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An evaluation of the attitudes that students have towards EDRS: 811 Quantitative Methods in Education

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**Introduction**

There is rising concern over the anxiety that students in the behavioral sciences frequently express regarding statistics. The anxiety is so prevalent that there is a special term that describes this fear called “statophobia” (Pretorios & Norman, 1992). This fear limits the ability for students to effectively learn statistics and creates a psychological and motivational barrier against statistics (Payne & Israel, 2010). However, researchers within the behavioral sciences agree that it is important for students to be able to understand statistical information in order to effectively carry out their own research as well as interpret and implement the research of others (Payne & Israel, 2010). Therefore, the purpose of this evaluation was to examine the attitudes and perceptions that current Ph.D. in Education students at George Mason University have towards the required course: EDRS 811: Quantitative Methods in Education. Specifically, this evaluation attempted to identify the patterns of attitudes that students have towards statistics across time as well as identify the impact that EDRS 811: Quantitative Methods have on student attitudes.

This evaluation was conducted for Dr. Anastasia Kitsantas and Dr. Gary Galluzzo. The main client of this evaluation is Dr. Kitsantas, who is the program coordinator of the Educational Psychology program while Dr. Gary Galluzzo is the program director of the PhD in Education Program. Dr. Buehl and Dr. Dimitrov are the instructors of EDRS 811 and main stakeholders of EDRS 811. Other consumers are also the Ph.D. in Education students who are required to take this course and that this evaluation aims to improve the experience for. Ultimately, this evaluation seeks to inform the client and stakeholders of the EDRS 811: Quantitative Methods experience of Ph.D. students and ways in which this experience can be improved upon.

 *Description of course.* EDRS 811 is a course designed to train students at the Ph.D. level to conduct and interpret quantitative research methods and analysis. More broadly, this course aims to prepare students to be knowledge creators through quantitative analyses. An additional and equally important goal of the course is to prepare students to be able to effectively consume research that uses quantitative methods of inquiry. The professors of the course are responsible for teaching students the statistical processes used to conduct research in education as well as equip them with the skills to be able to soundly carry out their own research.

 *Focus.* The primary goal of this evaluation is to examine the motivational factors that students have regarding statistics across time. In the preliminary discussions with the clients and stakeholders, several convergent themes emerged. Specifically, the client and stakeholders expressed concern over: 1) students level of anxiety prior to entering the class and the impact on their ability to focus on mastering the material, 2) student motivational aspects: affect, attitudes, values, difficulty, interest effort, and self-efficacy; and 3) students’ ability to retain information learned over time. The concerns of the clients and stakeholders were consolidated into three main research questions which were:

1. What are student attitudes prior to beginning EDRS 811 in terms of their math anxiety, attitudes towards statistics, and values?
2. What are student attitudes after completing EDRS 811 in terms so their math anxiety, attitudes towards statistics, and values?
3. How do students’ math anxiety, attitudes towards statistics, and values change from the beginning to the completion of EDRS 811?

**Evaluation Plan**

 *Limitations.* There are several limitations that may impact the findings of this evaluation. First, the number of students who responded to the survey was low. Out of the 450 students on the Ph.D. in Education listserv, only about 80 students responded. These 80 student respondents do not accurately represent the attitudes and motivations of all the Ph.D. in Education students at GMU. The low sample size was further compromised by splitting students into different groups for analyses. Therefore, the statistical power in the analyses should be treated with caution. Another limitation was that survey completion was completely voluntary. As a result, it can be assumed that students who had strong feelings (either good or bad) about statistics would be more compelled to respond than students who felt less impacted by the statistics course. Finally, the last limitation is that not enough variables were examined to provide a larger breadth of the context of EDRS 811.

*Methodological Approach*

With time limitations taken into consideration, a cross-sectional approach to the research questions was implemented in place of a repeated measures method. Students who have yet to complete (Pre 811) and have already completed (Post 811) EDRS 811 were administered questionnaires for pre-post comparisons. Specifically, since the purpose of this evaluation was to examine the impact of EDRS 811, the most ideal methodological approach would be to do a time-series design, where the attitudes of students are followed at Pre 811 to Post 811. However, since doing a true Pre-Post design would not be plausible given the time allotted for this evaluation, students who have yet to take EDRS 811 would be assessed separately with students who have already taken EDRS 811. This results in a cross-sectional evaluation design where the trends that emerge between groups and are assumed to be reflective of within group changes. That is, the experiences of post 811 students are assumed to be representative of the changes that pre 811 students would experience upon completing EDRS 811.

*Procedure and Participants.* Students were recruited to participate through the Ph.D. in Education email listserv. The program manager for the Ph.D. in education students, Joan Stahle, had sent out an email requesting student participation. After the first wave of data was collected I included an open-ended question for any additional comments. Students were informed of this additional question and were reminded to complete the survey with a second email. This was done in response to several student requests to provide further qualitative information regarding their experiences in EDRS 811.

A total of 87 students completed the questionnaire with a response rate of approximately 19%. Approximately 450 students are in the Ph.D. in Education listserv. The students who are included in the listserv are those who are currently enrolled as students as well as students who have completed their Ph.D. studies. Out of the 87 students, the average age of students were 39 years old with an age range of 23-62. Of the total number of participants, 81.6% were female. In terms of the ethnic background, 74% were White, 10% were African American, 6% were Asian, and 3% were labeled as “other” (e.g., mixed decent). One student who had classified herself as Middle Eastern was classified under the “Asian” category. Of the students who participated, 60% (n = 52) had already completed EDRS 811, 13% (n = 11) were currently enrolled in EDRS 811, and 28% (n = 24) have yet to complete the course. Of the 52 students who had already completed EDRS 811, most of them had completed it within 2008 (n =14) and 2009 (n = 19).

 As a result of the low number of currently enrolled in EDRS 811 students who completed the survey (n = 11), I made the decision to group them with students who had already completed the course, making the total number of post students to be 62. This was done because the survey was administered close to the end of the semester when students were preparing for their final exams. Additionally, analyses were run to determine if any differences existed between current and post students and significant differences emerged only on the self-efficacy measures, where current students were more self-efficacious to interpret SPSS output than post 811 students, (*t* (60) = 2.35, *p <* .05). Therefore, items pertaining to self-efficacy will be analyzed according to the three groups while all other variables will be assessed according to pre 811 students and current and post 811 students collapsed into one group.

 Missing data were dealt with by replacing the missing number with the mean of that variable by pre/current/post grouping. Specifically, there were several missing values for each of the subscales as a result of students skipping certain questions on the survey, however, the number of missing values were low. There were 6 missing values for the affect measure, and no more than 3 missing values for any other subscale. Since there was no evidence of students systematically skipping questions, the mean substitution method for coping with missing data was utilized. For example, the one missing value for a student currently enrolled in 811 was replaced with the overall mean of current 811 student perceptions of difficulty.

*Materials*

 *Demographic Questionnaire.* This was a generic questionnaire that queried student ethnic background, gender, age, and primary and secondary areas of concentration. An additional question included the semester and year the students had taken or plan to take EDRS 811.

 *Statistics Anxiety Scale (SAS: Pretorious & Norman, 1992).* This instrument measured student anxiety towards statistics with 10 items on a 1 (strongly disagree) to 5 (strongly agree) Likert-type rating scale. An example item includes, “I get a sinking feeling when I think of trying hard statistics problems” (α = 0.92).

 *The Survey of Attitudes Toward Statistics Scale (SATS: Cashin & Elmore, 2005).* This instrument measured students’ attitudes towards statistics with a total of 36 items measured on a 1 (strongly disagree) to 7 (strongly agree) Likert-type rating scale. A total of 6 subscales were included in this instrument which include: affect (ex: “I will like statistics,” 6 items, α = 0.89), cognitive competence (ex: “I can learn statistics,” 6 items, α = 0.82), value (ex: “Statistics is worthless,” 9 items, α = 0.85), difficulty (ex: “Statistics is highly technical,” 7 items, α = 0.70), interest (ex: “I am interested in using statistics,” 4 items, α = 0.84), and effort (ex: “I plan to work hard in my statistics course,” 4 items, α = 0.69).

 *Efficacy to Apply Statistical Knowledge.* This scale was created to evaluate the extent to which students feel capable of interpreting statistical information. Specifically, this measure is meant to explore the educational impact of EDRS 811 and how much information students were able to retain over time. The two items were: “I am confident in my ability to interpret SPSS output” and “I am confident in my ability to interpret the statistics in journal articles” measured on a 1 (strongly disagree) to 7 (strongly agree) Likert-type scale. Although there were only two items that formed this scale, reliability measures suggest an acceptable degree of internal consistency (α = 0.88).

 *Resources.* This was an open-ended question that asked students the types of resources they used to assist them with learning statistics. The question was: “Did you use any additional resources to help you learn/study statistics (e.g., tutors, additional books, study groups)?”

 It is important to note that the wording on the different pre, current, and post scales were changed to reflect the status of the students. For example, an item that read “I worked hard in my statistics course” for current and post students was changed to “I plan to work hard in my statistics course” for pre students.

**Results**

In terms of the first two evaluation questions: “What are student attitudes prior to beginning EDRS 811 in terms of their math anxiety, attitudes towards statistics, and values?”; and “What are students’ attitudes after completing EDRS 811 in terms so their math anxiety, attitudes towards statistics, and values?”, means and standard deviations were calculated. See Table 1 for the means and standard deviations of student responses on the attitudinal scales and see Table 2 for the means and standard deviations of pre, current, and post students on the self-efficacy scales.

Overall, the descriptive statistics show that that pre and post students generally have neutral attitudes towards statistics. With most of the means between 4.00 and 5.00 on a 1-7 Likert-type scale, these responses show that regardless of EDRS 811 status, students feel fairly neutral towards statistics. However, one value that was somewhat high was the item pertaining to “effort”. This indicated that pre 811 students (*M*=6.60; *SD* = 0.67) planned to apply effort into studying statistics and post 811 students (*M* = 6.55; *SD* = 0.84) did use a lot of effort into their studies. One value that was particularly low was anxiety, where pre (*M* = 3.10; *SD* = .63) and post students (*M* = 3.02; *SD* = 1.16) did not feel very anxious about statistics. The lowest reported mean was difficulty, where both pre (*M* = 3.05; *SD* = .85) and post (*M* = 2.98; *SD* = .91) students did not anticipate or feel that statistics would be too difficult. The self-efficacy means also show the same pattern, where students generally feel pretty neutral about their ability to learn to or actually interpret statistics.

Table 1

 *Attitudes of Pre and Post students*

|  |  |  |
| --- | --- | --- |
|  | Pre | Post |
|  | N = 25 | N = 62 |
|  | M(*SD*) | M(*SD*) |
| +Affect | 4.22(*1.49*) | 3.75(*1.54*) |
| +Cognitive +Competence | 4.82(*1.31*) | 5.11(*1.04*) |
| +Value | 5.30(*0.87*) | 5.77(*0.92*) |
| +Difficulty | 3.05(*0.85*) | 2.98(*0.91*) |
| +Interest | 5.33 (*1.39*) | 6.02(*0.90*) |
| +Effort | 6.60 (*0.67*) | 6.55(*0.84*) |
| -Anxiety | 3.10(*0.63*) | 3.02(*1.16*) |

+ These scales were measured on a 1-7 Likert scale

- The Anxiety scale was measured on a 1-5 Likert scale

*Table 2*

Self-efficacy perceptions of pre, post, and current EDRS 811 students

|  |  |  |  |
| --- | --- | --- | --- |
|  | Pre | Current | Post |
|  | N = 25 | N = 11 | N = 51 |
|  | M(*SD*) | M(*SD*) | M(*SD*) |
| +Self-Efficacy For Interpreting SPSS output | 5.28(*1.51*) | 4.09(*1.81*) | 4.49(*1.73*) |
| +Self-Efficacy For Interpreting Statistics in Journals | 5.40(*1.35*) | 4.09(*1.70*) | 4.63(*1.47*) |
| +Overall Self-Efficacy | 5.34(*1.37*) | 4.09(*1.63*) | 4.56(*1.51*) |

+ Self-efficacy items were measured on a 1-7 Likert scale

In terms of the third evaluation question: “How do students’ math anxiety, attitudes towards statistics, and values change from the beginning to the completion of EDRS 811?,” independent t-tests between pre and post students reveal that these students were different on measures of value (*t* (85) = -2.15, *p* = .03) and interest (*t* (85) = -2.71, *p* = .01) where post students valued more and were more interested in statistics more than pre students (Post: *M* = 5.77 *SD* = .92 and *M* = 6.02 *SD* = .90; Pre: *M* = 5.30, *SD* = .87 and *M* = 5.33 *SD* = 1.39, respectively).

In terms of self-efficacy beliefs, a one-way ANOVA was conducted. The results revealed that overall, pre, current, and post students reported different perceptions of self-efficacy to interpret statistics in journal articles (*F*(2,86) = 3.72, *p* = .03) as well as overall self-efficacy beliefs (*F*(2,86) = 3.47, *p* = .04). Fisher’s LSD post hoc tests reveal that pre students had statistically significantly higher self-efficacy beliefs for learning how to interpret statistics in journal articles (*M* = 5.40, *SD* = 1.35) as well as overall self-efficacy for learning beliefs (*M* = 5.34, *SD* = 1.37) than current EDRS 811 students (*M* = 4.09, *SD* = 1.70; *M* = 4.09, *SD* = 1.63, respectively) and post EDRS 811 students (*M* = 4.63, *SD* = 1.47; *M* = 4.56, *SD* = 1.51, respectively). It is important to clarify the differences in the questions administered to these two groups of students. The questions provided for pre 811 students queried their efficacy to *learn* how to interpret statistics in journal articles while post 811 students were asked about their efficacy to *actually* interpret statistics in journal articles instead of learning how to.

*Supplemental Results*

 *Statistics Anxiety.* Students’ level of anxiety was further examined with regression. Specifically, all attitudinal variables were entered as the predictor variables while statistics anxiety was entered as the independent variable. Two regressions were run, one with pre students only and one with post students only. In terms of pre student analyses, the results show that overall, all of the attitudinal variables explain 82% of the variance in statistics anxiety (*F*(8,24) = 8.98, *p* < .001; *R2* = .82) with cognitive competence (**= -.86, *p* < .01), value (**= .43, *p* < .05), and difficulty perceptions (**= .72, *p* < .01) contributing significantly to prediction. Specifically, these analyses show that cognitive competence is negatively related to anxiety while value and difficulty perceptions are positively related to anxiety.

 In terms of post 811 students, the results showed that all of the attitudinal variables explained 71% of the variance in statistics anxiety (*F*(8,61) = 16.55, *p* < .001; *R2* = .71). Although affect (**= .55, *p* < .001) emerged as the only significant predictor of statistics anxiety, value had approached statistical significance (**= .19, *p* = .08).

 *Resource usage.* Students’ use of additional resources and its impact on different attitudinal measures were examined. Specifically, students were asked to list any additional resources they used to study or prepare for exams. These analyses included the combined current and post EDRS 811 students. Independent t-tests were run with all of the attitudinal measures entered as the independent variables with resource usage entered as the grouping variable. On the survey, the question that queried students’ use of resources was an open-ended item, where students were asked to list all of the resources that they used during their EDRS 811 class. To analyze this quantitatively, this variable was coded into yes and no, where students who used resources were coded as 1 and students who did not use any resources were coded as 0. Additionally, it is important to note that students’ use of resources ranged from using several (e.g., study groups, additional books, and tutors) to just one (e.g., study group only). Therefore, the amount of resources used was not taken into consideration.

 The results revealed that students who used additional resources felt that statistics was less difficult (*t*(60)= -2.34, *p* = .02) and were less anxious statistics (*t*(60)= -3.07, *p* = .003) about statistics than students who did not use additional resources (Used resources: *M* = 2.79, *SD* = .92; *M* = 2.73, *SD* = 1.13: Did not use resources: *M* = 6.03, *SD* = .73; *M* = 3.63, *SD* = .99, respectively).

**Conclusions and Recommendations**

**Criteria for Judgment**

 Since this was a management-oriented evaluation, the criteria for judgment were whether the objectives of the course can be properly met given the current context. As previously stated, the goals of the course are to prepare students to be able to conduct and consume basic quantitative research. The rest of the discussion will focus on how each of the independent variables (i.e., attitudinal measures, resources, and open-ended responses) either promote or prevent goal attainment. First, each finding will be discussed in terms of how it either promotes or prevents effective learning of the statistical concepts taught in EDRS 811 followed by the specific recommendation.

*Attitudes*

 In terms of the attitudes that were examined, post 811 students valued more and were more interested in statistics than pre 811 students. This suggests that after course completion, students are more likely to realize the value and importance of statistics in addition to developing a stronger interest in the field. These are positive changes support the notion that the EDRS 811 course has successfully improved students’ perceptions about the utility, relevance, and worth (i.e., the measure of “value” incorporates these factors) of statistics in their professional and academic careers as well as their interest in the field. Additionally, the increase in value may be indicative of an increased understanding of statistics upon course completion. Specifically, even though an increased value and interest in statistics is not concrete evidence of understanding of statistics, it may indicate that because of students increased perceptions of the utility, value, and worth of statistics, their understanding of statistics also became clearer after course completion. In terms of self-efficacy, however, the results showed that pre 811 students had elevated levels of self-efficacy as compared to post and current 811 students. This may show that students who have yet to take the course have high confidence in their ability to master the skills, but when students actually take the course, they realize the complexity of the content and thus have a more decreased sense of actually applying statistics.

 This finding of decreased self-efficacy should be further clarified in terms of measurement differences. Specifically, pre 811 students were measured on their efficacy to *learn* statistics while post 811 students were measured on their efficacy to *actually interpret* statistics. This finding may suggest that students have elevated levels of efficacy prior to entering 811 to learn and master the concepts, however, after being exposed to the concepts, students may feel a bit lacking in their ability to actually apply what they learned.

 Ultimately, this indicates that the strength of EDRS 811 course is in its ability to convey to students the importance of statistics in the field of education. Students became more aware of the value of statistics in their field as well as developed an increased interest in statistics. However, a weakness in EDRS 811 is the inability for the course to increase student confidence in their abilities to actually apply the statistics in their field. This shows that although students enter EDRS 811 with a strong belief that they are able to master the skills, they do not feel confident in their abilities upon course completion that they are actually able to apply the skills. This may indicate that either: 1) students are not able to master and apply the statistical concepts after completing EDRS 811 or 2) more theoretically, there is a distinction between learning a concept or skills with actually applying concepts or skills. Additionally, it is not surprising that students felt efficacious to master skills. All of the students surveyed were all PhD students and it can be assumed that many of these students have had prior mastery experiences in their academic career.

 *Recommendation 1.* Altogether, students generally show a positive shift in attitudes in terms of value and interest in statistics upon course completion. This finding supports the objective of the course. However, the recommendation is that more effort should put into maintaining and instilling a positive sense of efficacy in students to interpret SPSS output and statistics in journal articles. A suggestion for changes in practice may be to ask students to interpret statistics in a journal article as well as SPSS output in the first day of course. Have a set of guiding questions for both the journal article and SPSS output (e.g., what does the significance value tell you? What is the independent variable in this output?) and ask students to complete the questions. Afterwards, collect their responses and hand it back to them at the end of the course to show students very explicitly how they have grown. Doing so may not only increase student self-efficacy, but also provide professors with an idea of how their own students have grown as well.

*Anxiety*

Supplemental analyses were run to add more breadth to this evaluation. Specifically, during the interviews with the clients, I noticed how interested that all parties were about student statistics anxiety. Although the evaluation questions did not specifically ask a question about anxiety, it may be important and useful to further examine this construct. In terms of anxiety, I found that approximately 82% of the variance in anxiety was explained by all the attitudinal measures, more particularly cognitive competence, difficulty perceptions, and value. Cognitive competence was negatively related to anxiety, which is not surprising. Students who feel that they are not as competent cognitively to master statistical skills can be expected to be more anxious about taking statistics. Additionally, students who felt that statistics was more difficult were more likely to feel anxious about statistics. Again, this is not surprising and was an expected finding. However, value was a positive predictor of anxiety. Specifically, students who valued learning statistics more were actually more anxious about statistics. These emerged as important predictors in both pre and post 811 students. Although this finding may seem counterintuitive, it aligns with prior research in anxiety, value, and performance, where students who value learning a topic more are more impacted by psychological factors like anxiety. This is due to the pressure that they will put on themselves to learn a topic whereas students who does not care about learning a topic will not experience that added anxiety of needing to excel.

 **Recommendation 2.**These findings suggest that there is a fine line between emphasizing the importance of statistics and reducing anxiety towards statistics. The recommendation here is to inform professors of *EDRS 810* of these issues and see if certain curriculum changes can be made to address statistics in that course. Specifically, EDRS 810 is a preview of EDRS 811 and can be used as a stepping stone into EDRS 811. For example, professors of EDRS 810 can dedicate a few class periods of instruction directly at issues of 811 such as describing to students what correlations are and hypothesis testing is, what a p-value tells you, and why variance and standard deviation is at the core of every statistics test. This way, students will have some sort of exposure to statistics prior to entering the course and may even develop some mastery experiences to alleviate the anxiety, increase cognitive competence, and decrease perceptions of difficulty. In terms of the value aspect though, professors should strongly emphasize that just like any course, mastery of content requires practice and one semester of statistics is not going to make a student an expert in quantitative methods in any way. This way, the anxiety may be lowered without the expense of devaluing statistics in addition to encouraging students to set realistic goals and expectations.

*Resources*

 A relatively basic yet important concept is the idea of how students used the resources around them. This discussion focuses on how student use of resources impacted their attitudes towards statistics. The results suggested that students who used resources to learn statistics were significantly less anxious about statistics as well as felt that statistics was less difficult. This shows that students who had and sought out more support actually got that support evidenced by their decreased perceptions of difficulty and anxiety.

 *Recommendation 3.* Professors of EDRS 811 should provide students with several resources to take advantage of such as tutor referrals, websites, handouts, and additional books. Also, professors can also provide study sessions and sign up list for study groups. With the many features of technology and the internet, EDRS 811 professors can also encourage students to have study sessions through virtual meetings such as Skype or Facebook chat. This may address the traveling issues that some students may face or timing issues. Study and review sessions can also be recorded and uploaded onto Youtube so students can access the material at a time that is most convenient for them. Providing more resources for students may require an increased effort from professors to use more technological approaches to teaching, however, this will allow students to feel less anxious about the course and allow them to focus more on mastering the material taught.

 *Recommendations for further evaluation.* Due to the limited time allotted for this project,a full evaluation was not able to be conducted. Future evaluations should investigate additional variables such as self-regulatory study strategies, student background and demographic characteristics (e.g., work status, number of hours worked, distance between home and school, number of children) to see if any outside uncontrollable factors are impacting student achievement. In terms of student self-regulatory strategies, examining these constructs would provide instructors with information about what types of learning strategies and processes that students are engaging to learn statistics. If students are engaging in traditionally ineffective strategies such as memorization and are not engaging in processes that enable more effective learning such as self-monitoring, professors would be more informed on how to train students to *learn how to learn* statistics. Another recommendation would be to examine an outcome variable such as a final exam grade, final paper grade, and overall final grade. Examining an achievement variable would not only provide information about how the different attitudinal variables interact to impact student achievement, but it would also help professors identify the factors that have the strongest impact on student achievement in EDRS 811 and focus the interventions directly on improving the constructs that impact achievement. Also, by delineating the different components of achievement (e.g., final grade and final paper grade), professors can identify what assessment strategies have the most impact on student learning. For example, do students feel that they learn more from writing papers or studying from tests and how does this relate to their final grades and attitudes towards statistics? Finally, future, more comprehensive evaluations should include qualitative components with professor and student interviews. Doing so would provide a more accurate description of the context of EDRS 811 that would result in more valid and effective judgments and recommendations.

Ultimately, it is important for Ph.D. in Education students to understand statistics and research in general. As knowledge builders, students must understand and evaluate the ways in which knowledge is built, whether through a series of numbers, or through a series of words. This evaluation attempted to focus the discussion on quantitative methods and the ways in which the context of EDRS 811 can be improved to better meet the needs of both the professors and students.

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