# Quality Analysis of Guangxi Computer Fundamentals Examination for Colleges and Universities

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**Keywords:** Computer Fundamentals Examination; Quality Analysis; Paper Making Improvement

**Abstract.** In order to evaluate correctly the work of the examination and teaching quality, educational measurement theory must be used to conduct analysis to the examination. By taking for example the written examination of Level 1 Guangxi Computer Examination for Colleges and Universities in July, 2012, the paper analyzes quality index including validity, reliability, difficulty degree and differentiation degree, provides a comprehensive evaluation about the examination work quality and the teaching level of computer fundamentals in Guangxi Zhuang Autonomous Region, and then proposes some countermeasures and suggestions on how to improve the examination work. Through test quality analysis and implementation of efficient feedback mechanism, it will promote to a certain extend the computer fundamentals examination and teaching of computer fundamentals.

## Basic Situation of   Joint Computer Examination in Guangxi Colleges and Universities

In order to better guide the software and hardware construction of computer fundamentals teaching to be carried out in all universities, regulate all requirements of computer fundamentals teaching, the unified examination of computer fundamentals course in Guangxi has been conducted since 1994. The purpose of joint examination of computer fundamentals courses is "to promote construction by examination, deepen reform by examination, improve teaching by examination, and enhance learning by examination," to comprehensively push on the teaching reform to the computer fundamentals course in all universities, and to effectively improve the application of computer technology by university students. By 2012, the computer fundamentals courses have been popularized in more than 50 schools in Guangxi Zhuang Autonomous Region, which include all its colleges and universities and some technical-secondary school.   57 schools have taken part in the joint computer examination, with a total student number of 140,000. The computer fundamentals course has been listed in the teaching program as a required course in all colleges and universities. The computer teaching quality has been regarded as an important content of teaching evaluation by the Education Department of Guangxi Zhuang Autonomous Region. As an influential examination, how can its paper quality be ensured and how can it evaluate effectively the teaching quality of computer fundamentals courses in colleges and universities? It is very necessary to conduct an overall analysis to all the examination papers and results through scientific and effective methods. In order to further improve the exam, the Guangxi Steering Committee of Computer Fundamentals Examination for Colleges and Universities has begun to organize experts to analyze the quality of each exam since 2011.

## Quality Analysis of the Examination Paper

The examination, to a certain extent, is a kind of sampling measurement, which is accompanied by statistical contingency. Therefore, it is very important to conduct quality analysis to the examination paper. Because of the importance of the examination, comprehensive analysis must be conducted to the reliability and validity of the exam paper by the organized experts after each examination. The analysis results will be a valuable reference to teaching and paper making quality improvement. The quality analysis of exam generally includes an analysis of such factors as validity,

reliability, degree of difficulty and differentiation of the exam [1].

A.    Exam Validity Analysis

Validity is a quality index to effectiveness and accuracy of the set goal achievement by the exam. It reflects the degree to which the exam results correspond to the expected goal. If the exam validity is more than 0.30, it suggests the exam is of high quality; while exam validity is less than 0. 20, it suggests the exam is of poor quality. It will be very convenient to adopt the percentage agreement method to analyze validity of the exam. The particular way is as follows:

1）    Divide all the students into high-scored, medium-scored or low-scored group according to their total scores of all the questions, and each group will account for one third of the total number;

2）    Respectively calculate the average scores of the high-scored group and the low-scored group in each question;

3）    Calculate the difference of the average scores of high-scored group and low-scored group in the question order;

4）    Respectively divide the full marks of corresponding questions with each question difference, and the result is the validity of the question;

5）    Finally, calculate the weighted average values of all the questions, and it will be the validity of exam. The calculation formula is as follows:

$$V = \frac{\sum_{i=1}^{n} V_i f_i}{\sum_{i=1}^{n} f_i} \tag{1}$$

In the formula, n represents the number of the question; $V_i$ represents the validity of question i; $f_i$ represents the score of question i. The validity getting from the analysis of the exam in July, 2012 is 0.35, which indicates the exam is of high quality.

B.    Reliability Analysis of Exam

Reliability of the exam is the dependability and the consistence level of measuring results. Reliability is an important index to measure the level of exam paper or exam quality. Supposing all the other terms are the same, the higher the reliability is, the better the measuring quality will be. The reliability of exam can be improved by such measures as improving the question quality, increasing the amount of questions, expanding the scope of questions, regulating the discipline, eliminating the interference factors to the examinee, and improving the objectivity and accuracy of the score. There are many kinds of methods to estimate reliability, such as retest reliability, duplicate reliability, homogeny reliability and Hoyt reliability [2]. The Cronbach formula will be adapted to measure reliability. The calculation formula is as follows:

$$r = \frac{n}{n-1}(1 - \frac{\sum_{i=1}^{n} S_i^2}{S^2}) \tag{2}$$

In the formula, r represents reliability; n represents the number of the question, $S_i^2$ represents the score variance of each examinee for the question i, and $S^2$ represents the full mark variance of each examinee. The reliability coefficient is 0.4~0.9 for the common examination, while only when the reliability is more than 0.7, can it be regarded qualified [3]. Taking the example of the exam in July, 2012 for an analysis, the reliability is shown in Table I. We can conclude that the reliability of computer fundamentals examination in the universities is higher, of less score error, the examination paper is more suitable for the examinees of universities. While the reliability of computer fundamentals examination in the vocational colleges is relatively lower, of more score errors, and the examination paper should take into more considerations the examinees in vocational colleges.

Table. I. Analysis of the examination reliability

| Level of the colleges | Exam reliability |
|---|---|
| Four-year program (with bachelor's degree) | 0.815 |
| Three-year program (with associate degree) | 0.773 |
| All the district | 0.806 |

C. Analysis of Difficulty Degree of the Exam

Difficulty refers to the degree of difficulty of the question. It is an index of suitable degree that the question is suitable to the knowledge and ability of the students, and also an important index to measure the quality of test paper. The difficulty of question is relative. Besides the examinee's level and the difficulty degree of the measured question, it is also related to such factors as paper making, test paper composing, and the knowledge and experience and adapted ness of the examinees. The calculation formula of difficulty is as follows: $P=K/N$ (K represents the average score; N represents full marks of the test paper).

It shows that the bigger the value of P is, the lower the difficulty will be; the smaller the value of P is, the higher the difficulty will be. In general, the average difficulty is controlled close to 0.7; we determine that if the value of P is less than 0.45, it represents "difficult"; the value between 0.45 and 0.75, it represents "medium"; while the value of P is more than 0.75, it represents "easy"; the proportion for the question level of "difficult, medium and easy" is adopted as 20%, 60% and 20% [2]. Generally speaking, the best test paper should be of the difficulty close to 0.5. When the difficulty is close to 0.5, the merits of students can be distinguished to the maximum degree [3]. However, in the practical evaluation process, the suitable degree of difficulty will also depend on the purpose of the examination. For the choice questions, the value of P should be more than the probability level. If the value of P is equal to the probability level, it shows that the subjects have answered the question by pure guesswork. If the value of P is less than the probability level, it shows that there are likely to be problems in the test questions.

The computer level examination in Guangxi colleges and universities consists of four answer modules and three optional modules. The analysis to the difficulty of the examination paper and all the modules has taken the one-level written examination in July, 2012 for example. The results are shown in Figure 1. From the analysis we can conclude that the examination paper as a whole is of smaller difficulty, with bigger difficulty difference among modules. The answer module 4(computer network technology) is relatively easier, while the optional module 3(information acquisition and release) is of bigger difficulty.
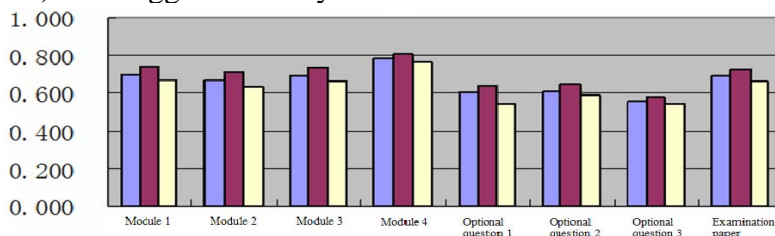


Notes: first, second and third column of each block in the figure respectively refers to colleges an d universities in the region, undergraduate education, and junior college education.

Fig.1. Analysis of the difficulty of level-1 written examination modules and the test paper

D. Analysis of the Differentiation Degree of the Exam

Differentiation degree refers to the degree to which the question distinguishes different examinees. In an examination paper with higher differentiation degree, good students get higher score and poor students low scores, which indicates it can distinguish the examinees of different levels in an examination paper with lower differentiation degree, the score difference between the good students and the poor students is so little that it cannot distinguish the examinees of different levels. Grouping at both ends method can be adopted to calculate the differentiation degree. The particular way is as follows:

1) Sorting all the examinees according to their scores;

2) 27% of the examinees will be sorted out as the high-score group (H), who are divided from the examinee of highest score; 27% of the examinees will be sorted out as the low-score group (L), who are divided from the examinee of the lowest score;

3) The following calculation will be done to each question of the examination paper: Respectively calculate the pass rate of each question in high-scored group and low-scored group. The pass rate of the high-scored group (PH) will then subtract the pass rate of the low-scored group (PL), and the gained value, D-value, is the differentiation degree of the question. The calculation

formula for differentiation degree of the question is: D=PH-PL, where D represents the distinction; PH represents the pass rate of the question in the high-scored group; PH represents the pass rate of the question in the low-scored group [4].

4) Calculate the weighted average value of distinction to all the questions, which will be used as D value, the differentiation degree of the examination paper.

$$D = \frac{\sum_{i=1}^{n} D_i f_i}{\sum_{i=1}^{n} f_i} \qquad (3)$$

Where n represents the number of questions; $D_i$ represents the distinction of question i; $f_i$ represents the weight of question i.

The differentiation degree D is between -1 and +1. Generally speaking, the differentiation degree of the question is generally required to be above 0.3. If D is no less than 0.4, it indicates that the question can be of well distinguishing function. If D is no more than 0.2, it indicates that the question can be of poor distinguishing function [5]. If D is a negative number, it indicates that there are some problems with the questions or the answers. Results of analysis to the differentiation degree of the examination paper in level-1 written examination in July, 2012 are shown in Figure 2. From the analysis we can conclude that module 4 (computer network technology) with a differentiation degree of less than 0.2, with poor differentiation degree and should be improved; while the differentiation degree of module 2, module 3, and optional module 1 is all more than 0.3, with good differentiation degree.
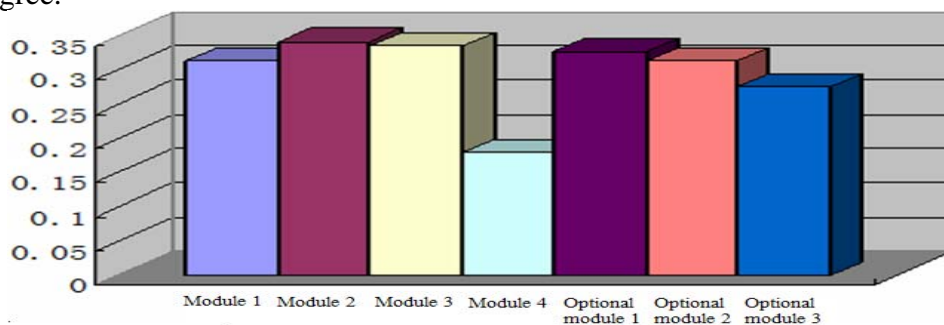


Fig.2. Distinction of each module of the level-1 written examination in July, 2012

## Improvement Measures to the Examination Paper Making

From the above analysis of validity, reliability, difficulty degree and differentiation degree of the written examination to computer fundamentals level-1 examination for Guangxi colleges and universities in July, 2012, we can conclude that the examination paper making is scientific and reasonable, and there is also something to be improved.

A. The Examination Paper Making Should Balance the Difficulty of Each Module of the Examination Paper.

From the analysis we can conclude that the optional module 1, 2, 3 is of bigger difficulty degree; especially the optional module 3 is of quite bigger difficulty degree. This module consists of 10 questions and aims to check the degree to which students have mastered the release information and the acquired knowledge. However, the number of questions with the correct rate less than 50% has come up to 4, which accounts for 40% of the total questions. The knowledge point that the 4 questions focus on is the fundamentals of webpage design, web technology. For that reason, we should make suggestion to the expert group that they should seriously consider the difficulty of corresponding knowledge points, which may also reflect the situation that there are teaching problems in this point in Guangxi colleges and universities.

B. The Examination Paper Making Should Fully Consider the Differentiation Degree of Students in Colleges and Universities.

This examination involves a wide range of examinees, which are different in knowledge foundations: the university students have mastered comprehensive knowledge, while the vocational college students are weak in part of the knowledge. Therefore, the examination paper making should

not only take into consideration the overall pass rate of Guangxi colleges and universities, but also distinguish the knowledge level of university students and the vocational college students. For example, in module 1-4, 80% of the knowledge points should be mastered by both the university students and the vocational college students, and 20% of the knowledge points should be better mastered by university students, which should be considered during examination design.

C.    Examination Paper Making Should not only Follow the Test Syllabus, but also Consider the Development of New Computer Technology.

The optional module 1-3 aims to check the degree to which students have mastered such knowledge as computer network technology, multimedia technology, information release and acquisition. With the fast development of computer technology, the test syllabus relatively cannot catch up with the current teaching trend, while the teaching should keep up with the latest technology in time; thus we suggest that 10-20% of the examination paper making should contain the latest technology.

## Conclusions

Guangxi Steering Committee of Computer Fundamentals Examination For Colleges and Universities has paid high attention to the exam quality analysis. Experts will be organized to analyze such quality index as validity, reliability, difficulty degree and differentiation degree of the examination afterwards, in order to get a comprehensive understanding to the examination paper making quality and the degree to which students in Guangxi colleges and universities have mastered the basic computer knowledge. The paper making experts will be organized for a closed-up study to the analysis results after examination, aiming to make a full preparation for paper making of next time. Every year, the examination analysis results will be submitted to the educational administration office and teachers of computer fundamentals, through such methods as the university computer fundamentals examination work conference of the whole autonomous region and the university computer fundamentals examination teaching seminar of the whole autonomous region, to promote the computer fundamentals teaching of all the colleges and universities. Of course, the analysis discussed in this article is only the overall work for examination of the whole autonomous region. Further research to the detailed analysis to every university will be made in the future, to form a college-edition analysis report as the quality reflection to the computer fundamentals courses of all the colleges and universities, to provide more targeted guide for the weakness of the different universities and colleges. The report can also make it easy for the universities to find problems, solve problems and improve the teaching quality.

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