

# Post-Graduate Quantitative Research Methodology: A Strategic Plan to Alleviate Student Anxiety

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## Abstract

Quantitative Research Methodology (QRM) is a module oftentimes considered by students and scholars to be challenging and anxiety-provoking. There are numerous negative attitudes toward QRM from learners leading to lower interest and reduced engagement. In the present study, it was observed that students tend to persistently perform poorly in the QRM module in a psychology postgraduate program in Sri Lanka. To further shed light on the identified issue, the current action research was conducted among three student cohorts. Initially, each cohort's performance was quantitatively analyzed and compared to observe trends in student achievements. Following this process, a sample of instructor feedback on a few failed students was randomly selected. A qualitative analysis of feedback revealed difficulty in research paper formulation and deficits in statistical knowledge as two major reasons for inferior learner performance. The researchers introduced a strategic plan to address the issue, which includes unique tutoring sessions. The suggested strategy would help to alleviate anxiety and improve student learning prior to the final examination. The tutoring sessions are developed utilizing Samejima's Graded Response Model (GRM), which is a form of Item Response Theory (IRT) that succeeds in providing a psychometrically robust framework to assess student ability. Thus, the present research initiates a dialogue to encourage educators in Sri Lanka to use data-driven strategies to assess learning, assessments, and feedback in postgraduate psychology programs.

**Keywords:** *Quantitative Research Methodology, Item-Response Theory, Graded Response Model, Statistics Anxiety*

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## Introduction & Literature Review

The Quantitative Research Methods (QRM) module is an important component in professional competence development and empirical practice of psychology. QRM courses are observed to be challenging (Combes, 2018; Murtonen, 2005), especially among degree candidates in psychology (Daniel, 2018). Similarly, due to the challenging nature of the module, students have developed a negative attitude towards QRM (Shaukat et al., 2014). In addition to that, research has found that students have little interest and motivation toward research modules due to previously formed fear and dislike for statistical theory. This makes students avoid or engage less in research methods classes and focus more on modules which they consider to possess more value (Counsell & Cribbie, 2020).

Moreover, existing difficulty in understanding the subject oftentimes generates a lower interest and anxiety toward QRM (Milligan et al., 2014). The difficulty students experience could also be due to the nature of the content delivered in QRM courses. Besides, as per Roberts and Castell (2016), undergraduate students also complain of difficulties coping with the module due to the method of lecture delivery, which leads them to have a negative attitude from the beginning of the methods class. Furthermore, many of the concepts included in the lessons of quantitative methods classes are relatively complex. Some of the concepts and assigned coursework could easily be considered worthy of individual courses.

Apart from the common difficulty in research methods, students tend to prefer either qualitative or quantitative research (Bryman, 2007). A majority of students incline to interpretative research as they consider the associated methods to be less rigorous and comparatively easier to comprehend (Darder, 2015). Moreover, as current research suggests, varying conceptions on identifying feasible methodology for research are determined by the nature of knowledge students acquire and processes involved in learning theories and concepts. Therefore, it is of great importance to explain the reasons why students have diminished preference for QRM (Daniel, 2016), as a lack of interest oftentimes results in poor performance (Gnepp et al., 2020).

Similarly, instructors of research methodology courses also experience difficulty in teaching QRM despite the level of education (Nind & Lewthwaite, 2018). As Brown (2017) reports, complexities in instructing research could be due to the broadness of content and time constraints associated with content delivery. As a result, lecturers must be able to acknowledge the intricacies of teaching QRM in their lesson plans (Ivankova & Clark, 2018). Further, sources available for teaching research methods cannot be obtained through a single devoted scholarly journal. Most of the time, resources are scattered across disciplines and journals. Thus, it is an added difficulty for instructors to successfully plan lessons and deliver content. This forces lecturers to conduct more experimentation on teaching using a trial-and-error approach.

Even though the problems experienced by university students in learning research methods are available in the current body of knowledge, strategies to alleviate student anxiety in QRM are not often addressed (Hsu & Goldsmith, 2021). Therefore, the present study was conducted to identify some of the common reasons for student failure in QRM at the postgraduate level to develop a strategic plan to enhance student performance as means of alleviating research and statistics-related anxiety.

### Present Study

The present study prioritizes consistently low student performance in the Quantitative Research Methodology (QRM) module of the Master of Science (MSc) in Applied Psychology program provided by a Higher Education Institute in Colombo, Sri Lanka. The study employs the pseudonym HEIC to identify the institution in consideration. HEIC is a private tertiary institution and an autonomous franchisee of a university in the United Kingdom. The MSc in Psychology offered by HEIC is a one-year program, which includes three semesters. Annually, two student cohorts are recruited with diverse backgrounds and academic abilities. This program requires students to follow statistical theory and quantitative methodology as a mandatory module. The required knowledge would be delivered within the first semester of the program. The lectures are delivered only five days for the semester, and the duration of a lecture is 4.5 hours per day.

The module consists of two assessment components. One component includes an exam, which accounts for 40% of the grade, while the remaining 60% is credited for coursework. The exam includes 40 multiple-choice questions (MCQs). In contrast, the coursework component requires students to provide a 3000-word research report for an experimental study rationale using a dataset provided by HEIC and continue analysis with the help of the *Statistical Package for Social Sciences (SPSS)*. Based on prior observations, students tend to perform well during exams. However, they fail to perform similarly in the coursework component, resulting in students failing the overall module.

Student feedback highlights the method of lecture delivery as the primary contributing factor to higher rates of failure. Students tend to experience difficulty in concentrating for 4.5 hours even though they receive a 30-minute break in-between. Furthermore, students were having difficulties while running statistical tests on *SPSS* as they were lacking appropriate assistance during the module. The majority of students who get enrolled in the MSc Psychology program have pursued basic degrees in non-psychology majors; therefore, operating *SPSS* for the first time during the class is a new experience. Moreover, from the 22.5-hour direct lecturing, only 1.5 hours are dedicated to teaching *SPSS*, which causes students to be in a helpless position since the assistance received is not adequate. The instructor highlights students' inability to relate psychological theory with statistical output as the major reason for student failure. Moreover, the instructor observes that students find it difficult to deduce psychological theory rationally due to limitations in understanding the scientific methods. Student feedback also indicates that they do prefer more interaction during class, such as class activities on reading and understanding journal articles. However, students are aware of the fact that it is not possible to have such activities during the given timeframe. However, to resolve major recurring student issues, the instructor has indicated that appropriate measures should be introduced to amend the method of delivery during the QRM module.

Therefore, the present study aims to introduce a potential strategic plan to improve the overall student performance in the QRM module of the MSc in Applied Psychology program while alleviating the anxiety the students endure. To accomplish the current aim, the study initially focused on exploring the reasons for the low performances of students during the QRM module.

## Methodology

### Study design and procedure

The methodology employed by the present study is action research. The design employed obtaining coursework marks of the students in each cohort for the QRM module through progression reports of students. As per program guidelines, the coursework of students are submitted to the online platform, Turnitin. Subsequently, the instructor assesses students' coursework through Turnitin. Therefore, the instructor's feedback on students' assignments was obtained by accessing Turnitin. This action research was conducted in a Higher Education Institute in Colombo, Sri Lanka, which is identified by the pseudonym HEIC in the present study. The study population includes students who studied the QRM module and were following the MSc in Applied Psychology program at HEIC. Students from the cohort of February 2016, September, and February 2017 were considered for the present study. Coursework marks and grades of the students in all three cohorts were obtained from student progression reports. The instructor's feedback for the coursework was also obtained from Turnitin in the written format.

### Analysis

Data were analyzed using the statistical software *SPSS 20*. A line graph was used to overview the average scores of each student cohort enrolled in the QRM module. The line graph helped to determine the nature of issues that were caused during the three cohorts. Furthermore, a frequency table was used to demonstrate the failure rates of each cohort using its percentage.

Initially, descriptive and inferential statistics were conducted to understand the obtained data. As the present study was not planned as experimental research, the course material used for the three student cohorts is considered similar in its rigor and relevance. Furthermore, the same instructor conducted lectures for all three cohorts. Thus, the consistency in the delivery style helped to avoid differences in teaching methods and any other material used for teaching for the three cohorts. It became an important aspect to identify whether significant differences in achievement are present through the variance of scores obtained for the coursework by each cohort.

Subsequently, a *One-Way Analysis of Variance (ANOVA)* statistical test was conducted to observe the statistical significance among the cohorts for their achievement in the QRM module. In addition, *Ryan-Einot-Gabriel-Welsch-Q (REGW-Q)* test was conducted to observe the differences precisely. The major function of this test is to observe cohort effects when the significance of variances is observed for more than two groups.

Furthermore, a normality curve and a histogram were used to graphically observe the distribution scores for each cohort, where the normality curve helped in determining the skewness of collected data. For instance, if a negative skew is observed, it would depict that the majority of students have performed well despite the poor class average. Poor performance of the class average would result in extreme scores as it poses an undesired weight on the overall average. After observing the normality distribution scores of each cohort, the *Kolmogorov-Smirnov and Shapiro-Wilk* test was conducted to test the statistical accuracy in determining normality.

Consequently, qualitative feedback from failed students was entered into Microsoft Excel. Subsequently, the data was processed using the data binning technique, which helps to quantify qualitative input to observe common themes of student failure among the three cohorts. Therefore, to align with the data binning technique, feedback by the instructor was categorized and aligned under set themes to proceed with frequency calculations. Additionally, qualitative feedback from students was randomly selected. The above analytic plan was an immense help for researchers to understand the gravity of existing issues with a clear overview, making it easier to plan a precise and structured intervention to avoid the recurrence of the issue. Moreover, based on the obtained findings, researchers could implement a recommendation plan; and the same could be tested on future cohorts and have a comparison against the previous teaching strategy through “Analysis of Variance.” During the comparison, the effectiveness and success rates of the implemented strategy could further be demonstrated and validated.

### Ethical considerations

The present study was conducted by adhering to the current *British Psychological Society (BPS)* ethical standards. Furthermore, consent to conduct the research was obtained from HEIC. Anonymity and confidentiality of students were maintained throughout. Students were made aware of the study. They were assured their anonymity would be maintained and were asked their honest opinions on QRM lectures. Students’ honest opinions of QRM lectures were obtained anonymously to safeguard confidentiality. Students were provided with the information of researchers to either help the study or to clarify any doubts regarding the study.

### Results

The data analysis of the present study includes data from 33 student participants from all three student cohorts.

### Descriptive analyses

#### Figure 1

*Mean scores obtained by the three cohorts, February 2016 (F16), September 2016 (S16), and February 2017 (F17)*

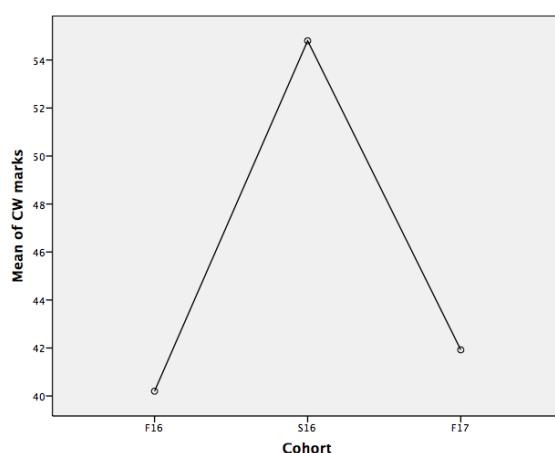


Figure 1 demonstrates the performance of all three student cohorts. The graph depicts that cohort S16 has performed better compared to the other two cohorts. However, the class average of the S16 does not show a positive outcome.

**Table 1**

*Descriptive statistics pertaining to the three cohorts*

Cohort	Number of students	Class Average	Highest score	Lowest score	# Passed (%)	#Failed (%)
F16	10	40.20	52	20	60%	40%
S16	10	54.80	72	35	90%	10%
F17	13	41.92	62	20	54%	46%

As per Table 1, the first cohort F16 had a passing rate of 60%, the second cohort points out a passing rate of 90%, and the third cohort had a passing rate of 54%. The outcome of the analysis has contradicting evidence with a significant difference despite the same tutoring methods used for all three cohorts. S16 has the highest passing rate of 90% claiming only one student failure. Meanwhile, the cohorts F16 and F17 have low levels of passing rates with above 40% class failures. However, the causes for the contradicting results are unclear at this point, and the researchers reached a consensus on qualitative assessment in determining the causes.

## Inferential analyses

### Analysis 1

#### Is there a difference between the cohorts in terms of their achievement?

To answer the above question, *One-Way ANOVA* was conducted, and the statistical test showed cohorts to have a significant effect on their achievement  $F(2,27) = 4.414$ ,  $P = .021$ . *REGW-Q* test further suggested that F16 and F17 cohorts be identical in their performance and S16 be significantly better in their achievement. Even though one cohort performed better, the problem still exists. Additionally, the average of the cohort which performed better is low compared to the required performance expectations of the program. This suggests that in general, all the cohorts did not meet the required standards and performed poorly. Therefore, this issue was decided to be raised in order to figure out areas for improvement.

To identify areas for improvement, three qualitative feedbacks from the F17 cohort were randomly selected. As previously mentioned, data binning techniques were used to reveal problems students encountered while following the module. The technique demonstrated major issues that students have undergone, which caused them to perform poorly in coursework. The first major issue that students have faced includes problems in academic writing and research paper formulation, while the second issue includes the inability to grasp statistical concepts.

**Table 2***Common problems encountered by the instructor in failed students' coursework*

Student	Bins						
	Problems in academic writing/Research paper formulation				Statistical problems		
	Lack of conciseness, logic/Redundant Information	Lack of understanding of the Anatomy of a research paper	Inability to review research literature	Lack of Clarity/Organization/ or Incomplete	Inability to follow APA method	Lack of understanding on statistical operations	Difficulty in interpreting statistical output
Student 1	1						
Feedback		1					
Score = 30/100			1			1	
Student 2				1			1
Feedback			1				
Score = 35/100	1				1		
Student 3	1		1				
Feedback		1					1
Score = 20/100					1	1	
Percentage	100%	100%	100%	66%	100%	100%	66%

The above table demonstrates data of randomly selected students and problems the instructor has addressed in each coursework. The randomly selected student work incorporated in this analysis was given 20, 30, and 35 out of 100 marks. Common issues that the students encountered were lack of conciseness and *logic, provision of redundant information, difficulties in understanding the anatomy of a research paper, inability to review literature, lack of clarity/organization, inability to follow the APA method, lack of understanding on statistical operations, and difficulty in interpreting the statistical output*. Even though students complain about experiencing difficulties in navigating SPSS, research results explain otherwise, where students have the capability to handle the software, but have deficiencies in understanding statistical theory.

## Discussion

The present action research is based on the difficulties post-graduate students encounter during the QRM module in their MSc in Applied Psychology program at HEIC. This study aimed to introduce a potential strategic plan to improve the overall student performance in the QRM module of the MSc in Applied Psychology program while alleviating the anxiety the students endure. Therefore, we propose the following objectives to be followed in order to address the issues in relation to poor performance among the students in the QRM module.

### **Objective 1: To create a structured series of tutoring sessions on academic writing and statistical theory**

To achieve *objective 1*, the instructor should create a series of tutoring specifically targeted at assisting students to overcome problems noted in Table 2. The tutoring should be spread across two days, where one day is dedicated to assisting students with academic writing, and the other day to statistical theory. Spreading the total tutoring time across two days facilitates the instructor to reduce the cognitive load the tutoring content would have on students, which could be considered an advantage. Reduced cognitive load, therefore, could help students to utilize the limited cognitive resources in their short-term memory appropriately (Carlson, 2013; Carroll, 2004). This has profound benefits on learning and would improve the retention of learned material in the long-term memory of the students (Carroll, 2004).

The first day of the tutoring session (4 hours), would be dedicated to assisting students with writing an academic research paper, while providing a specific focus on logic, anatomy of a research paper, reviewing the literature, organization of content, and APA formatting. The second day of tutoring would facilitate the understanding of statistical theory and interpretation. The 4 hours of tutoring sessions would be interactive sessions where students will be given a series of questions before and after tutoring on a specific topic. For example, on the first day, students will attempt to answer a question on “logic” without the instructor’s assistance. The instructor would then provide feedback on the students’ answers, followed by some tutoring and a second attempt at answering another question on “logic” with similar theoretical context and rigor. For each topic (the 7 problems identified in *Table 2*), 5 questions (with dichotomous answer options such as “Yes” or “No”) would be generated, with a total of 35 questions for the series of tutoring. Lee, Palazzo, Warnakulasooriya, & Pritchard (2008) utilized this method in a university physics class and found it to be effective in increasing student learning.

The accuracy of the content intended to be utilized for tutoring and the creation of questions would be assessed through the **Delphi process**. The Delphi process helps to obtain content validity via the consensus of a group of subject matter experts. For the purpose of this tutoring series, the 35 questions will be assessed by a group of 5 expert lecturers on statistics, academic writing, research, and psychology. 70% of expert consensus would be sought for each item of the questionnaire of 35 items in order to be utilized in the tutoring series. However, obtaining consensus is a tedious process that requires substantial time. While identifying that as a potential roadblock, researchers also acknowledge the potential benefit of establishing the required level of validity for the content that would be utilized to create the tutoring series for students.



### **Objective 2: To pilot the tutoring sessions on a newer student cohort**

To achieve *objective 2*, students enrolling for the next cohort will be chosen. Once the lectures for the QRM module are delivered, the tutoring series would commence providing students a time period of three weeks to complete their QRM coursework upon the completion of the required tutoring sessions.

### **Objective 3: To evaluate the effectiveness of student learning as facilitated through tutoring via the resulting Item Characteristic Curves of the 2PL model**

To achieve *objective 3*, the researchers introduce the utilization of *Item Response Theory (IRT)* due to its characteristics of validity and reliability. The 2 parameter (PL) model is chosen in this study and it is inspired by the 2PL logistical IRT model used by Lee, Palazzo, Warnakulasooriya, & Pritchard (2008). Through this model, the effectiveness of tutoring on student learning can be successfully assessed. However, IRT is a complex statistical procedure. In order to facilitate easier interpretation of results and analysis, tutoring sessions would use questions with dichotomous answer options as the 2 PL model only works for dichotomous data. The only limitation is that IRT 2 PL model is not capable of assessing the “*practice effects*” and “*carryover effects*” the previous questions would have on the students as they progress through questions and associated tutoring sessions. However, according to Lee, Palazzo, Warnakulasooriya, & Pritchard (2008), this is very minimal and would not cause significant changes in the standard deviation (SD) of the student score distribution for the 35 questions. Further, utilization of IRT requires no finances since analyses could be performed with open source software such as R statistical package. The “*latent trait modeling*” (LTM) package by Rizopolous (2006) will be used for the purpose of this analysis. Given below is the statistical formula of the 2PL IRT model.

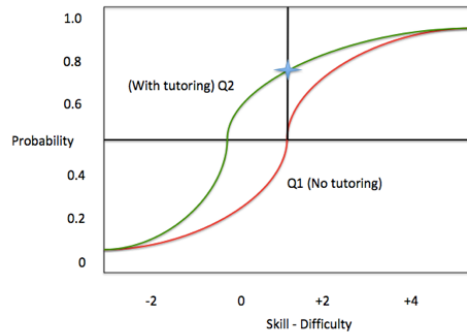
$$\Pr(X_{ij} = 1) = \frac{e^{\lambda_j \eta_i - \alpha_j}}{1 + e^{\lambda_j \eta_i - \alpha_j}}$$

In this model,  $\eta_i$  represents the ability of the subject  $i$ . In a given item  $j$ , the difficulty is determined through  $\alpha_j$ . Further, according to this model  $\lambda_j$  is the discrimination parameter of the item  $j$ . For each item, an Item Characteristic Curve (Figure 2) can be generated, and based on the Item Characteristic Curve (ICC); the probability of a student choosing the correct option at varying difficulty levels can be distinguished. Further, each item’s ability to discriminate (usually determined by the slope of the curve, and discrimination is higher as the curve gets steeper) can be investigated. Therefore, the higher the ability to discriminate, the higher the chances of detecting the student “learning” (Figure 2).

According to *Figure 2*, a student who attempts the first question (hypothetical) of a particular topic would require a skill of +1 to possess a 0.5 probability of arriving at a correct response. Theoretically, with tutoring, a student who attempts the second question of the same topic would possess about a 0.8 probability of arriving at a correct choice with for the same level of skill. Moreover, in theory, the student should possess a higher probability of getting a correct answer choice as the number of questions progresses further in a chosen topic. If the above analysis is conducted accurately *objective 3* could be achieved.

**Figure 2**

*Proposed 2PL model of IRT (A basic impression of its application)*



**Objective 4: To evaluate the effectiveness of the tutoring sessions on the QRM course, with a targeted passing rate of 90%**

To achieve *objective 4*, tutoring sessions should be completed, and coursework must be graded. Afterward, passing rates of students will be assessed quantitatively, and the effectiveness of tutoring on the overall attainment of the students will be statistically tested. To follow the above process, students' scores in future cohorts should be compared against the previous three cohorts using statistical analyses *One-Way ANOVA* (Table 3) and *REGW-Q* post hoc test (Table 4). Theoretically, newer cohorts' variance of scores should differ significantly compared to the scores of the previous three cohorts in order to demonstrate the effectiveness of tutoring on the overall performance of the students. A major limitation of the study would be the required time period for completion. Ideally, grades of the first semester (for a cohort enrolled in February) would be available by mid-June or early July. Therefore, objective 4 could be achieved after the month of June due to the time requirement for enrolment and notification or results.

### Conclusion

In conclusion, according to the authors' point of view, the present action research would help the students who follow the MSc in Applied Psychology program and also complete the QRM module without being anxious during the module. Since, research focuses on recurring issues that have been taking place with previous batches, knowledge of the causation of these issues will further assist in the development of effective interventions in the future. Therefore, to alleviate the anxiety of students, their negative attitudes should be alleviated by changing the techniques in delivering the module and helping students to engage with the lecturer to improve their overall performance. The present action research addresses most of the issues highlighted by students and the instructor. However, to bring the most out of the current research, the highlighted objectives should be accurately met, resulting in a positive outcome for the performance of the students.

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