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# BLENDED LEARNING MODALITY IN TEACHING STATISTICS IN A GRADUATE PROGRAM OF A STATE UNIVERSITY IN THE PHILIPPINES

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## Abstract

*Graduate students commonly experience apprehension towards statistics courses, leading to lower achievement and negative perceptions of the subject. This mixed-methods research study aimed to explore the effects of blended learning on graduate students' achievement and perception of statistics in the Master of Arts in Education program. Blended learning combines online and face-to-face learning modalities. The study included 67 participants who completed tests for parametric and non-parametric statistics and 12 who underwent interviews. Results showed that students showed mastery of specific statistical topics, particularly correlation and regression tests and tests of difference with paired and independent samples. The students attributed their success to blended learning, which promotes flexibility, ease of learning statistics, independent learning, and motivation. Regardless of the field of specialization, students' scores in statistics were similar. However, challenges such as internet connection, software use, and technicalities of concepts and software like SPSS were reported. This study suggests that blended learning is beneficial for improving graduate students' achievement and perception of statistics and that proper support and guidance are needed to address the challenges of this learning modality.*

**Keywords:** *Blended Learning; Statistics Education; Graduate Education; Learning Modality.*

## A. Introduction

One of the challenging courses a graduate student in a graduate program could take is statistics. The significant role of learning statistics could lead to the success of graduate students in conducting research and completing a graduate degree. According to Ramirez et al. (2012), the ultimate goal of statistics education is to produce statistically literate adults who appropriately use statistical thinking.

However, mathematical concepts make statistics challenging for students (Bhowmik et al., 2019). Baglin et al. (2017) suggested that 76.6% of higher-degree students have introductory or lower levels of statistical knowledge. Kaplan & Rogness (2018) pointed out that an incomplete or incorrect understanding of the statistical domain could be due to misinterpreting the technical use of terms with different everyday meanings. Moreover, Onwuegbuzie & Daley (1999) found that achievement in statistics classes can be predicted by statistics anxiety arising from poor statistics computation.

These issues in statistics education could be due to how the course is taught. Many traditional approaches to statistics education rely on direct instruction (Kirschner et al., 2006), while Carey & Dunn (2018) suggest teaching statistics using an active learning approach. Likewise, Cherney (2003) found that actively engaging students with technology is also a successful tool to increase students' involvement in a statistics class.

Siemens' (2005) Connectivism theory strongly emphasizes using technology in teaching and learning. According to this theory, the development of internet technologies has provided individuals with new opportunities to learn and share information across the World Wide Web and among themselves. The importance of technology in modern education has been highlighted by the identification of online peer networks as an effective platform for knowledge sharing and learning. With various platforms and tools available, technology has become indispensable for improving teaching and learning experiences.

One approach that could be used is blended learning, a combination of traditional face-to-face and online learning. Evidence from the study of

Yusoff et al. (2017) shows that blended learning can be used as a teaching approach for less proficient students in Introduction to Statistics. Hughes (2007) also pointed out that well-prepared blended learning for 'at-risk' learners improves coursework submission and module retention. This can also increase student motivation, satisfaction, and subjective learning outcomes (Ma & Lee, 2021; Fazal & Bryant, 2019; Woltering et al., 2009). Furthermore, there is a statistically significant increase in student performance under the blended learning approach (Setiawan et al., 2022; Ulfa & Puspaningtyas, 2020; Yusoff et al., 2017; Kiviniemi, 2014; Morris, 2010).

On the other hand, some teachers believe that traditional teaching is more effective at providing students with the necessary knowledge than blended learning (Ashraf et al., 2021). Moreover, several studies noted no statistically significant improvement in students' achievement in blended learning classes (Yu, 2021; Melton et al., 2009; Akyüz & Samsa, 2009; Alshwiah, 2009). Similarly, a meta-analysis conducted on the effectiveness of blended learning reported mixed findings (Poirier et al., 2019).

Also, studies on the effects of blended learning focus on mathematics (Setiawan et al., 2022) and basic statistics (Yusoff et al., 2017) for K-12 level (Liu & Wang, 2022; Topping et al., 2020; Fazal & Bryant, 2019), and college level (Deng et al., 2022), while the impact of blended learning in graduate students specifically in advanced statistics has not been much explored.

Thus, this study would provide insights into the significant contributions of utilizing the blended learning modality in the graduate student's performance in a one-semester Statistics course and their perception of blended learning.

Specifically, the study answers the following questions.

RQ1. What is the performance of the graduate students in parametric and non-parametric statistics and hypothesis testing?

RQ2. Does the performance of the graduate students in parametric and non-parametric statistics vary significantly?

RQ3. What is the graduate students' perception of the blended modality in advanced statistics?

## B. Method

This study is a mixed-method research (Creswell & Plano Clark, 2018) conducted in a statistics class in the graduate program of a state university in the Philippines. This involved 67 graduate students taking a Master of Arts in Education (MAEd). The students were in two intact groups. The first group comprised 32 MAEd Social Science and English students, while the second comprised 35 MAEd Mathematics and Science students. Of 67 students, 12 were included in the focus group discussion (FGD).

The blended learning modality in the statistics class covered a total of 16 meetings (3 hours per meeting) or a total of 48 hours. Out of 16 meetings (48 hours), four meetings (12 hours) were allotted for face-to-face classes and hands-on activities. In comparison, 12 meetings (36 hours) were allotted for asynchronous or synchronous online learning using *Edmodo, Facebook Messenger*, an *e-module*, and supplementary instructional videos.

Two researcher-made tests were used to gather information on the student's performance in Statistics. The two tests have a "Good" Content Validity Index of 0.89 and 0.85 (Lawshe, 1975) and acceptable reliability coefficients of 0.87 and 0.82 (Ursachi et al., 2015). These tests are hands-on and practical tests covering the topics of inferential statistics, particularly the parametric and non-parametric tests. Moreover, skills tested in the tests include formulating the hypotheses, determining the significance level, identifying the appropriate statistical tool, processing data in SPSS, presenting results in tabular form, interpreting results, and writing conclusions. Further, a Focus Group Discussion was conducted, and results were coded and analyzed in *Atlas.ti* using thematic analysis. The accuracy and trustworthiness of the analysis were ensured by three evaluators who evaluated the researcher's analysis (Creswell & Plano Clark, 2018). Quantitative data were analyzed using frequency count, average percentage, and bar graph for descriptive statistics, Analysis of Variance (ANOVA) for inferential statistics.

## C. Result and Discussion

### 1. Result

The research findings obtained from the processing of data gathered are as follows.

#### a. Students' Performance in Non-Parametric and Parametric Statistics Tests

The graduate students' scores in the tests showed that the average midterm test (non-parametric statistics) score is 44.39 out of 60 points. Mathematics majors have an average score of 45.75, Science majors have 43.53 points, Social Studies majors have 43.17 points, and English majors have 45.57 points. On the other hand, the student's average score on the final-term test (parametric statistics) is 58.97 out of 80 items. Mathematics majors got a mean score of 60.31; science majors got a mean score of 59.26; social studies majors got a mean score of 58.11; and English majors got a mean score of 58.14. Overall, the spread of scores from the mean in the two tests ranges from 4.02 to 5.44.

*Table 1. Students' Performance in Non-Parametric and Parametric Statistics Tests*

| Specialization | Non-Parametric Examination Score (60 points) | | Parametric Examination Score (80 points) | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Mathematics | 45.75 | 4.23 | 60.31 | 5.63 |
| Science | 43.53 | 3.91 | 59.26 | 5.06 |
| Social Studies | 43.17 | 3.59 | 58.11 | 3.79 |
| English | 45.57 | 4.05 | 58.14 | 7.43 |
| Total | 44.39 | 4.02 | 58.97 | 5.44 |

#### b. The difference in the Students' Performance in Non-Parametric and Parametric Statistics Tests

The scores of the students from the different fields of specialization (Table 1) showed that mathematics majors consistently got the highest mean scores. In contrast, social studies majors consistently got the lowest mean scores. However, computation from the Analysis of Variance, F(63,3)

= 1.942 and Sig. Value = 0.132 showed that the scores of the students in the mid-term test from the different fields of specialization did not vary significantly. Similarly, mean scores from the final-term test of the students from the different fields of specialization showed no significant variation, as shown by the values of F(63,3) = 0.590 and a sig—the value of 0.624.

*Table 2. The difference in the Students' Performance in Non-Parametric and Parametric Statistics Tests*

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Non-Parametric Test Scores** | | | | | |
| Between Groups | 90.245 | 3 | 30.082 | 1.942 | .132 |
| Within Groups | 975.665 | 63 | 15.487 | | |
| Total | 1065.910 | 66 | | | |
| **Parametric Test Scores** | | | | | |
| Between Groups | 53.327 | 3 | 17.776 | .590 | .624 |
| Within Groups | 1898.614 | 63 | 30.137 | | |
| Total | 1951.940 | 66 | | | |

**c. Students' Average Percentage of Scores in Statistics Lessons**

The study found three topics in non-parametric statistics where more than 75% of the students have correct responses. As shown in Figure 1, the "Test for One-sample Case: Kolmogorov-Smirnov one-sample test", "Test for Two Related Samples: Wilcoxon Signed Rank Test", and "Spearman Rank-Order Correlation Coefficient" were the topics where 78.66%, 81.04%, and 85.67% of the graduate students got the correct answers, respectively. On the other hand, the Test for Two Independent Samples: Mann-Whitney U Test, K-Independent Samples: Kruskal-Wallis Test, and K-Related Samples: Friedman's Analysis of Variance was the non-parametric statistics topics that fell below the set performance target.

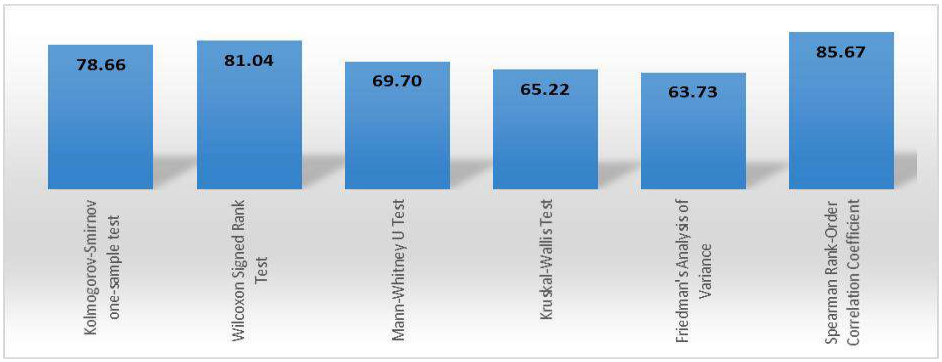


*Figure 1. Average percentage of the correct responses of graduate students for the topics in non-parametric statistics*

Moreover, the parametric statistics topics where more than 75% of graduate students got correct responses are "Pearson Correlation Coefficient" (83.73%), "Test for Two Related Samples: T-Test for Related Samples" (81.19%), "Test for Two Independent Samples: T-Test for Independent Samples" (79.10%), and "Linear and Multiple Regression" (75.07%). Further, as reflected in Figure 2, "Test for K-Independent Samples: Analysis of Variance (ANOVA)" (72.84%), "Multivariate Analysis of Variance (MANOVA)" (66.12%), "Analysis of Covariance (ANCOVA)" (69.10%), and "Multivariate Analysis of Covariance (MANCOVA)" (62.54%)" were the parametric statistics topics where below 75% of the students answered correctly.

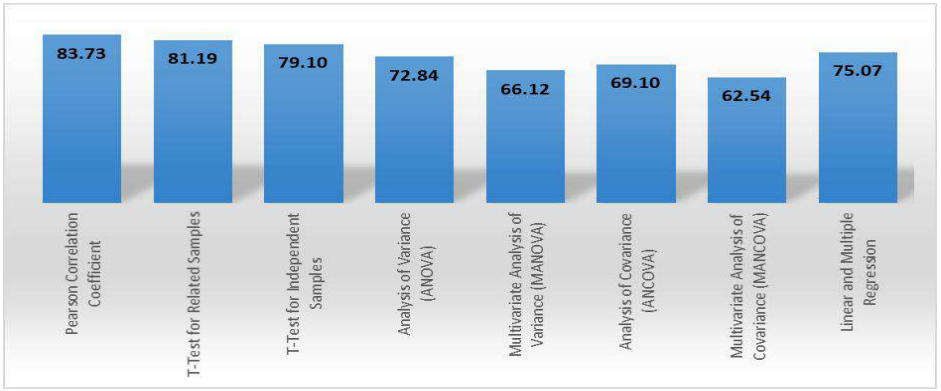


*Figure 2. Average percentage of the correct responses of graduate students for the topics in parametric statistics*

**d. Average Percentage of the Correct Responses in Steps in Hypothesis Testing**

The tests given to the students focus on performing statistical analysis following the steps in hypothesis testing. Figure 3 shows that, for a non-parametric test, 75.12% of the graduate students were able to write the hypothesis and identify the level of significance correctly, 80.60% could correctly determine the appropriate statistical test, 73.26% could correctly compute data using SPSS, 73.63 can correctly write the decision and interpretation of the results, and 73.88% can make the correct conclusion. On the other hand, for a parametric test, 74.35% were able to determine the hypothesis and level of significance, 74.72% were able to determine the appropriate statistical test correctly, 73.79% were able to use SPSS software for computation correctly, 73.13% could make an appropriate decision and interpretation from the results, and 72.57% could correctly write a conclusion.

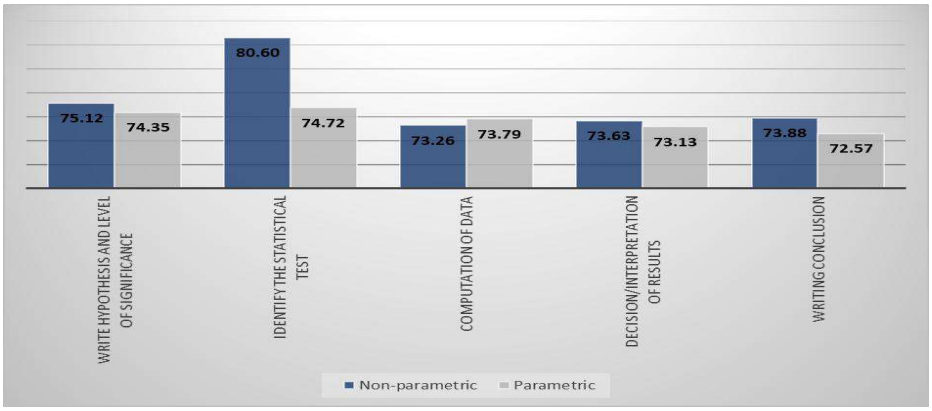


*Figure 3. Average percentage of the correct responses of graduate students in steps in hypothesis testing*

**e. Graduate Students' Perceptions of the Blended Learning Modality in Statistics Class**

The transcript of the interview of the 12 graduate students was analyzed using thematic analysis. It showed their views of blended learning in statistics class as "promote flexibility in learning", "facilitates ease of learning statistics", "encourages independent learning and increases motivation", and "challenging and overwhelming".

Promote flexibility in learning. The blended learning modality used in the Statistics class was designed for graduate students to decide when and where to learn through asynchronous and synchronous modes of communication in *Edmodo* and *Facebook* Messenger and through the e-module and instructional videos. Thus, they were able to learn statistics anytime and anywhere. This was confirmed by students 1, 2, 3, 5, 7, 9, 10, and 12.

Student 1: "…I can watch the videos even when i am in school...";

Student 2: "I was not able to join in the online class because at that time the internet was very slow. However, i read your discussion Sir the next day";

Student 3: "... we conducted group sessions at a café because there is free internet connection….";

Student 5: "…I am learning even when i am in tricycle by reading the conversation in *FB Messenger*….";

Student 7: "…because there were many papers to do, i was not able to do the task in the module. What i did was i work double time during my free time";

Student 9: "…I access the online classroom at midnight because at that time my internet connection is reliable";

Student 10: "…I downloaded and uploaded my outputs in the computer shop because the signal at home is weak….";

Student 12: "...since i am already familiar with some lessons, i worked right away on them and focused much of my time on topics I found difficult";

Facilitates ease of learning Statistics. The blended learning modality offers several benefits to students' learning processes. Compared to traditional strategies in teaching statistics, students were more at ease in the blended modality class, particularly on the online component. The resources used and the presentation of content through software computation and interpretation freed the students from the burden of memorization and manual computation. This boosted the students' confidence and improved their performance in the course.



The benefits of the resources used were manifested in the statements given by students 1, 3, 4, 6, 7, 8, 9, 10, and 11.

Student 1: "…the materials were easy to use and understand...";

Student 3: "…although the lessons were difficult, instructional videos were very helpful in understanding the lesson";

Student 4: "…lessons were made easy to understand, examples were realistic, i can relate to the situations, I'm really interested if there is technology";

Student 6: "…the materials were really good especially the instructional video. I'm thinking I can do it even without the help of others";

Student 7: "The e-module was easy to follow….";

Student 8: "…I find Edmodo helpful, especially in reviewing the discussion….";

Student 9: "…I back-read in Facebook Messenger to catch up on the discussion i missed";

Student 10: "I'm always online, but i did not post any comments because my questions had already been discussed. So what i did is read the discussions to clarify what i did not understand";

Student 11: "…I already understand the lessons from the discussion in Messenger...".

Similarly, using SPSS software made the students confident in their computation, presentation, and interpretation of the results in the different activities. This is evident in students 1, 2, 4, 7, 8, 9, and 11.

student 1: "i thought i was going to fail in this subject because i am not really good at computation, but using spss, i am confident in my answers";

Student 2: "…at the start, i struggled using the software, but later i appreciated its use throughout the semester….";

Student 4: "…SPSS made me not worry about computation….";

Student 7: "…I am really satisfied with the course, i was able to compute for the p-value and provide a correct interpretation….".

Student 8: "… I did not imagine this is how easy to compute for the correlation, compared to computation with formula….";

Student 9: "…although i am not good at numbers, i am confident that my answers in the computation and interpretation in the hypothesis testing were correct";

Student 11: "…learning SPSS is useful to me not just in this course but also in my research. i believe i can run t-test, Pearson r, Mann-Whitney Test, etc. on my own".

Encourage independent learning and increase motivation. The offsite or online component of the blended learning modality in statistics allows learners to review the provided learning materials independently. The online learning component post challenges the students to study statistics with minimal assistance from the professor through *Edmodo* and *Facebook Messenger*. Although this notion is expected to hinder learning statistics, graduate students could use the situation to learn independently, which later motivated them to study further. This is manifested in the statements of the following students.

Student 2: "… the e-module is user-friendly, but it is not the traditional module i expected….";

Student 3: "…the success i got from doing the module through watching the instructional videos kept me going and i was able to finish the course without the feeling of anxiousness in solving numbers";

Student 5: "…I am excited to open *Edmodo*. It is my first time using this and i find it okay. The learning materials are all available whenever i need them";

Student 6: "…I feel motivated to work on the activities every time i open the module….";

Student 7: "…since the materials can be done independently, i did not ask for help from my classmates";

Student 8: "I did not bother asking my classmates because my questions were already answered in the group discussion….";

Student 10: "…that is why i did not join in the online discussion. I just use the time practicing some problems you gave Sir";



Student 12: "… the lessons were difficult, but i could catch up on my own through the videos provided….".

Challenging and overwhelming. While blended learning modalities benefit students, they pose challenges and difficulties in using technology and course content. The following students confirm these.

Student 1: "I experienced problems downloading the learning materials from *Edmodo* because of a slow internet connection. Apart from that, the overall experience was great";

Student 2: "I'm very excited about every activity. The only thing that hindered my performance in this blended learning is the internet connection";

Student 3: "This is my first time experiencing this mode of teaching. Maybe I was just looking or comparing it to face-to-face classroom. But the experience was really challenging, especially the internet connections and learning the SPSS";

Student 5: "…I got trouble using the SPSS and *Edmodo* at the start. Luckily there is an instructional video provided";

Student 7: "…My laptop at home is outdated. I get frustrated whenever I can't connect successfully or it keeps me lagging every time I work for the activities";

Student 8: "The content is new to us. It's okay because it's applicable to our degree, but it seems heavy because we are studying statistics, SPSS, and *Edmodo* at the same time, where I got troubled with new terms like covariate and SPSS procedures";

Student 9: "Our problem is we are not math majors. I just got overwhelmed with the course content and activities and got confused on some technicalities, but the learning experience is great";

Student 10: "…I feel shocked at first when I saw the volume of topics, videos, and activities in *Edmodo*….";

Student 12: "…although there is lots of demand in terms of complying with the activities, I was able to do it on time….".

## 2. Discussion

The results show that while there are topics in parametric and non-parametric statistics where students gain mastery, there are still topics where many graduate students struggle. Although primary mathematics graduate students have higher mean scores, as expected, in both non-parametric and parametric examinations, the mean scores of the students, regardless of the field of specialization, have no significant difference, making the mastery of the topics almost similar.

Mastery of the topics may have resulted from pedagogical reforms in statistics, improved instructional techniques, and computer-based methods in teaching statistics (Tishkovskaya & Lancaster, 2012). The blended learning modality is one of the pedagogical innovations in teaching, combining the benefits of face-to-face classes and online learning. As Hadjerrouit (2008) noted, online resources of the blended learning model were a critical factor that positively influenced the students' learning.

Kiviniemi (2014) recorded a statistically significant increase in student performance under the blended learning approach. Furthermore, Simmons (2014), as cited by Schwab-McCoy (2019), found that blended course students were likelier to perform well in the class. This also confirms the findings of Morris (2010) that the use of blended learning approaches improves students' academic performance in higher education courses and is effective concerning achievement (EL-Deghaidy & Nouby, 2008).

On the other hand, the non-mastery of the topics could be related to the graduate students' attitude and anxiety in statistics. As Macher et al. (2013) emphasized, statistics anxiety is one of the most potent negative influences on performance in statistics courses. This was noted for the following students.

Student 4: "Sir, we are not math majors. That is why we struggle with numbers";

Student 10: "I am nervous even by just thinking that I will take statistics as my subject";



Student 11: "I don't like statistics in the first place because it is math. That is why I took English as my major";

Student 12: "…I have difficulty with numbers and it makes me nervous every time we have laboratory activities".

Although (Tishkovskaya & Lancaster, 2012) pointed out that statistics education is a unique and rapidly evolving discipline, and computer-based and Web technologies are an essential and integral part of statistics today, as observed by DeVaney (2010), students in online statistics courses have decreased in statistics anxiety. The total experience of the graduate students in a one-semester statistics class may have improved a fraction of their views about the course. However, the anxiety that accumulated over time is still present. This is evident in the results of the steps in hypothesis testing, where a lower percentage of correct responses were found in computation, making decisions, interpreting the results, and drawing conclusions.

The study's findings on students' perceptions of using blended learning in a statistics class are consistent with Graham's (2006) findings that blended learning provides flexibility and pedagogical richness. Similarly, Dela Torre (2013) has shown that students have a moderate to very high perception of blended learning, particularly on ease of use and accessibility, quality of content, usage, purpose, and general outcomes. The study of Chandra & Fisher (2009) emphasized that the effectiveness of blended learning materials can be attributed to their convenience, enhanced enjoyment, and clear, easy-to-follow, and understandable characteristics.

Furthermore, in the survey by McGuinness (2019), responses showed that the accessibility, ease of use, design, and duration were deemed effective regarding user engagement. These characteristics of the blended learning modality make learning easier for students than traditional methods. Therefore, in a blended learning modality, online time was used by students to interact with educational resources (Means et al., 2013).

With the nature of statistics, students tend to hesitate and become uninterested in the course but blended learning connects to the relevance of the interests and practices of contemporary learners (Ashraf et al., 2021). Some students have a special kind of ICT-related adaptive expertise which develops in a beneficial interaction between school guidance and challenges and individual interests and activities. Ilomäki (2008) reveals that, in general, students are capable and motivated users of new technology, and blended learning empowers learners as it provides provisions for individualized learning experiences, personalized learning support, virtual learning environments (VLEs), flexible study, and broad access to digital resources, shared tools, and information (Gulch, 2006). Further, blended learning positively impacts students' enthusiasm for learning (Mahpudin et al., 2022).

Despite many benefits for students, blended learning has weaknesses and challenges. Many argue it is demanding for teachers and students (Ashraf et al., 2021). Moreover, some reported challenges students face in learning a new technology, especially adult students (Salim et al., 2018). Also, outdated technology, lack of internet access outside of the class (in the online component), low bandwidth, slow processing speeds, and experienced technical difficulties hinder the students from completing assignments and activities (Safford & Stinton, 2016; Henrie et al., 2015). McGuinness & Fulton (2019) also identified several technological challenges disrupting students' learning, such as browser incompatibility and general Internet connection issues. Technological user interfaces are also challenging for students (Prasad et al., 2018). With these technology challenges, students need to be oriented to a technology's design features and instructions about how the technology will be used (Jeffrey et al., 2014).

## D. Conclusion

The scores of the graduate students represent their mastery of the topics of non-parametric and parametric statistics. Their scores are comparable despite 77% of graduate students not majoring in mathematics,

which implies that the blended learning modality, together with the instructional materials used, helped learn statistics, not only for those students with a numerical advantage. Students attributed their success in learning to the use of non-parametric and parametric statistical tools in the implementation of blended learning modality in statistics class, particularly the online components, which include the use of e-module, instructional videos, and online platforms such as *Edmodo* and *Facebook* messenger. Moreover, the blended learning modality in the statistics class promotes flexibility because they can learn anytime and anywhere.

Using e-modules, instructional videos, and online platforms facilitated the ease of learning statistics. Through these learning materials, students re-read and re-visit the topics they found confusing. Also, the blended learning modality encourages them to be independent learners, which makes them explore every available resource to clarify learning and increases their motivation as a result of every success they have in statistics. On the other hand, the topics that were not mastered do not mean they needed to understand them fully. They attributed their lack of mastery of the topics to the challenges they encountered, such as confusion about the technical operations of the SPSS software, the variables' groupings, and the covariates' application. The Internet connection, available technology, and volume of content and activities are also considered factors for successfully implementing the blended learning modality in the Statistics class.

With the stigma associated with statistics as a course, instructors may innovate and try other modalities of teaching statistics, especially those that use technology that would lead to mastery of the appropriate use of different statistical tools, which could be used by the graduate students in conducting research and teaching their students. Instructional materials such as e-modules and instructional videos are highly recommended in this course, where presentations and interpretations of significant results are more important than the memorization of formulas. This way, students would gain a better understanding of statistics and may experience less anxiety as a result. Moreover, the adoption of blended learning modalities

in mathematics-based courses may be considered in the undergraduate and graduate programs to improve the students' mastery.

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