DEVELOPMENT OF A GRADUATE EDUCATIONAL RESEARCH COMPETENCY TEST (GER-CT)

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ABSTRACT

Admission to a graduate program comes with an assumption that a student can do research independently. Unfortunately, in most cases, the assumption proves otherwise. Research is blamed for the dropping survivability and rising drop-out rate among graduate schools. This study aimed at developing a 50-item test that would gauge the graduate students' research competency. A pool of multiple choice items (k=100) was constructed and was administered to a development sample (n=300) composed of Master's degree students. Results show that the Graduate Educational Research Competency Test (GER-CT) is a reliable measure of research competency ($\alpha = 0.734$). Principal component analysis using orthogonal rotation with Kaiser normalization identified five underlying factors of the GER-CT: perception, numeracy, application, analysis, and evaluation.

Keywords: test development, research competency, graduate education, principal component analysis

INTRODUCTION

Research is a term loosely used in everyday speech to describe a multitude of activities, such as collecting masses of information, delving into esoteric theories, and producing wonderful new products (Walliman, 2005). Calmorin and Calmorin (2007) define research as the scientific study of trend or event which involves careful collection, presentation, analysis and interpretation of data or facts that relates man's thinking with reality. Oxford Encyclopedic Dictionary (1992) defines research as the systematic investigation into the study of materials and sources in order to establish facts and reach new conclusions; it is an endeavour to discover

new or collate old facts, among others, by the scientific study of a subject or by a course of critical investigation.

For the graduate school student in the master's and the doctorate levels, research is an academic requirement that would bring them a step higher in the academic ladder. This notion is based on the fact that most graduate programs today require students to submit an acceptable thesis (for master's level) or dissertation (for doctorate level) prior to the confirmation of the degree.

Research, as a part of academic requirement for graduate degrees, traces its history before the end of the 13th century in Paris when candidates for higher education defended their theses (Calmorin & Calmorin, 2007). A thesis is a report of the process and results of research, extending from a central proposition, hypothesis, or problem to a definite generalization growing out of facts while a dissertation is a thesis covering a limited range which further must be a contribution to knowledge. A landmark study by Almack (1930) emphasized that research as an academic requirement is a result of independent work.

Such requirements are consistent with the theory of higher education. As universities are now organized, three fairly definite stages in the educational process are recognized: period of the mastery of knowledge; period of mastery of the techniques by which knowledge is tested and additions are made to the sum total; and period of discovery or research (Almack, 1930).

Research is one of the things that every graduate school student should be ready for. Students in higher or further education, whether full-or part-time, may be required to complete research projects of one kind or another. Requirements that involve independent research are inevitable in most, if not all, academic courses.

In some instances, the research project forms a relatively minor part of the course; in others, the project is virtually the whole basis on which award is made (Sharp, Peters, and Howard, 2002; Denscombe, 2002). On top of that, thesis or dissertation writing comes as the ultimate universal requirement for a student to finally earn a higher degree. In fact, people judge a recently graduated master's or doctorate by his or her research (Azuma, 2003).

The scenario manifests that a student's admission to a graduate program comes with an assumption that he can do independent research. Graduate school administrators argue that the assumption is evidenced by documents that the students submitted prior to admission to the program. Unfortunately, in most cases, the assumption proves otherwise.

Most students in the graduate school have apprehensions regarding research and thesis writing. Some say it is difficult to write a thesis. Others are afraid of the long process related to the research undertaking (Garcia, Nuevo, & Sapa, 2007). According to Barnes (1995), the students' lack of interest is due to their view that research is complex, ambiguous and open to doubt. Consequently, they are not driven on by curiosity and may perceive doing a research more as a chore than a process that fosters the personal development of the student (Sharp, Peters, and Howard, 2002). Phillips and Pugh (2000) say that new graduate school students often have the idea that people who possess higher degrees are outstandingly brilliant. In a way, this impression inhibits development among new students as they are given the notion that they are not outstandingly brilliant and therefore cannot expect to be awarded higher degrees. Similarly, reading completed theses or dissertations convinces new graduate students that they would never be able to write anything even remotely resembling such document either in length or quality.

As a result, research is often blamed for the dropping survivability rate and rising drop-out rate among graduate schools. Graduate school students tend to take halt after their academic requirements and delay their thesis or dissertation writing; worse, they take the risk but fail and soon forget their dreams of obtaining a higher degree all together. Meanwhile, other students who fortunately are given research tasks earlier on in their academic courses get tired of the arduous tasks entailed by the requirement and eventually drop out of school for reasons that they cannot cope with what is expected.

In a longitudinal study of doctoral programs from 1958 to 1988, it was reported that among all those who enter a doctoral program, only about half actually complete it (Bowen &Rudenstine, 1992 as cited by Faghihi, Foroozandeh, Ethington, &Corinna, 1996). This extensive study examined English, History, Economics, Political Science, Mathematics, and Physics doctoral programs at ten major research universities in the United States of America.

A similar finding was divulged by a recent six-year executive report submitted by one state university in the Cordillera Administrative Region to the Commission on Higher Education. Apparently, the increasing dropout rate in the master's and doctorate levels is due to the non-compliance of research requirements (BSU Executive Report, 2007). This scenario only goes to show that research competency is recognized as one of the most important components in graduate education (Chon, n.d.). In fact, to assess students' mastery of research concepts for application, universities in the United States of America administer a research competency test to their graduate school students upon completion of their academic requirements before they start writing their final papers. Only the students who obtain a passing mark in the research competency test are allowed to proceed to thesis or dissertation writing.

For any particular research topic, three levels of learning outcomes have been described. They are: being familiar with research, having knowledge of research, and being competent at research. A research competency is a description of this third level and specifies the knowledge and skills required. It does not describe how they may be acquired, although it is useful to provide this information in a competency document. However, it should be borne in mind that there are usually many ways in which a specific competency can be acquired (Royal College of Surgeons, 2007).Research competencies may be conceptualized as the degree to which an individual believes he has the ability to complete various research tasks (Bieschke, et al., 1993).

Eaton (2007) define research competency as the level of knowledge and understanding, with sufficient practical experience, to be able to carry out a specified aspect of research. Mahmud and Zainol (2008) say that research competency is evidenced by the ability to demonstrate knowledge in identifying researchable problems, developing research questions and/ or research hypotheses, reviewing relevant literature, matching purpose, design and methods, applying appropriate statistical techniques, interpreting results and finally, effectively communicating the research findings.

The low survivability rate in graduate schools would probably be increased if universities in the Philippines would adapt the same scheme. However, the research competency test to be administered should possess proven validity and reliability and should be free from bias such that

students' preparedness for research work would be accurately gauged.

Objectives:

- It was therefore the aim of this study to develop an instrument to assess the research competency of graduate students, particularly in the Master's degree level.
- Specifically, the study sought to determine the reliability coefficient of the GER-CT and identify its underlying structures.

MATERIALS AND METHODS

Participants of the Study

Master's level students enrolled in the private and public or state universities in the Cordillera Administrative Region and Region I were involved in the study. Two-stage random sampling technique was employed in selecting the subjects. A total of 300 students participated in the study (Table 1), with 137 (45.70%) enrolled in private universities and 163 (54.30%) in state universities and colleges (SUCs). It can be further gleaned from the table that the majority of the respondents are females (nf = 205; 68.33%). In terms of civil status, the majority of the respondents are single (ns = 178; 59.33%).

Table 1. Students who participated in the study

	Frequency	Percent
Type of University		
Private Universities	137	45.70
State Universities and Colleges (SUCs)	163	54.30
Total	300	100.00
Gender		
Female	205	68.33
Male	90	30.00
NR*	5	1.67
Total	300	100.00
Civil Status		
Single	178	59.33
Married	110	36.66
Widow/er	2	0.67
Separated	5	1.67
NR*	5	1.67
Total	295	100.00

**NR – no response indicated*

The Instrument

This study intended to develop a competency test designed to examine the capability of Master's students in research, which may be administered alongside other areas (e.g., field of specialization). Such is thebasis for the design of the research competency test ofaverage length (k=50).

The construction of the test was guided by the following objectives: That the test will gauge the graduate student's ability to: 1) describe the research process; 2) specify the importance of literature review in the research process; 3) select among given options a correctly written problem statement; 4) restate a problem statement into a hypothesis; 5) identify the independent, dependentvariables, and extraneous variables in a given research problem; 6) distinguish the sampling technique described in a given situation; 7) given a research situation, determine the most suitable instrument to be used to gather data; 8) identify the research design appropriate for a given research problem; and 9) evaluate a given research problem founded on ethical principles.

The construction of the Graduate Educational Research Competency Test (GER-CT) was guided by a methodological framework (Figure 1). The construct "research competency" was first defined both constitutively and operationally. A table of specifications(Table 2) was then constructed based on the set definition and the prescribed contents of the course Methods of Research, which includes: 1) research process, 2) research problem, 3) ethics and research, 4) variables and hypotheses, 5) reviewing the literature, 6) sampling, 7) instrumentation, 8) research design and methodology, 9) descriptive statistics, and 10) inferential statistics.

Items were distributed in Bloom's taxonomy of educational objectives: knowledge, comprehension, application, analysis, synthesis, and evaluation.Then, an item pool of multiple-choice questions with four options were generated with the prescribed number of items in the test blueprint doubled (k = 50 x 2 =100).

Content validity of the GER-CT was established by comparing the items to the test blueprint constructed. Five professors teaching Methods of Research from two different higher learning institutions were tapped to

validate the instrument. The GER-CT was then revised according to the comments and suggestions of the experts. After which, the GER-CT was packaged and administered to the development sample (n=300).

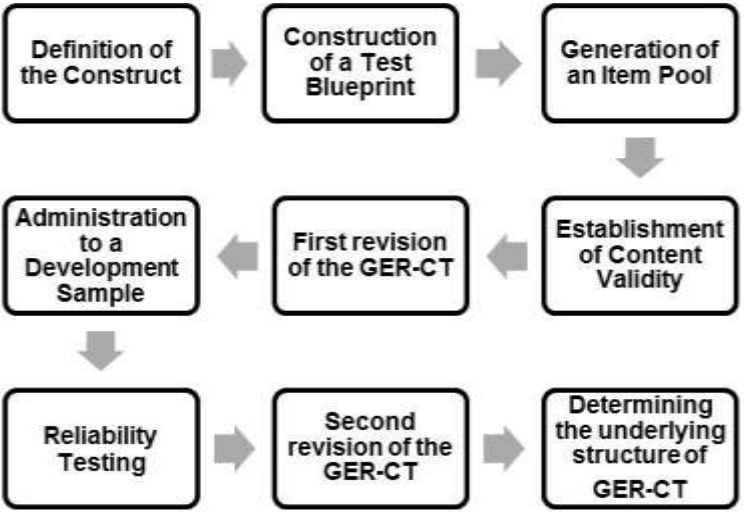

Figure 1. Methodological framework of the development of the GER-CT

Responses were coded and tested for reliability. Cronbach's alpha was used to determine the internal consistency of the instrument. The instrument underwent second revision by way of deleting the items to reach its maximum reliability coefficient. Finally, remaining items were subjected to factor analysis to determine the underlying structure of the instrument.

Procedure for Data Collection and Analysis

Permission from the academic heads of selected universities and colleges was sought. Upon approval, proper coordination was done with the respective graduate school professors as regards the schedule of classes where the GER-CT was administered.

Topic	Prescribed number of Items*						Total
	K	C	Ap	An	S	E	
The Research Process	2 (4)		1 (2)	2 (4)			5 (10)
The Research Problem			2 (4)		3 (6)		5 (10)
Ethics and Research				2 (4)		3 (6)	5 (10)
Variables		2 (4)	2 (4)		1 (2)		5 (10)
Reviewing the Literature	2 (4)	2 (4)					4 (8)
Sampling	2 (4)		3 (6)				5 (10)
Instrumentation		2 (4)	2 (4)				4 (8)
Research Design and Methodology	3 (6)		4 (8)				7 (14)
Descriptive Statistics	2 (4)			3 (6)			5 (10)
Inferential Statistics		2 (4)				3 (6)	5 (10)
Total	11 (22)	8 (16)	14 (28)	7 (14)	4 (8)	6 (12)	50 (100)

Legend: K-Knowledge, C-Comprehension, Ap-Application, An-Analysis, S-Synthesis, E-Evaluation. Numbers in parentheses indicate number of items in the item pool.

The researcher personally administered the GER-CT to the graduate school students. In doing so, the standard operating procedures of test administration were adhered to. Then, the answer sheets were scored dichotomously (1 = correct; 0 = wrong). Responses to the items were recorded and subjected to appropriate statistical analysis.

Cronbach's coefficient alpha (α) was used to determine the reliability of the scores in the GER-CT.Exploratory factor analysis (principal component analysis) was employed to identify the grouping or clustering of the variables. Orthogonal rotation (varimax) with Kaiser normalization was the rotation method specified.

The Statistical Package for the Social Sciences (SPSS) v.16 was used to process the data.

RESULTS

Reliability of the GER-CT

Three runs of Cronbach's alpha were done to obtain the maximum reliability of the test (Table 3). Deletion of items was done in between such that the reliability coefficient would improve. The first run involved all items of the GER-CT (k=100, $\alpha 1 = 0.644$). For the second run, 31 items were deleted (k=69, $\alpha 2 = 0.726$). Five more items were recommended for deletion for the third run (k=64, $\alpha 3 = 0.734$). One item was recommended for deletion for the fourth run. However, the removal of the item from the roster caused coefficient alpha to decrease by 0.002 ($\alpha 4 = 0.732$). Thus, the inclusion of 64 items in the test was considered final and the maximum reliability coefficient of the instrument is $\alpha = 0.734$.

Table 3Reliability statistics showing Cronbach's coefficient alpha

Run	Number of items included	Cronbach's Coefficient Alpha (α)	Items that will improve alpha if deleted	Number of items with improved α if deleted
1	100	0.644	1, 6, 7, 10, 13, 14, 19, 20, 21, 23, 29, 35, 36, 39, 41, 42, 45, 62, 64, 65, 66, 67, 68, 73, 75, 84, 87, 90, 93, 97, 99	31
2	69	0.726	34, 58, 79, 92, 95	5
3	64	0.734	60	1
4	63	0.732	-	-

Items for possible inclusion in the final version of the GER-CT were matched according to topics vis-à-vis the prescribed number of items in the test blueprint (Table 4). The table shows that the number of items prescribed for every topic is satisfied even with some items deleted to obtain the maximum reliability of the test. A total of k=50 items were selected to be included in the final version of the GER-CT on the basis of the items' content validity. Fourteen items were saved for banking.

Table 4 Distribution of items in the GER-CT

Topic	Number of Items in the TOS (Item Pool)	Number of items for possible inclusion in the GER-CT	Items for inclusion in the final version of the GER-CT*
The Research Process	5(10)	7	2, 3, 4, **5**, 8, **9**, 11
The Research Problem	5(10)	6	12, 15, 16, 17, **18**, 19
Ethics and Research	5(10)	8	22, **24**, 25, 26, 27, **28**, 30, **31**
Variables	5(10)	5	32, 33, 37, 38, 40
Reviewing the Literature	4 (8)	4	43, 44, 46, 47
Sampling	5(10)	10	**48**, 49, 50, 51, **52**, **53**, 54, 55, **56**, **57**
Instrumentation	4 (8)	4	59, 60, 61, 63
Research Design and Methodology	7(14)	8	69, **70**, 71, 72,74, 76, 77, 80
Descriptive Statistics	5(10)	7	81, **82**, 83, 85,**86**, 88, 89
Inferential Statistics	5(10)	5	91, 94, 96, 98, 100
Total	50(100)	64	

** - Items in bold print are for item banking*

Underlying Structure of the GER-CT

Principal component analysis (PCA) with orthogonal rotation (varimax) was conducted on the final version of the GER-CT (k=50). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO=.568, which is within the acceptable limits, KMO >0.50 (Field, 2009). The foregoing result confirmed that principal component analysis would yield distinct and reliable factors. Further, Bartlett's test of sphericity ($\chi 2$=1623.660, $p < .001$) indicated that the correlations between items were sufficiently large for PCA.

Given the large sample size, and the convergence of the scree plot and Kaiser's criterion on five components, this is the number of components that were retained in the final analysis. Table 5 shows the factor loadings after rotation.Factor loading is the regression coefficient of a variable for the linear model that describes a latent variable or factor in factor analysis (Field, 2009).

As gleaned from the table, component 1 has factor loadings that range from 0.206 to 0.519; factor loadings of component 2 range from 0.213

to 0.604; the factor loading of component 3 range from 0.188 to 0.492; and component 4 has factor loadings from 0.146 to 0.471; and those of component 5 from 0.216 to 0.487.

Significance of factor loadings depends primarily on the sample size. For n=300, factor loadings of .298 and higher is recommended as significant (Stevens, 2002 as cited by Field, 2009). Results indicate that minimum factor loadings were slightly less than the minimum requirement of .298, but were offset by significantly higher maximum values.

Factors	Factor Loadings		Number of Items	Items
	Min	Max		
1	0.206	0.519	13	2, 11, 25, 30, 37, 38, 43, 44, 50, 59, 61, 72, 77
2	0.213	0.604	8	51, 63, 81, 83, 85, 88, 89, 96
3	0.188	0.492	13	3, 4, 8, 15, 16, 17, 22, 26, 40, 47, 54, 60, 74
4	0.146	0.471	8	27, 33, 49, 80, 91, 94, 98, 100
5	0.216	0.487	8	12, 19, 32, 46, 55, 69, 71, 76
Total			**50**	

DISCUSSION

Reliability of the GER-CT

Reliability means that a measure should consistently reflect the construct that it is measuring (Field, 2009). It is the psychometric property which pertains to the consistency of measurement—that is, how consistent test scores or other assessment results are from one measurement to another (Linn and Miller, 2005).Reliability is determined by estimating the influence of various sources of error. If there is little error, then the reliability is high or strong. If there is much error, the reliability is low or weak.

Cronbach's alpha (α) was employed to obtain the reliability coefficient of the GER-CT.The maximum reliability coefficient obtained isα = 0.734 (k=64), which is slightly higher than the .7 margin (Kline, 1999

as cited by Field, 2009; De Vellis, 1991). The results indicated that the scores generated from the GER-CT are reliable measures of the research competency of graduate students. In other words, the GER-CT can produce consistent scores from one administration to another or from one set of items to another—that is, a student who obtains a high score the first time he takes the GER-CT would get a high score the next time he takes the test.

Underlying Factors of the GER-CT

To establish the construct validity of the instrument, principal component analysis with orthogonal rotation (varimax) was done on the 50-item GER-CT.

The items that cluster on the same component suggest that factor 1 represents the graduate students' perception on the basic concepts of research (13 items); factor 2, concepts that involve numeracy (8 items); factor 3,application of research concepts (13 items); factor 4, analysis of research concepts (8 items); and factor 5, evaluation of research situations (8 items).

Perception pertains to questions in the GER-CT that ask the graduate school students about basic concepts in research. Some items included in this component ask about the characteristics of research, classification of variables, procedure of reviewing the literature, steps in data collection, and characteristics of some research designs. Numeracyrelate to items that entail computation and interpretation of numerical values. Items under this component are mathematical by nature. Questions that ask the graduate school student to interpret given statistical values, make sense of graphs, and determining the areas under the normal distribution curve belong to this component. Application refers to items in the test that call for the use of research concepts in different situations. Items in this component include identifying an appropriate research design given a situation, determining a sampling technique that fits a given research problem, and recognizing the ethical principles violated in a given research situation.Analysis refers to items that involve examining elements, relationships, and organizational principles. Items under this component ask the graduate school student to identify the correct diagram that pictures a particular research design,

compare procedures to determine the appropriate sampling technique described, and recognize errors in given problem statements to.Evaluation pertains to items that ask the graduate student to make decisions based on internal and external criteria. Some items under this component let the student decide on statistical and ethical procedures to undertake in given situations.

The principal component analysis with orthogonal rotation (varimax) done on the 50-item GER-CT reduced the 10 components of research competency to five underlying structures. Essentially, the construct can be measured in these factors. In other words, research competency is described as perception of research concepts, numeracy, application of research concepts, analysis of concepts, and evaluation of research situations.

Acceptable as it may be, it is recommended that researchers intending to use the GER-CT should make clear to the respondents about the motive of the study and of the test. The psychometric properties of the GER-CT may be improved by testing its reliability in the doctorate level.The instrument may also be administered to graduate students from different areas of the Philippines to establish its norms.

SUMMARY AND CONCLUSION

The study was conducted primarily to develop a research competency test for graduate students. Specifically, the study aimed to determine the reliability and the underlying structure of the Graduate Educational Research Competency Test (GER-CT).

A 100-item multiple-choice test was constructed based on the contents of basic research courses in the graduate school. Content validation was done by tapping five professors teaching research methods in two different higher education institutions to compare the test blueprint and the items of the GER-CT. Items were then revised as suggested.

The instrument was administered to a development sample (n=300) consisting of Master's level students from government and private institutions. Respondents' answers to the items were recorded and analysed. Cronbach's coefficient alpha (α) was used to determine the internal consistency of the scores in the GER-CT. Exploratory factor analysis (principal component analysis) was employed to identify the grouping or clustering of the variables. Orthogonal rotation (varimax) with Kaiser normalization was the rotation method specified.

CONCLUSIONS

The following conclusions were drawn based on the findings:
1. The GER-CT is a valid and reliable instrument to gauge research competency of graduate students in the Master's level.
2. Items of the GER-CT converge in five factors: perceptionon the basic concepts of research; numeracy; application of research concepts; analysis of research concepts; and evaluation of research situations.

RECOMMENDATIONS

Based on the conclusions drawn from the results of the study, the following recommendations are forwarded:

1.The reliability of the GER-CT may be tested in the doctorate level; analysis of the reliability of the five factors of the GER-CT may be performed as well.

2.Confirmatory factor analysis may be done with development sample obtained in the doctorate level.

3.The GER-CT may be adopted as part of an admission test for the Master's level of study.

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