

-Development of Rubric for Empirical Rating of Postgraduate Students Research Skills

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Abstract

The study developed and validated a rubric for empirical rating of post graduate students' research skills. Instrumentation research design was adopted for the study. The study was carried out among the five units from the Department of Science Education University of Nigeria, Nsukka. One research question and one hypothesis guided the study. Purposive sampling technique was adopted. A total of 177 students' project reports were used to collect the data using "Empirical Research Skill Rating Rubric (ERSRR)". The instrument was subjected to a preliminary (face) and empirical validation. The instrument was trial tested on 20 Post graduate students of Nnamdi Azikiwe University, Awka. Project reports of twenty students who have done their seminars and waiting for Oral (external) examination was graded by four different raters (lecturers). The four raters (lecturers) graded the projects to empirically rate the research skills deployed by each student. A reliability coefficient of 0.78 and 0.80 was obtained using Cronbach alpha and inter rater's variability, indicating that the instrument is reliable. The data collected was analyzed using mean and standard deviation while the hypothesis was tested using analysis of variance (ANOVA) at 0.05 level of significance. The result shows that post graduate research skills were high, and there is no significant difference in the mean scores of students in different areas. The study recommended that higher institutions of learning should adopt the developed instrument in assessing their students since it has been confirmed reliable and when used across different subject areas, the results did not significantly differ.

Keywords: Validation, Rubric, Research and Research Skills

Introduction

Research is the hallmark of University education. Students at this level are usually provided with the opportunity to engage in independent writing and oral presentations. The early knowledge of the basics in research is of immense benefit to students if they are to explore educational ideas that make impact, because it adds to the existing pool of knowledge. Research is a systematic exploration into educational materials and like-resources, with the aim of confirming facts and reaching a decisive conclusion (Jagoda & Biljana, 2013). Research deals with the development of new ideas or knowledge from the existing literature, principles and ideas. It has to do with a level of creativity of the researcher because a well-conducted and systematic research gives rise to new concepts, ideas and

methodology. According to Tavares and Eva (2013) research is the creation of new knowledge and principles through the application of existing knowledge in a systematic way.

Research is inventive and procedural in nature. According to Organization for Economic Co-operation and Development (OECD (2015)) it is a creative and systematic adventure carried out in order to increase the pool of knowledge; it involves the collection of relevant information, reviewing, organizing and analyzing such information with the singular aim of enhancing understanding of a topic or phenomenon. Research employs scientific methods to explore specific problems, with the aim of providing necessary information to ameliorate such problems. Research systematically involves a number of processes in an attempt to proffer practical solutions to the problem under study. A number of abilities are deployed to critically examine the concept or topic under investigation; these abilities employed in investigation processes are referred to as research skills.

Research skills are vital ingredients of educational investigation process. They are skills employed by individual researchers to find head-way in each of the processes or steps involved in research. Research skills include all the abilities employed in starting and completing a research study (Kauts & Kaur, 2020). Research skills enable researchers to know where and how to find relevant information and create outline for writing and reporting findings. Communicating research findings in writings of reports follows a systematic procedure as well as shows the level of skills students have acquired and deployed in the research processes. Report writing shows an empirical manifestation of students' research skills. In other words, a research report can be used to assess the amount and quality of research skills possessed by the researcher.

It has become a challenge in using students' research report to assess their research skills. This is due to the subjective nature of the grading system employed by those who assess these students. In using a subjective grading system, the scores obtained from such assessment is usually prone to bias and may even be faulty, since the scoring of such report is solely dependent on the assessor's view and opinion about research. In subjective assessment of scores, students are arbitrarily assigned scores, and this has serious implication as the assessor's judgment could be done by guessing. As such, grading is not uniform across all levels of students. Grading requires a lot of time and critical thinking. Subjective grading of students is usually influenced by the relationship of such student with the assessor. Many a time, there is no explanation to how the students got the grades they were given, hence, the grades do not accurately reflect what a student has learnt or is learning, especially for the universities in the South East that have similar grading rubric that do not specifically outline the ingredients that should constitute the grading system for a particular area of research expertise. Thus, the graders arbitrarily assign grades based on how they feel it should be and not how it actually is with respect to a given standard. To ameliorate such situation, it is therefore necessary to develop a rubric that will guide the assessment of students. This study investigated the development and validation of a rubric for empirical rating of post graduate students' research skills.

A rubric is a simple way to set up grading criteria for assessments. A rubric is a scoring tool that outlines the criteria for a piece of work or that which counts in a work (Andrade, 2008). A good rubric describes levels of quality for each criterion; and the level of

performance can be written as different ratings e.g. excellent, good, fair, and poor; or in numeric values e.g. 4, 3, 2 and 1. According to Brookhart (2013) a rubric is a coherent set of criteria for students' work that include descriptions of level of performance quality on the criteria. The major purpose of a rubric is to assess performances. These performances can either be when the activity is on-going or using the product (outcome) of such activity to make evaluation. A well-developed rubric helps to reduce the guessing in evaluation and helps the students to understand and learn from their mistake (Burghart & Panettieri, 2009). Rubrics also offer productive opportunities for enriching the student-teacher relationship and improving instruction (Gallo, 2004).

To develop a rubric, it is necessary to establish learning goals and assessment criteria distinguishing between project or skill assessment, and also introduce the rubric to the students and the assessors, so that they can know how to use them to improve their skills (Gallo, 2004). This is the formative property of a rubric. Wolf and Stevens (2007) identified specific steps in creating a rubric; these steps include; identifying performance criteria, setting performance level, and creating performance description. Zahid and Khanam (2019) outlined four major components of a rubric: task description, scale, dimensions and description of the dimensions. The task description relates the actual assignment given to the students; the scale deals with the grading criteria e.g. excellent, competent (or numeric values of 4, 3, 2, and 1); dimensions of assignment include; organization, clarity, argument, and grammar. Way and Rairigh (2006) added that applying the rubric and reviewing its effectiveness to know if it is necessary to make modifications. This process of determining the effectiveness and dependability is known as validation.

Allen and Knight (2009) collaboratively developed and validated a rubric that integrates baseline data from academics and professionals that insured precision in grading papers in multiple sections of a course. Cyr, Smith, Broyles, Holt (2014) also developed, evaluated and validated a scoring rubric for written case reports. Stellmack, Konheim-Kalkstein, Manor, Massey and Schmitz (2009) described the empirical evaluation of the reliability and validity of a grading rubric for grading APA-style introductions of undergraduate students; rank-order correlations between graders who used the rubric and an experienced instructor who ranked the papers separately and holistically provided evidence for the rubric's validity. Williams, Northcote, Morton, and Seddon (2017) also reported that a good rubric should be used by various teachers and have all of them arrived at similar scores (for a given assignment). Reliability also can refer to consistency over time (for example, if you are scoring your 100th essay – the rubric allows you to judge the 100th essay with the same criteria that you judged the 1st essay).

Ugwu (2014) developed and validated an instrument for assessing secondary school students' practical chemistry skills acquisition in qualitative analysis. Cronbach alpha reliability technique and Kendall's coefficient of concordance were used to establish the reliability, and the instrument was found to be reliable. The present study developed and validated a rubric for empirical validation of post graduate students research skills. According to Stevens and Levi (2005), grading rubrics can be used to assess a range of activities in any subject area. Arter and McTighe (2001) also affirm that rubrics allow for consistency in grading for those who team-teach the same course, assigned to the task of grading, and serve

as good documentation for accreditation purposes. Huba and Freed (2003) reported that rubrics offer the possibility of objective, consistent evaluation minimizing difference in grades even when multiple raters are involved in evaluating a student's work. Jonsson and Svingby (2004) asserted that 'reliable scoring of performance assessments can be enhanced by the use of rubrics, especially if they are analytic, topic-specific, and complemented with examples and/or rater training. The present study developed and validated rubric for empirical rating of research skills of post graduate students.

Research Question

The study was guided by the following research question:

1. What are the mean scores of Post graduate students' research writing skills with respect to their subject areas?

Hypothesis

The following hypothesis was formulated for the study:

1. There is no significant difference in the mean scores of Post graduate students' research writing skills with respect to their subject areas?

Method

The study adopted instrumentation research design. Instrumentation research design is a type of design that deals with the process of constructing research instrument that could be used appropriately in gathering data on a study (Bitonio, 2014). This design is suitable for the study because the study deals with the development and validation of rubric for empirical rating of post graduate students' research skills. Purposive sampling technique was employed and Science Education Department, University of Nigeria, Nsukka was selected. Purposive sampling was used because the department is multi-disciplinary; hence, it is made up of different subject areas namely; Biology Education, Chemistry Education, Integrated Science Education, Measurement and Evaluation and Physics Education; therefore constituting a good sample. All the completed projects that have been assessed at the seminar stage and ready for Oral (External) Examination were used for the study. A total of 177 students' project reports were used to collect the data. A total of 72 projects from Biology Education, 56 from Chemistry Education, 18 from Integrated Science Education, 23 from Measurement and Evaluation and 8 from Physics Education. The data was collected using the developed instrument (Empirical Research Skill Rating Rubric (ERSRR)). The ERSRR is made up of sections A, B, C, D, E and F. Section A contains comprehensive information about preliminary pages of thesis writing, sections B, C, D, E and F contain comprehensive information about chapter one, two, three, four, and five respectively. The instrument (ERSRR) was designed in five point-Likert scale of 1, 2, 3, 4, and 5 showing the degree to which post graduate students actually possess these research skills.

The instrument was first subjected to a preliminary validation (face validation) and later to empirical validation. For the face validation, three experts from Measurement and Evaluation Unit, Department of Science Education, University of Nigeria, Nsukka validated the instrument. For the empirical validation, the instrument was trial tested on 20 Post

graduate students of Nnamdi Azikiwe University, Awka. Project reports of twenty students who have done their seminar and waiting for Oral (external) examination were graded by four different raters (lecturers) using the developed instrument (ERSRR). The four raters (lecturers) graded the projects to empirically rate the research skills deployed by each student. Cronbach Alpha reliability technique and Kendal coefficient of concordance were used to determine the internal consistency and degree of agreements by the raters respectively. A reliability coefficient of 0.78 was obtained using Cronbach alpha while a coefficient of 0.80 was obtained for the degree of agreement of the raters using Kendall's coefficient of concordance, indicating that the instrument is reliable. The data collected from the 177 post graduate students from Department of Science Education, University of Nigeria, Nsukka was analyzed using mean and standard deviation while the hypothesis was tested using analysis of variance (ANOVA) at 0.05 level of significance.

Results

Research Question 1: What are the mean scores of Post graduate students' research writing skills with respect to their subject areas?

Table 1: Mean and standard deviation of Postgraduate students project reports by subject area

Subject Area	N	Mean	Std. Deviation	Std. Error
Biology Education	72	63.53	10.91	1.29
Chemistry Education	56	64.55	10.71	1.43
Integrated Science Education	18	62.28	11.66	2.75
Measurement and Evaluation	23	64.61	11.59	2.42
Physics Education	8	60.25	11.22	3.61
Total	177	63.72	10.91	0.82

Table 1 shows the mean scores of postgraduate students' project reports with respect to their subject areas. Biology education students have a mean score of 63.53 with a standard deviation of 10.91, Chemistry Education, Integrated science education, measurement and evaluation and Physics education have a mean scores of 64.55, 62.28, 64.61 and 60.25 respectively with standard deviation of 10.71, 11.66, 11.59 and 11.22 respectively too. This is an indication that the postgraduate students have good research skills with respect to their areas of specialization, since the mean scores were more than 50%.

Hypothesis 1: There is no significant difference in the mean scores of Postgraduate students' research writing skills with respect to their subject areas?

Table 2: ANOVA summary table for the difference in mean scores of Post Graduate students' project reports

Groups	Sum of Squares	df	Men Square	F	Sig.
Between Groups	193.503	4	48.378	0.401	0.808
Within Groups	20766.373	172	120		
Total	20959.876	176			

Table 2 shows that the associated probability value for the calculated F (0.401) for the differences in the mean responses of Post graduate students with respect to their study areas with an associated probability of 0.808. Thus, Post graduate students' research skills, with respect to their subject area is not significant since associated probability value of 0.80 is greater than 0.05 level of significance.

Discussion of Findings

The findings of the study show that Postgraduate students of Science Education (Biology Education, Chemistry Education, Integrated Science Education, Measurement and Evaluation and Physics Education) all have a high level of research skills. This could be attributed to the method adopted by the department in providing training for the students with respect to the area of the study of each student. The mean rating of each subject area also shows that there is no significant difference. The implication of this is that the Empirical Research Skill Rating Rubric (ERSRR) for Post graduate Students would provide reliable result when used to assess students across the subject areas. This is in line with the findings of Williams, Northcote, Morton, & Seddon (2017) that a good rubric should be able to be used by various teachers and have all of them arrive at similar scores (for a given assignment). Reliability also can refer to time (for example, if you are scoring your 100th essay – the rubric allows you to judge the 100th essay with the same criteria that you judge the 1st essay).

The result is also in agreement with the findings of Stevens and Levi (2005) that grading rubrics can be used to assess a range of activities in any subject area. The ERSRR is in agreement with the findings of Arter and McTighe (2001) that rubrics allow for consistency in grading for those who team-teach the same course, assigned to the task of grading, and serve as good documentation for accreditation purposes. The result agrees with the findings of Huba and Freed (2003) who reported that rubrics offer the possibility of objective, consistent evaluation, minimizing difference in grades even when multiple raters are involved in evaluating a student's work. The findings is also in line with the findings of Jonsson and Svingby (2004) that conclude that 'reliable scoring of performance assessments can be enhanced by the use of rubrics, especially if they are analytic, topic-specific, and complemented with exemplars and/or rater training.

Conclusion and Recommendations

Based on the findings of the study, it was concluded that postgraduate students have good research skills and always deploy these skills in their project report writing. It is also indicative that students from the various units in the departments must have undergone collaborative study, as well as peer tutoring in order to be conversant with the various research skills learnt; and are also committed to deploying the research skills for greater academic advancement. Based on the findings of the study, the study recommends that higher institutions of learning should adopt the developed instrument in assessing their students, since it has been confirmed reliable, and when used across different subject areas, the results did not significantly differ.

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