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# INTEGRATION OF RUBRICS IN PEER-ASSESSMENT: EFFECT ON UNDERGRADUATE STUDENTS' STATISTICAL SELF-EFFICACY AND PERFORMANCE

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## ABSTRACT

*This study was undertaken to investigate the effect of rubrics integration in peer-assessment on self-efficacy and performance of undergraduate students in basic statistics in Rivers State. The non-equivalent quasi-experimental research design was used for the study with a sample of 69 undergraduate students who served as volunteers. The study was guided by two research questions and two corresponding null hypotheses. The study used two instruments for data collection for two variables under consideration, namely Statistical Self-Efficacy Scale (SSES) and Statistical Performance Test for Undergraduates (SPTU). Reliability of the SSES and SPTU yielded alpha coefficients of 0.90 and 0.73 respectively. Data for the study was collected over eight weeks and involved the collection of both pre-test and post-test scores. Mean, standard deviation and mean difference were used to answer the research questions while analysis of covariance was used to test the null hypotheses. Results showed that rubric integration with peer-assessment had a positive effect on students' statistical self-efficacy and performance. This implies that rubrics integrated with peer-assessment were more effective than traditional teacher-based assessment. Based on this result, it was recommended that Curriculum developers should make ample effort to include rubrics in the curriculum and syllabus to show to the students the criteria of expectations required of them.*

**Keywords: Rubrics, Basic Statistics, Self-efficacy, Peer-assessment, Undergraduate Students, Rivers State.**

## Introduction

The Nigerian society is fraught with a series of challenges that threatens the very fabric of society. These challenges cannot be effectively resolved unless a focused and intentional synergistic relationship is built between the economical, social, political and cultural sectors of the country. To effectively achieve this required synergy, it is pertinent that a radical paradigm shift in the educational sector is implemented in the higher education sector, especially for prospective educators and teachers. Teaching as a profession is often derided for being out of touch with current reality and very few teachers today are proud of their job. The resultant effect of this unpleasant situation is that many schools are manned by teachers who lack the requisite skills of understanding the curriculum, provide modern learner-based

instructions and implement innovative assessment frameworks. The resultant effect of this situation is best left to the imagination.

At the higher education level, many students are still assessed with traditional assessment systems where their input is not required. The unique learning patterns of students are poorly understood by teachers and teachers often adopt a one-size-fits-all approach when providing instruction and assessment. Therefore, most students see coming to school as a ritual for pleasing society, without appreciating the significant value of education in their lives. Many students in higher education, including pre-service teachers, only participate in assessments and examinations to fulfil course requirements. Others even engage in examination malpractice to meet the minimum expectation of the course without understanding the course objectives.

The subsequent problem of this situation is that when they eventually become teachers, they may not have the requisite skills to develop, administer and analyze innovative and authentic assessment systems. Rather, they would retain and recycle the traditional system of assessment that has exacerbated the discrepancy between instructional requirements and societal demands. Unless teacher educators are provided with a clear understanding of modern innovative assessment practices, they are likely to continue using the traditional assessment which is boring, uninteresting and unmotivated to students. However, the promise of innovative assessment practices such as the integration of rubrics into peer-assessment is more likely to engender students' participation, self-motivation and positive attitude toward teaching and learning. It is therefore against this background that the current study investigated the extent to which the integration of rubrics using peer-assessment impacts students' performance in a basic statistics course.

For students, especially those at the tertiary level of education studying for qualifications in teaching and ancillary professions to be certified as graduates, there is a need for them to attain a minimum standard of performance in statistics. This is because applied research studies in various fields including business, management, arts, agriculture, engineering, and the sciences often involve the collection, organizing, analyzing and interpreting of data from which inferences and conclusions can be made (Li, et al, 2012). In this regard, therefore, it has become pertinent that most colleges, universities and higher education institutions have included statistics-based courses as part of the requirements for students' learning. In most statistics courses, the focus has been on developing students' competencies in quantitative reasoning and problem-solving. In their study of students' performance in statistics, Li et al (2012) showed that while a large number of students continue to show commendable results, a reasonable number of students continue to perform below-expected standards in the United State. As such, it has become important to look for ways or strategies for improved performance of students in this cross-disciplinary competence.

Considering the centrality of statistical knowledge in students' academic, personal and professional lives, there has been extensive investigation into various predictors, factors and strategies to improve students' performance. For example, Dalaval, et al (2015) showed that social comparison feedback had a significantly greater effect in improving students' performance in statistics compared to temporal comparison feedback among psychology undergraduate students in France. Similarly, Patron and Smith (2009) showed that using

online assessment had a significant positive effect on students' performance in a business statistics course.

As these two studies showed, students' performance is often a function of various instructional, environmental and personal factors, including the assessment format. However, both studies above fail to integrate aspects of students' agency, which is an essential component of authentic assessment. This has been severely criticized in the higher education sector because such forms of assessment fail to provide students with the opportunity to reflect on how the learning experiences relate to their everyday experiences. It is therefore on this basis that peer assessment has been recommended as an alternative to traditional assessment which lacks students' input. According to Cornell University (n.d.) utilizing assessment techniques such as these helps students to take responsibility for and manage their learning, and enables students to learn to assess and provide constructive feedback to themselves and peers. Similarly, Sambell, et al (2013) and Chetcuti and Cutajar (2014) argued that the peer assessment mode develops students' independence, personal responsibility and critical thing, as well as how to handle criticism and judge others more responsibly.

Peer assessment is an assessment mode in which students are required to provide grades on other students' work based on specified and generally agreed-upon criteria. According to Orluwene and Ekim (2020), peer assessment involves a series of processes by which students are given the opportunity of identifying the quality of their peers' work based on an identified benchmark to establish the extent to which the learning objectives have been achieved.

The above definitions of peer assessment require clear criteria for students to not only understand but also apply the assessment criteria for a more objective evaluation. Commenting further, Goodrich in Andrade and Valtcheva (2009) proposed that access to clear criteria on which to base assessment, a specific task or performance to access, direct instruction and practice of assessment as well as opportunities to revise and improve on task performance are the hallmark of authentic assessment. It was in this regard that Panadero and Johnson (2013) suggested that for any impact on peer assessment to be meaningful, students should have access to the learning objectives before they start performing the task so that they can use the criteria to establish more realistic goals, monitor more accurately and evaluate the final product more objectively. One strategy that has shown promise in ensuring that students are not only aware of the assessment criteria but also their application and utilization is the integration of a rubric.

A rubric is a document which specifies the requirements and expectations for an assignment or a group of assignments through the listing of the criteria and a description of the various levels of quality needed to achieve the criteria (Reddy & Andrade, 2010). The distinctive feature of a rubric is that it facilitates both input and feedback, as such its usage has been greatly adopted in not only higher education (Simon & Forgette-Giroux, 2001), but also at other levels of education (Reddy, 2001). With this feature, rubrics have been shown to improve the psychometric properties of assessment instruments by ensuring consistency in grading, as well as for supporting the deep learning process in school-based assessments where students need to get prompt and accurate feedback on their progress and academic development.

Despite these potential benefits of using rubrics, research on the utility and efficacy of using rubrics has not yielded a consensus result, especially within the context of higher education. From the review done by Jonsson and Svingby (2007), there have been mixed outcomes of rubrics on students' performance. While some studies showed improvement in students' performance based on their use and development of rubrics, others have shown no significant difference in the quality of work done by students with or without rubrics. Moreover, most of the studies on the effectiveness or otherwise of the use of rubrics have been conducted in western countries, with no study to the best of these researchers' knowledge investigating the effectiveness of utilizing rubrics on students' self-efficacy and performance within the Nigerian higher education context.It was therefore against this background that the current study investigated the extent to which the integration of rubrics affects theself-efficacy and performance of students' using peer-assessment in Basic Statistics.

**Aim and Objectives of the Study**

The study was aimed at investigating the integration of rubrics into peer-assessment among undergraduates and the effect on students' self-efficacy and performance in a basic statistic course. In specific terms, this study had the following objectives:

1. To determine the effect of the integration of rubrics on students' self-efficacy in statistics using peer assessment in an undergraduate basic statistics course based on their pre-test and post-test mean scores.
2. To ascertain the effect of the integration of rubrics on students' performance in statistics using peer assessment in an undergraduate basic statistics course based on their pre-test and post-test mean scores.

**Research Questions**

Based on the above-listed objectives, the following research questions were developed to guide this study:

1. What is the effect of the integration of rubrics on students' self-efficacy in statistics using peer assessment in an undergraduate basic statistics course based on their pre-test and post-test mean scores?
2. What is the effect of the integration of rubrics on students' performance in statistics using peer assessment in an undergraduate basic statistics course based on their pre-test and post-test mean scores?

**Hypotheses**

The following null hypotheses were tested at a 0.05 level of significance:

1. There is no significant effect of the integration of rubrics on students' self-efficacy in basic statistics using peer assessment based on their pre-test and post-test mean scores.
2. There is no significant effect of the integration of rubrics on students' performance in basic statistics using peer assessment based on their pre-test and post-test mean scores.

**Methodology**

**Research Design:** The non-equivalent quasi-experimental research design was adopted for this study. This design was considered the most appropriate for this investigation because it was done in a school setting involving humans. Akuezuilo (2002), stressed that in the school setting it is not always possible to use a pure experimental design in conducting educational research. The reason is that the school authorities may not allow the control or manipulation

of some relevant variables which they may consider a disruption of school activities. In this study, two groups of students were assigned to two conditions, while the groups were obtained using randomization, subjects in the groups were not assigned to the groups based on randomization. In the current study, there were two groups, one experimental group and one control group. Both groups received both pre-test and post-test before and after the administration of treatment respectively.

**Population of Study:** The population of the study was composed of all third-year students in the Department of Educational Psychology, Guidance and Counselling in Ignatius Ajuru University of Education and Department of Educational Psychology, Guidance and Counselling, University of Port Harcourt during the 2019/2020 academic session. The students were chosen for the study based on the fact that there were taking a course titled "*Basic Statistics and Research Methods*" which was a required course which prepares students for basic and intermediate statistics which can be used in their final research project in their fourth year.

**Sample and Sampling Techniques:** A non-probability convenience/purposive sampling technique was used for the study. A convenience sampling technique was adopted for the study because it is not possible to randomize the subjects in the current research. Furthermore, this sampling technique was considered appropriate because these researchers were only interested in students who were currently undertaking a course in basic statistics and research methods. Thus, this sampling technique meets the specified need of these researchers. The sample consisted of 69 students who volunteered to participate in an extra-mural class for Basic Statistics and Research Methods. These students were drawn from the departments in the institutions mentioned above. According to the requirements for executing non-equivalent quasi-experimental design, the departments were purposively selected from the three institutions. Students from the two institutions were also randomly assigned to the control group and the experimental group for the study.

**Experimental Procedure**: The recruitment of student volunteers was done two weeks into the commencement of the second semester of the 2019/2020 academic session. Those who volunteered were required to fill a form through the Google Form® platform. Initially, a total of 92 students from the two departments volunteered. However, at the commencement of classes in the third week, only 65 students were present. Students' volunteers were assigned into two groups based on their institution, comprising the experimental group and the control group. In the first week of training, students were presented with a course syllabus of the various topics that will be covered, the sub-topics, and the needed materials and resources for achieving success in the class. Students were also given a schedule of the course that would be held and the specific times during the work. This was done after ample deliberations to ensure that it does not clash with the regular class activities of the students. It was also at this point that pretest data for students' self-efficacy and performance in statistics were also collected.

Students in the peer-assessment group were guided on the approach to engaging in peer assessment. This was done by explaining the value of peer assessment and informing the students of the general procedure that would be adopted. Students were also exposed to the assessment criteria and the opportunities available to them to improve their performance.

Students were also given rubrics to guide them in scoring the performance of their peers. In addition to the above, the best practice strategies suggested by Double, et al (2017) were also integrated such as ensuring anonymity in grading by providing random numbers for students to use in their submissions at the end of every week. Students in the peer-assessment groups were encouraged to not only provide a numerical grade but also a written assessment on qualitative feedback. This was to ensure that the students thoroughly assess the performance task rather than giving a vague grade which does not represent the effort or performance in the task. Students in this group were given two days to provide grading, feedback and comments on the performance of their peers.

In the control group, students were taught weekly and at the end of the eighth week without any form of assessment or grading. The assessment was only done at the beginning and end of the training period which was used as the pretest and post-test scores. Students were taught using the regularly assigned textbook.

**Instruments for Data Collection**: Broadly, two instruments were used for data collection. These instruments were used to assess the variables of statistical self-efficacy and statistics performance. The first instrument for the study was the Statistical Self-Efficacy Scale (SSES). This instrument was an adapted instrument from the Self-Efficacy in Statistical Practice Scale by Pathirage (2015). The researcher adopted the instrument by reducing the number of items from the original 37-items to 15 items. Furthermore, the grading format in the original instrument was done based on the percentage of self-reported confidence. In the current adapted instrument, the researcher used a four-point Likert Scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE) and Very Low Extent (VLE). This was done because these researchers believe that students are more familiar with it and are more likely to respond. The items were also reduced to minimize the tendency of response fatigue which could result from long items.

The second instrument for this study is a researcher-developed cognitive instrument aimed at assessing students' knowledge of statistical principles and practice. This instrument was titled "Statistical Performance Test for Undergraduates" (SPTU). This instrument was drawn based on the undergraduate syllabus of *Basic Statistics and Research Methods* in the two institutions. The instrument was constructed in an essay format and is composed of five items each focusing on the real-world application of statistics. Students are at liberty to respond to the instrument based on their knowledge and understanding of the statistical principles. Similar instruments were administered to all students in the experimental groups and the control groups. This was done to ensure uniformity of administration and response collection at the pre-test and post-test phases.

**Validation of the Instrument**: To ensure face and content validities of the instruments were established, copies of the instruments along with the topic of the work, objectives of the study, research questions and hypotheses were given to three experts in Measurement and Evaluation at the Ignatius Ajuru University of Education, Rivers State University, and the University of Port Harcourt. These experts were requested to evaluate the instruments on item content, relevance, comprehensiveness, clarity, and literacy demand. Their suggestions, corrections and modifications would be incorporated into the final version of the instrument before administration.

The reliability of the instruments was established through appropriate statistical techniques. For the SSES, the instruments were administered to 20 students in one of the departments not selected for the study. The SSES yielded a Cronbach Alpha coefficient of 0.90. This value indicates that the instrument had a suitable level of reliability.For the SPTU, the reliability coefficient analysis was done using the test-retest method. To do this, the instrument was administered to the above 20 students twice over a two-week interval. Thereafter, scores from both administrations were correlated using Pearson Product Moment Correlation. The result yielded a correlational coefficient of 0.73 which showed that the instrument possessed a suitable level of temporal stability reliability to be used as a data collection tool.

**Administration of the Instrument**: Data for the study were collected through the use of the paper-and-pencil format. This format was preferable to the use of an online tool because more students were familiar with it. In addition, the data were collected at the beginning and the end of the study. Data collected at the beginning of the study were referred to as pre-test data while those at the end were referred to as post-test data. In total, eight weeks were used for data collection. The first week was used for the debriefing of the participants and the collection of pretest data. Six weeks were used for instruction and practice of assessment, while the eighth week was used for closure and collection of post-test data.

**Method of Data Analysis:** In providing answers to the research questions, mean, standard deviation and mean difference were used for both research questions. In testing the null hypotheses, a paired-samples t-test was used.

**Result Presentation**

**Table 1:** Mean and standard deviation of students' statistics self-efficacy in experimental and control groups

| Group | n | Mean | SD | Mean Difference |
|---|---|---|---|---|
| Peer Pre-test | 27 | 38.92 | 5.04 | 26.17 |
| Peer Post-test | 27 | 65.09 | 6.81 | |
| Control Pretest | 42 | 30.71 | 5.84 | 9.30 |
| Control Post-test | 42 | 40.01 | 6.18 | |

An observation of the result displayed in Table 1 indicates that when the pretest and post-test values of students' statistics self-efficacy in the experimental group where rubrics was integrated with peer assessment as well as those in the control group were compared, the mean difference obtained were 26.17 and 9.30 respectively. These values indicated that students who were assessed with peer assessment using rubrics had a higher increase in statistics self-efficacy more those in the control groups who were assessed using traditional assessment without rubrics.

**Table 2:** Mean and standard deviation of students' statistics performance in experimental and control groups

| Group | n | Mean | SD | Mean Difference |
|---|---|---|---|---|
| Peer Pre-test | 27 | 42..98 | 7.66 | 18.10 |
| Peer Post-test | 27 | 61.08 | 8.36 | |
| Control Pretest | 42 | 45.72 | 6.09 | 2.99 |
| Control Post-test | 42 | 48.71 | 8.42 | |

An observation of the result displayed in Table 2 indicates that when the pretest and post-test values of students' statistics performance in the experimental group where rubrics was integrated with peer assessment and those in the control group were compared, the mean difference values obtained were 18.10 and 2.99 respectively. These values indicated that students who were assessed with peer assessment using rubrics had a higher increase in statistics performance than those in the control groups who were assessed using traditional assessment without rubrics.

**Table 3: ANCOVA analysis of the effect of rubrics on students' statistics self-efficacy**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 13070.748[a] | 2 | 6535.374 | 11202.846 | .000 |
| Intercept | 256.072 | 1 | 256.072 | 438.956 | .000 |
| PrStaSe | 2733.165 | 1 | 2733.165 | 4685.152 | .000 |
| Group | 2607.185 | 1 | 2607.185 | 4469.200 | .000 |
| Error | 38.502 | 66 | .583 | | |
| Total | 184396.390 | 69 | | | |
| Corrected Total | 13109.250 | 68 | | | |

a. R Squared = .997 (Adjusted R Squared = .997)

From the result of the analysis shown in Table 3 which tests the effect of rubrics integration on students' statistics self-efficacy, the result revealed an F-value of 4469.200 at 1 and 66 degrees of freedom with a corresponding p-value of 0.0005 which was lesser than the chosen alpha guiding the study. Since the p-value was lesser than 0.05 the chosen alpha level, it, therefore, indicates that integration of rubrics in peer assessment had a significant positive effect on students' statistics self-efficacy than the traditional assessment method without rubrics.

**Table 4: ANCOVA analysis of the effect of rubrics on students' statistics performance**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 3127.918[a] | 2 | 1563.959 | 2478.590 | .000 |
| Intercept | .498 | 1 | .498 | .789 | .377 |
| PsStaPf | 3004.533 | 1 | 3004.533 | 4761.636 | .000 |
| Group | 1704.148 | 1 | 1704.148 | 2700.764 | .000 |
| Error | 41.645 | 66 | .631 | | |
| Total | 140716.121 | 69 | | | |
| Corrected Total | 3169.563 | 68 | | | |

a. R Squared = .987 (Adjusted R Squared = .986)

From the result of the analysis shown in Table 4 which tests the effect of rubrics integration on students' statistics performance, the result revealed an F-value of 2700.764 at 1 and 66 degrees of freedom with a corresponding p-value of 0.0005 which was lesser than the chosen alpha guiding the study. Since the p-value was lesser than 0.05 the chosen alpha level, it, therefore, indicates that integration of rubrics in peer assessment had a significant positive effect on students' statistics performance than the traditional assessment method without rubrics.

**Discussion of Findings**

The result further showed that the integration of rubrics in peer assessment was the most effective strategy for improving students' self-efficacy and academic performance in statistics. The reason why this may be so might be because peer assessment allows students to critically engage with the assessed material, compare and contrast performance with their peers, and identify gaps or errors in their knowledge. In addition, peer assessment may improve the communication of feedback, as peers may use similar and more accessible language, as well as reduce negative feelings of being evaluated by an authority figure (Liu, Lu, Wu, & Tsai, 2016). This result of this study is similar to that obtained by Udechukwu (2020) who showed that peer assessment had a significantly greater effect in shaping students' performance in a statistics course than self-assessment. Similarly, Orluwene and Ekim (2020) showed that peer assessment had a significantly higher impact on students' achievement in Chemistry than self-assessment.

**Conclusion**

The conclusion drawn from this study is that in terms of their effect on improving students' self-efficacy and academic performance in statistics, the integration of rubrics in peer assessment was more effective, than the conventional or traditional form of assessment which does not include the use of rubrics. These effects were found to be statistically significant.

**Recommendations**

Based on the results obtained from the data collection and analysis, the following recommendations were made:

1. Curriculum developers should make ample effort to include rubrics in the curriculum and syllabus to show to the students the criteria of expectations required of them.
2. Instructors and lecturers taking statistics courses should endeavour to understand the role of non-cognitive factors such as self-efficacy in promoting students' active engagement in statistics-related courses.
3. Remedial and additional support should be given to students to enable them to improve their attitude, self-efficacy and performance in statistics-related courses.
4. The use of peer assessment is only effective when it is broken down into smaller groups. On this basis, it is recommended that statistics classes should be broken down into smaller manageable groups for improved self-efficacy and academic performance.

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