experts. It was also found out to be effective in developing the basic systematic skills and competencies of the students as indicated by the significant difference in the pretest and posttest mean scores.

Also in Biology, Agbuggo (1998) constructed and validated modules on Taxonomy. The modules were found to be valid in terms of objectives, content, activities and instructional characteristics. Hence, it was concluded that the modules can be effective in helping students acquire and assimilate systematic/taxonomy concepts.

The learning modules on Variation and Similarity, developed by Medrano (1998), was found to have a high content validity. It was also found out that the experimental group performed better than the control group. This is an indication that the learning modules on Variation and Similarity was more effective that the traditional method of instruction.

Mejia (1997) developed and validated a module for teaching Statistics. Results of the experiment revealed that there is a significant difference between the mean scores of the experimental and control groups, in favor of the experimental group. It was also found out that the module in Statistics met the criteria outstandingly in terms of objectives, presentation, comprehensibility, and usefulness.

OBJECTIVES OF THE STUDY

This study was conducted to develop and validate a work text in Statistics for nursing students. Specifically, it pursued the following objectives:

1. To determine the assessment of the evaluation committee on the worktext along the content characteristics in terms of objectives, clarity, and relevance, and instructional characteristics in terms of design, suitability, and testing method;
2. To determine the agreement of the evaluation among committee members on the work text;
3. To measure the mean pretest and posttest scores of the students exposed to the worktext (experimental group) and those who were not (control group); and

4. To compare the mean pretest and posttest scores of the students between the experimental and the control group.

METHODOLOGY

This study employed the descriptive and comparative methods of research. The specialized research design was used in the development and content validation of the worktext. After the content validation of the worktext, the non-equivalent pretest-posttest control group design was used for the try out of the worktext.

The respondents of the study was composed of 61 nursing students of the University of Northern Philippines-College of Health Sciences. The stages followed in the development of the worktext is shown in Figure 1. The planning stage included proposal-making and outlining of the topics, gathering of information from related sources. Statistics books and Statistics syllabus were used as bases in the sequencing of topics. The worktext consists of nine (9) chapters with the following topics: basic concepts in statistics; collection and presentation of data; measures of central tendency; measures of dispersion; measures of position; probability; vital statistics; nature, scope and significance of demography, and fundamentals of inferential statistics.

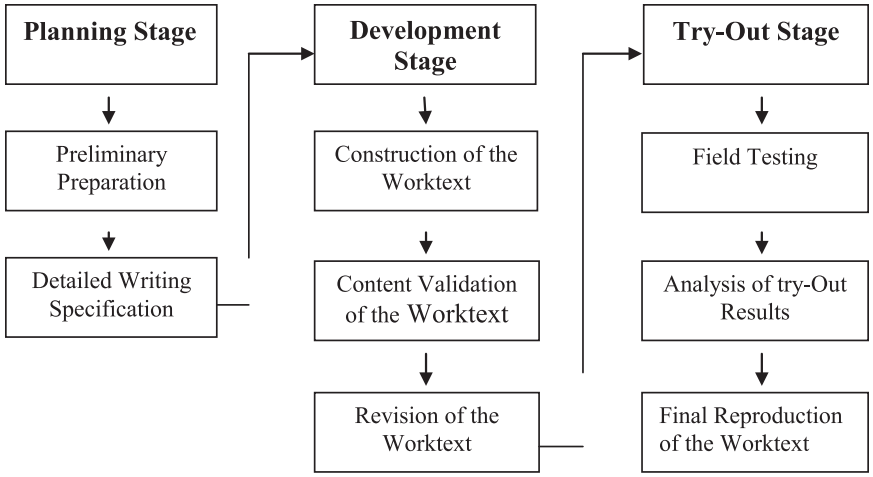

Figure 1. Flowchart of the stages of the worktext development

The development stage covered the formulation of the objectives of the worktext and the objectives of each chapter. Each chapter has the following parts: presentation of the concepts, worked out examples and exercises. Questions with answers were likewise presented within the text. The content validation was also done in this stage. The Instructional Materials Development Committee (IMDC) of the university served as evaluators of the worktext. The committee was composed of the Vice President of Academic Affairs as the Chair, the Discipline Chair in Mathematics and three other Statistics teachers in the university as members. They evaluated the worktext in terms of content characteristics and instructional characteristics. Content characteristics covered objectives, clarity, and relevance. On the other hand, instructional characteristics included design, suitability, and testing method. The worktext was revised based on the comments and suggestions of the evaluators. The consistency of the evaluation of the members of the committee was also looked into in this stage.

Finally, the try-out stage included the pilot testing of the worktext making use of two intact Statistics classes at the College of Health Sciences. One class made use of the worktext, called the experimental group, while the other class did not use the worktext, called the control

group. Only one teacher, one of the researchers, taught the two classes. A pretest was given to both groups before the start of the lecture. The same test was again administered to both classes after discussing all the topics. The results of the pre and post testing served as the pretest and posttest scores, respectively. These were later analyzed statistically. After the pilot testing, the final reproduction of the worktext was made.

In the evaluation of the worktext by the IMDC in terms of content and instructional characteristics, the questionnaire adopted from Estrañero (2001) was used. To evaluate the performance of the students during the pilot testing, a 50-item test in Statistics was constructed by the researcher. The test covers the following content areas: basic concepts in statistics; collection and presentation of data; measures of central tendency; measures of dispersion; measures of position; probability; vital statistics; nature, scope and significance of demography, and fundamentals of inferential statistics. The test was constructed at the level of knowledge, comprehension, application, and analysis. This was presented to Statistics teachers for content validity. The test has a validity index of 4.48 which suggests that it is very much valid. Likewise, the test was pilot tested to a group of nursing students other than the students considered in the study. From the 50-item test, 10 were discarded based on the results of the item analysis. Hence, the final version of the Statistics Test composed of 40 items. The test was found to have a high internal reliability (KR_{20}=.89).

To analyze the data gathered in the study, the mean, was used in expressing the general evaluation of the validators on the worktext, and in expressing the overall pretest and posttest scores of the students in the experimental and control groups. The coefficient of concordance was employed to determine the significant agreement among the validators in their evaluation of the worktext. Likewise, t-test was utilized to determine the significant difference between the pretest and posttest mean scores of the experimental and control groups.

RESULTS AND DISCUSSION

Evaluation of the worktext. The validators of the developed worktext in Statistics were the members of the Instructional Materials Development Committee (IMDC) of the university. They evaluated

the worktext in terms of its content characteristics and instructional characteristics. Generally, the worktext was rated outstanding.

The content characteristics of the worktext were assessed in terms of objectives, clarity and relevance. The objectives of the worktext were assessed as "outstanding" by the validators. This suggests that the objectives of the worktext are clearly stated, focus on the development of critical thinking of the students, are attainable, and well defined. In terms of clarity, the worktext was also rated "outstanding". This indicates that the fundamental concepts are clearly explained, the explanation of the concepts/principles are accurate, clear and concise, the examples given are adequate to assist the students in learning the concept, the vocabulary used is within the reading ability of the students, the language of the worktext is clear in terms of vocabulary, and the instructions in the worktext are easy to understand. In terms of relevance, an outstanding rating was also given by the validators. This means that the activities given in the worktext serve as enrichment task for a clearer and better understanding of the concepts discussed, and the questions and exercises given are relevant to the understanding of the concepts developed in the worktext. In general, the content characteristics of the worktext were rated outstanding by the validators.

On the other hand, instructional characteristics were assessed in terms of design, suitability and testing method. The validators evaluated the design of the worktext as very good. This suggests that the lessons in the worktext can be performed even without help from the teacher, the style of writing and presentation is simple and appealing to the students, and the steps to be followed in each activity is systematically presented. In terms of suitability, an outstanding rating was given by the validators. This means that the worktext is appropriate for students with varied attitudes and learning abilities, the lessons and activities can be carried out individually or by group, and the lessons and activities are always ready to be used anytime. The testing method characteristic of the worktext was also evaluated outstanding by the validators. This indicates that the tests given at the end of each chapter of the worktext reflect the objectives of that part of the work text. This also means that the tests are designed to determine how well the students perform the specific learning tasks defined by the objectives of each chapter in the worktext. In general, the instructional

characteristics of the worktext were evaluated outstanding.

Agreement of the validators' evaluation of the worktext. This study also determined the degree of agreement of the validators in their evaluation of the developed work text. Kendal Coefficient of Concordance and X^2 were used to test the degree and significance of agreement, respectively. The computed W suggests that there is a high degree of agreement of the validators' evaluation of the characteristics of the worktext.

The significance of the agreement, measured in terms of X^2 suggests that there is a significant agreement of the validators in their evaluation of the developed work text (X^2 computed > X^2 tabular). This also implies that the validators were consistent in their outstanding evaluation as regards the quality of the developed worktext.

Pretest scores of the experimental and control groups. Prior to the pilot testing of the worktext, a pretest was administered to both the experimental group (students who used the worktext) and the control group. The results are displayed in Table 1.

As shown in the table, the students who were taught using the worktext, the experimental group, obtained an overall mean pretest score of 11.28, described as poor performance. The students under the control group garnered an overall mean score 11.51, also interpreted as poor performance. Although the control group had a higher overall mean score over the experimental group, both groups have a pretest score described as poor before the start of the experimentation suggesting that the two groups have more or less the same mean performance in Statistics. Furthermore, this implies that at the beginning of the experimentation, the two groups were more or less equivalent in terms of their pre-entry performance in Statistics and hence, were comparable.

Table 1 Summary of the pretest scores of the experimental and control groups

Result	Experimental Group (N=32)	Control Group (N=29)
No. of Items	40	40
Highest Score	17	18
Lowest Score	6	7
Standard Deviation	2.95	2.80
Variance	8.70	7.84
Mean	11.28	11.51
Descriptive Rating	**Poor**	**Poor**

The values of the standard deviations indicate that the two groups are considered to have more or less the same dispersion with regards to their overall scores considering the very slight difference in the values of the standard deviations.

Test of significant difference in the pretest mean scores between the experimental and control groups. The performance of the two groups of students (experimental and control) were compared statistically through the t-test of significant difference between means for independent samples. This was done to determine whether the two groups differ significantly in their pretest scores in the Statistics Test before the start of the pilot testing.

It is evident that no significant difference existed between the mean scores of the students under the experimental and control groups in their overall performance in the Statistics Test ($p > .05$). This means that the two groups of students have more or less the same pre-entry understanding on the basic concepts of Statistics before the start of the experimentation. This also verifies earlier findings as regards to the descriptive comparison in the pretest scores of the two groups of students. Hence, it could be concluded that at the start, the two groups of students are statistically equivalent and are comparable.

Posttest scores of the experimental and control groups. After one-semester of intervention, i.e., exposing the two groups of students on the use of the developed worktext and the traditional method of instruction, the Statistics performance of these students were again determined making use of the same test administered before the

start of experimentation. The results of the test (posttest scores) are exhibited in Table 2.

Table 2 Summary of the posttest scores of the experimental and control groups

Result	Experimental Group (N=32)	Control Group (N=29)
No. of Items	40	40
Highest Score	35	30
Lowest Score	18	14
Standard Deviation	3.56	4.21
Variance	12.67	17.72
Mean	29.73	21.68
Descriptive Rating	**Very Satisfactory**	**Satisfactory**

The group of students who were exposed to the developed worktext garnered an overall mean posttest score of 29.73, which is within the level of "Very Satisfactory" performance. It should be recalled that this group of students only had a poor performance before they were exposed to the worktext. This indicates that there was an improvement in the performance of the students in Statistics from "Poor" to "Very Satisfactory" after exposure to the developed worktext.

On the other hand, the students under the control group, after exposure to the traditional method of teaching, obtained an overall mean score of 21.68, interpreted as "Satisfactory" performance in Statistics. It should also be recalled that before the start of the experimentation, the students had a "Poor" performance in Statistics. After one-semester of intervention, there was an improvement of their performance from "Poor" to "Satisfactory".

Test of significant difference in the posttest mean scores between the experimental and control groups. In the previous findings, the experimental and control groups were proven to be equivalent. Hence, the use of the posttest scores as a basis in determining whether the use of the developed work text in teaching Statistics is significantly better than the traditional lecture method on nursing students' achievement

is safe.

The performance (posttest scores) of the experimental and control groups after the intervention period were then compared statistically through the use of the t-test of significant difference between means for independent samples.

The difference in the overall mean posttest scores between the experimental and control groups are statistically significant (t-prob < .05). This means that the students under the experimental group had significantly higher overall performance in the Statistics Test than the students under the control group. Hence, the null hypothesis which states that there is no significant difference in the overall performance in the Statistics Test between the two groups of students is hereby rejected.

CONCLUSIONS

The developed Worktext in Statistics can be used as an instructional material for nursing students. The evaluators were unanimous in their assessment of the content and instructional characteristics of the developed worktext. As to its effectiveness, the worktext can enhance nursing students' understanding of the concepts in Statistics, and develop their skills in applying the concepts learned to practical situations.

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