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Dealing with Dual Anxieties

by Kenneth Preston and Dorothy Radin

Abstract

Focusing on time as an issue, research was done to examine the concept of timed examinations as a possible reason for low scores in mathematics classes. This paper details the research and its results. In this study, the time allotted for a statistics examination was increased in order to determine if test scores improved. Mean scores from ten 90-minute introductory statistics exams were compared to mean scores from 50-minute exams given in prior introductory statistics classes to test for improvement. An Analysis of Variance (ANOVA) using an alpha (α) of 0.05 was used to make the determination. The results indicate that there was a significant difference (with a p -value of 0.009) between the classes' mathematical test scores—50 minutes versus 90 minutes. Expanding the time allotted for an examination while keeping the content of the examination constant did improve the students' overall grades.

Introduction

“Tests and evaluations are a nearly unavoidable part of our world” (Goonan, 2003, p. 257). Of major concern, then, is the elimination of test anxiety. Test anxiety not only produces low test scores but also causes students to be less motivated (Hancock, 2001). Because of this, educators need to choose ways to assess students' knowledge that will give valid evaluations while minimizing test anxiety. According to Cross (1996), a major cause of failure in the classroom is test anxiety brought on by timed tests. Beasley, Long, and Natali (2001) reported that placing individuals under time constraints tended to reduce performance. In addition, work by Tobias (1978) linked test anxiety directly to the amount of time a student had to complete the evaluation. The subject of mathematics can also cause anxiety for today's student. Coupled with test anxiety, there is potential for lower-than-deserved grades based on the student's knowledge (Chapell et. al., 2005).

Spielberger and Vagg (as cited in DiBattista & Gosse, 2006) indicated that students who had anxiety traits tended to view examinations as more stressful because of their evaluative nature and so they tended to feel a higher level of anxiety when taking a test. According to Nolting (1997), there are two primary types of anxieties that students can experience: “somatic” and “cognitive.” Somatic anxiety is the loss of body control and is characterized by sweating with pain in the neck and stomach. During tests, somatic anxiety can cause students to have actual physical symptoms such as sweating and light headedness (Gall, 1996). Cognitive anxiety manifests itself in loss of concentration, such as during an examination. Students experiencing cognitive anxiety tend to have feelings of doubt and low self-worth. Since these symptoms may be present in all cases of anxiety, determination requires physiological measurement. This research uses an accepted social research assumption that these physical characteristics may have been present but not measured directly.

There are two primary subject area anxieties exemplified in this study: test anxiety and mathematics anxiety. A third type of anxiety that may have presented itself in

this research is statistics anxiety. There is a lack of empirical literature distinguishing between these two types of anxieties—general and mathematical (Baloglu, 1999). Because this study is concerned with the improvement of test scores among mathematics students, no distinction will be referenced or implied between mathematics or statistics anxiety. In this paper, both terms are used interchangeably.

Students' perceptions about a course tend to influence their grades in statistics. Zanakis and Valenzi (1997) stated that “preconceived notions about statistics, feelings of weak mathematical background, and limited computer exposure may increase student anxiety and fear in undergraduate courses in statistics” (p. 11). Some researchers indicate that much of this anxiety may be due to poor preparation by the students. For example, Pan and Tang (2005) believed that “statistics anxiety is not only due to the lack of training or to insufficient skills, but it is also due to misperception about statistics and negative experiences in previous statistics classes” (p. 205).

Test and mathematics anxieties each have their own characteristics. Separately they can adversely impact an individual and together they can be devastating. The difference between the two is that test anxiety is a learned behavior that can be unlearned (Nolting, 1997). Mathematics anxiety can be extreme; this anxiety is often caused by having a negative attitude due to a previous bad experience (Nolting, 1997). Combining these two components creates an environment that has been defined as “the set of phenomenological, physiological, and behavioral responses that accompany concern about possible negative consequences of failure on an exam or similar evaluative situations” (Zeidner, 1998, p.17).

Test Anxiety

“Almost any student will agree that examinations are one of the most stressful parts of college life” (Weber & Bizer, 2006, p. 283). Measuring a student's progress through examinations helps schools with needs assessments to improve instruction, strengthen courses, or completely change teaching techniques (U.S. Department of Education, 1993). Testing is therefore a necessary ingredient in higher education. Because of this, test anxiety becomes a real phenomenon of concern in education that should be eliminated.

Harris and Coy (2003) indicate that test anxiety is composed of three major components: “cognitive,” “affective,” and “behavioral.” Students who experience test anxiety from the cognitive perspective lack self-confidence. They are worriers who doubt themselves and their activities. The affective perspective of test anxiety can cause students physical distress, such as nausea, perspiration, or spasms. Strong emotions such as worry may also be present. From the behavioral perspective, students often have poor study skills, are unprepared, and physically exhausted during the test.

The exact cause of test anxiety is still unknown, but most experts indicate that it is probably a fear of a poor evaluation. “Student achievement is an important learning outcome” (Hancock, 2001, p. 284), and the examination is a demonstration of his or her performance. Poor test evaluations not only affect student performance in that particular course, it also affects overall grade point average (GPA) (Chapell et al., 2005). Thus, the student has a lot to lose if he or she performs poorly on tests due to anxiety. One reason for test anxiety might be due to the practice of timed exams. Research indicates that a major cause of failure in the classroom is test anxiety brought on by timed tests. In a

report on statistics anxiety, Onwuegbuzie and Seaman (1995) showed that “both low and high anxious students performed better on the . . . examination under the untimed condition than under the timed condition” (p. 115).

Mathematics Anxiety

Mathematics anxiety goes beyond the testing. It is concerned with the act of numerical manipulation. The National Council of Teachers of Mathematics defined mathematics anxiety as “an inconceivable dread that interferes with manipulating numbers and solving mathematical problems in a variety of everyday life and academic situations” (as cited in Black, 2005, p. 43). Mathematics anxiety causes apprehension and arousal concerns because it involves the manipulation of numbers in academic, private, and social environments (Hopko, 2003; Richardson & Suinn, 1972).

Kazelskis et al. (2000) supported the concept that there was no clear distinction between measures of mathematics anxiety and test anxiety. That research found that the intercorrelation between the major measures of mathematics anxiety and test anxiety was 0.51. In addition, Baloglu (1999) indicated that the lack of empirical literature did not help researchers in distinguishing between the different anxieties. As a result, this correlation prevents researchers from separating the two types of anxieties and thereby confounds it. An evaluation of test anxiety by Zeidner and Matthews (2005) demonstrated that there may be different forms that “are distinguished by the antecedent conditions and context invoking anxieties . . . They have important structural similarities” (p.141). This lack of evidence in distinguishing between anxieties along with the structural similarities indicates that “anxiety is heterogeneous with respect to its cause and consequence” (Zeidner & Mathews, 2005, p.160) allowing researchers to combine the different anxieties into a single study.

Tobias (1978) stated that students’ math anxiety is not a failure of intellect but a failure of nerve. This anxiety can be overcome. Tobias linked math anxiety directly to the amount of time a student had to complete an examination. “People remember math as being taught in an atmosphere of tension created by . . .the demands of timed tests” (p. 31).

Math phobia is often extrapolated to statistics, and the “fear of math spills over into fear of data” (Tobias, 1978, p. 28). Statistics anxiety may be a critical factor in influencing and attaining a student’s academic and vocational goals. As a result of the emphasis on statistical techniques in today’s society, many “mathphobes” could be excluded from a number of career fields.

Summary

The concept of dual anxieties involves two fields where anxiety is present: test anxiety and mathematics anxiety. These two anxieties are normally separated by the academic area but to a mathematics student they can both be present. The purpose of this study was not to identify, analyze, or separate these anxieties but to try to ease their previously established impact on the student during timed math tests. This study tested the hypothesis that increasing the time a student has to complete an examination would improve his or her performance on that examination.

Materials and Methods

Cohort

The subjects under study were college students over a period of several years. The issue of cohort is defined as follows: A cohort group can be defined as any group of individuals who have the same experiences at the same time or a group of similar individuals who have a similar experience but at different times (Microsoft, 2007). Because of the uniqueness of this research, the definition of cohort is defined as a similar group of individuals (e.g., undergraduate college students) who had a similar experience (e.g., taking an introductory statistics course from the same instructor over an extended period of time).

Testing Process

At most colleges and universities, math examinations are confined to the time continuum of a class period, normally 50 minutes. Within this 50-minute time period a student must enter the classroom, organize his or her papers, get the calculator ready, take a deep breath, prepare the necessary forms for scoring the test, and then take the examination. Coupling these preparatory activities with a student's math anxiety places him or her at an inherent disadvantage on the examination, possibly increasing the student's chances for failure, thereby perpetuating the phobia. Therefore, this study began with the theory that if the time allotted for the statistics examination were increased, the students' performance would improve, resulting in better grades. The situation involved allotting more time on each of the individual examinations while maintaining the integrity of the examination process. A second goal was to ensure that any change in the testing schedule was not in any way punitive.

Two testing times were selected when all the statistics students could meet and take the examination as a group, regardless of their section or instructor. All of the examinations were given on the same day with a morning and an afternoon session provided. Students were then allowed to attend either of the two testing times. The examination time was extended from the 50 minutes previously allotted to 90-minutes. Approximately 200 statistics students were enrolled in the introductory statistics courses each semester.

The previous practice for statistics classes was for each instructor to give the same examination in all sections. This allowed for uniformity in scoring and kept competition between instructors to a minimum. This also allowed instructors to compare test results to insure continuity. Selecting a common time for all students to take the exam had a secondary benefit of reducing the temptation to share exam information among students. Before this change, the examination was given to several different sections at different times throughout the week causing some concern for cheating. This factor is not part of the study but needs to be mentioned because of the potential side effect of inflated grades prior to this single-day testing process. During the semester, three individual examinations were given. These were the examinations that were used in the analysis. The final examination times of one hour and forty-five minutes were set as a matter of school policy, and this time could not be adjusted.

Hypotheses

The research hypothesis is that increasing test time will increase the mean test scores of college students in an introductory statistics course.

Research Criteria

During the past several years a number of different instructors have taught multiple sections of an undergraduate introductory statistics course. To eliminate teaching methodology and teacher characteristics as confounding variables, only one instructor's classes were chosen for this study. This instructor was chosen because she taught the same course before and after the exam time change. Thus, the course content, syllabus, and delivery did not change during the study although the text did change. Computations for this research used only test scores for this instructor's students. The examinations remained consistent during the study period and utilized a five-response, multiple choice format, thereby eliminating any grading bias.

Data

Three examinations were given during the course of the semester—plus a final. Only the three examinations were used for this study since the final examination time period was administratively set at 105 minutes and could not be altered. Data were collected over a five-year period. In four semesters, ten classes of students took the examinations during the traditional 50-minute period. In the next five semesters, 10 different classes of students took the examinations in the expanded 90-minute time frame.

Class sizes in the earlier 50-minute classes ranged from a high of 49 to a low of 24. In later semesters, class sizes ranged from 40 to 23. Since a single instructor taught each of the statistics classes under study, all of the individual class examinations were combined as a single component for evaluation purposes. The sample sizes met the minimum requirement for population validity in all instances, and the analysis used the combined mean scores for each of the different examinations. The examinations were grouped based on their position in the course to ensure that there was no variation of difficulty exhibited from one examination to another.

Results

The N values are the number of examinations used in the study, not the number of participants. The number of students on each examination exceeded 30, and the mean test scores from each semester class were used from the groups before and after the time extension. These sample sizes and mean test scores per semester are given in Tables 1 and 2 below.

Table 1
Test Means and Samples Sizes for Classes Taught Before Consolidated Exams and Extended Exam Times

Year	Semester	Exam 1		Exam 2		Exam 3	
		Mean	n	Mean	n	Mean	n
First	Fall	58.4	49	57.6	46	57.8	46
		64.0	45	62.4	36	64.7	36
	Spring			57.1	27	63.4	27
Second	Spring			61.4	26	62.2	27
		72.6	30	67.0	28	75.4	29
		76.6	33	69.6	35	73.8	35
Third	Fall	79.5	30	65.9	32	70.7	31
		74.0	26	65.0	26	66.2	24
		77.2	33	60.3	31	63.8	32
		77.4	33	63.8	34	70.3	32

Table 2
Test Means and Samples Sizes for Classes Taught After Consolidated Exams and Extended Exam Times

Year	Semester	Exam 1		Exam 2		Exam 3	
		Mean	n	Mean	n	Mean	n
Third	Spring	70.3	28	66.2	24	65.4	23
		77.6	37	72.3	39	64.3	38
		76.3	35	66.4	39	64.3	38
Fourth	Fall	79.0	35	74.9	35	74.5	34
		76.5	35	72.8	34	70.8	36
		72.2	30	71.8	28	73.7	23
	Spring	75.1	40	72.5	35	63.5	35
Fifth	Fall	70.6	31	59.9	31	58.6	28
		77.2	36	75.5	36	71.0	37
		76.9	40	74.2	38	69.1	38

The research statistical package used was Minitab[®]. The research methodology used the one-way ANOVA test as a means to determine significance. The significance level alpha (α) was selected to be .05. The results of the analysis are given in Table 3 below.

Table 3
Time Test Difference ANOVA

Source	DF	SS	MS	F	P
Factor	1	263.9	263.9	7.41	0.009
Error	56	1992.9	35.6		
Total	57	2256.7			

Level	N	Mean	St.Dev.
50 minute exam	28	67.075	6.689
90 minute exam	30	71.343	5.203
Pooled St. Dev. = 5.966			

The results indicate that there is a significant difference between the mathematical test scores (p -value=0.009) with the 90-minute exams giving greater (e.g., better) test scores than the 50-minute exam (71.3 vs. 67.0, respectively).

Conclusion

One form of assessment in a learning environment is the written test. This measures student achievement and gives teachers feedback on instruction. Yet anxieties can often cause students to perform poorly and give teachers a false evaluation of student progress. This is particularly true in an introductory statistics classroom where both test anxiety and mathematics anxiety can occur.

While this study only dealt with the connection between timed exams and improving the mean scores of those exams, the underlying concern was to relieve the anxiety level of the students by increasing the amount of time to take the test. In this limited study, it would not be responsible to claim that the results indicated that anxiety was lowered, only that test scores were raised by increasing the exam time. However, this increase in performance does support the results of Beasley, Long, and Natali (2001) and Ouwuebuie and Seaman (1995) that address both anxiety and timed exams.

Since this current study was conducted over a five-year period at a small southwestern private Christian university where class sizes ranged from 23 to 49, these research results can be generalized to a similar population, but may not apply to universities with dissimilar student bodies. Future research should be conducted directly on test and statistical anxieties in the context of timed tests. Finally, math instructors should make every effort to increase the amount of test time in order to provide students an opportunity to perform at their best level.

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