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Full Length Research Article

A CORRELATIONAL STUDY OF STUDENTS 'THEORETICAL AND PRACTICAL EXAMINATIONS SCORES IN COMPUTER APPLICATIONS COURSES IN BAYERO UNIVERSITY KANO

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ABSTRACT
Computer Application Packages I and II are courses offered by students of Computer Science with Economics in Bayero University, Kano, Nigeria, in year 1 and year II respectively. The examination of all these courses consists of two aspects; the theory aspect and the practical aspect. These two aspects are vital and are expected to complement each other. In other words, for a student to do well in any of the courses, he/she must perform well in both the theoretical and practical aspects of the examination. This paper is aimed at finding the correlation that exists between students' theoretical and practical performance in the two courses. A total of 100 students that haven taken the two courses were used in this research. Using the Pearson Product Moment Correlation Coefficient, the Coefficients of Correlation obtained are 0.644, 0.560, 0.718, 0.909 and 0.454. These results showed that there is a statistically significant and strong positive relationship between students' theoretical and practical scores as a result of which the null hypotheses were rejected.

INTRODUCTION
Examinations are generally administered to test the level of students' understanding of subjects/courses that have been taught to them over a given period of time. In most subject areas, the examinations are theoretical; either in the form of multiple choice questions or essay questions. In a few subjects, such as Physics, Chemistry and Biology, where the course of study has a substantial practical component over and above the theoretical component, students are given both theoretical and practical examinations to test their understanding of each of the components studied. One would expect that theoretical examination results for a given set of students would be highly correlated to their practical examination results. Surprisingly enough, studies conducted in Potiskum, Yobe State, Nigeria, as explained in (Mohammad, 2011), for a set of 1200 senior secondary students taking Chemistry for their West African School Certificate (WASC) examinations showed little correlation between the performance of students in their theoretical and practical examinations. Other studies reported in (Nawaz, Mahmood, & Akram Rana, 2013) and (Jaishree, Saee, & Usha, 2014) have also given low correlation values. On the other hand, some other studies such as those in (Ajayi & Omole, 1999) and (Uwaifo, 2012) had fairly strong correlation figures.

In our research, we have tried to measure the correlation between the theoretical and practical examinations of students taking computer applications courses at the university level. In general, other than for students of Computer Science and related disciplines, such courses are aimed at teaching students how to practically use computer applications in their day-to-day personal or working lives. In many places where they are offered, the examinations at the end of the courses are theoretical rather than practical because of the logistic difficulties of setting up practical examinations. If the correlation here is also low, it would appear that examinations should focus more on the practical aspect of using the computer applications rather than on testing the theoretical principles. With more and more computer courses being introduced at the primary, secondary and tertiary levels of the educational system all over the world, it is important to ensure that the testing methods are aligned with both what is taught and ultimately its usefulness to the students.

Literature Review
There have not been many papers that have tried to analyze the correlation between student's theoretical and practical scores in the same course. The results appear to be mixed as far as the level of correlation is concerned. Notable among them include Omole and Ajayi (1999) that investigated the correlation between the theoretical and practical scores of students in some basic science courses at Kwara State College of Education, Nigeria. A sample of 110 students was used in their research. The correlations obtained were 0.41, 0.56, and 0.66 for Chemistry, Physics and Biology respectively, as a result of which their null hypotheses were rejected. Their results showed that there was a statistically significant relationship between students' theoretical and practical scores. Among the most related, involving a large sample size, is that of (Mohammad, 2011) that compared and tried to find the relationship between students' achievement in theoretical and practical aspects of chemistry MOCK WASC examination 2007-2009 session within Potiskum educational zone of Yobe State Nigeria. A total of 1200 SS3 students drawn from twelve secondary schools was used in their research. Their results showed that students performed better in the theoretical aspect than in the practical aspect of the MOCK examination but revealed that there was no significant correlation between students' achievement in the theoretical and the practical aspects of the examination. (Uwaifo, 2012) also investigated the relationship between students' theoretical and practical performance in Technology based subjects for a total of 75 students of Ambrose Alli University, Ekpoma, Nigeria. Correlation values of 0.61, 0.54 and 0.44 were obtained in the subjects Technical Drawing, Metal-Work Technology and Wood-Work Technology respectively. Their results showed that there was a statistically significant relationship between students' theoretical and practical performance. (Nawaz et al., 2013) also examined the relationship between Post-Graduate Science students' achievements in theoretical and practical examinations. Their study analyzed the exams of students enrolled in a two year master's program in the Department of Basic Sciences (Botany,

Chemistry, Zoology and Physics) at the University of Punjab, Pakistan. A sample of 1114 students was used. Their results showed that there is a weak correlation (<0.5) between the theoretical and practical scores of the students in all subjects except Zoology (>0.5). (Jaishree et al., 2014) also inspected the correlation between 40 students that have enrolled in the Bachelor of Dental Sciences (BDS) program in the year 2009 at the University of Maharashtra, Nagpur. The theoretical scores of these students in final year university examinations in the subject of Prosthodontics and Conservative Dentistry were compared with their scores in practical examinations of the same subject. Correlation coefficients of 0.177 and 0.250 were obtained. Their results showed that there was no correlation between students' theoretical and practical scores in the two courses.

With these diverse results, there is clearly no definitive answer as to whether or not there is a strong correlation between the theoretical and practical examinations scores of courses and subjects taken in secondary and tertiary educational institutions. Neither are there reasons to explain this large diversity ranging from strong correlation to no correlation at all. As new information and communications technologies (ICTs) offer ever newer and easier methods of evaluating and testing the performance of students, especially on the practical side, and as the theoretical and practical skills required for different professions keeps on changing, it is necessary to investigate further into the relationship between theoretical and practical examination scores.

METHODOLOGY

This research is aimed at studying the correlation between the theoretical and practical examinations for students taking computer applications courses at the university level. The data used is from the examination results obtained for students of Bayero University Kano Nigeria enrolled in the B.Sc. (Computer Science with Economics) program. As part of their program, they take 2 courses on Computer Applications Packages aimed at giving them practical working knowledge on popular office automation packages such as Microsoft Word, Microsoft Excel and Microsoft PowerPoint. Both courses focus on the same applications but the second course, after reviewing the contents of the first course, goes deeper and covers more advanced topics. At the end of each of these courses, students had to take theoretical examinations as well as practical examinations at the same time. While the theoretical questions were different from those of the practical examinations, they were all on the same subject area based on what was taught in the courses. The teaching method for all the courses was one in which the lecturer demonstrated on his/her computer through a projected screen and each of the students did the same thing on his/her computer.

The design of the study in this paper is "ex post facto" in which the researcher cannot manipulate the variables because their manifestations have already occurred (Psychology Glossary, n.d.) (Ajayi & Omole, 1999). The data from two sets of students that have taken the 2 courses namely Computer Applications Packages 1 in their first year and Computer Applications Packages II in their second year was analyzed using SPSS version 20.0 statistical tools. SPSS is a full-featured data analysis package that is specifically designed to handle large and complex data. It is now the most widely used package in both academic and business circles (Arkkelin, 2014).

Pearson Product-Moment Correlation Coefficient (r) analysis was used to find the relationship between their theoretical and practical examination scores. Correlation is a statistical method that is simple to calculate and interpret which is used to determine a possible linear association between two continuous variables (Mukaka, 2012). Pearson correlation is the most widely used correlation statistic to measure the degree of relationship between linearly related variables and whether and how strongly pairs of variables are related (Web Centre, n.d.). The Pearson correlation coefficient is a single value that measures the strength of the linear relationship between two variables (PennState Eberly College of Science, n.d.). A positive relationship signifies that the two variables increase at the same time while a negative relationship signifies that when one increases the other decreases. Most of the variables show some kind of relationship; however correlation can measure in one figure the degree of the relationship. Pearson correlation is ideal in our research as we want to measure the linear relationship between theoretical and practical examination scores. The main focus is to find out how much the score of a student in a theory exam is related to his/her practical results. Pearson correlation is selected because the examination scores are normally distributed. The normality of the data was determined using Kolmogorov-Smirnov (K-S) and the Shapiro-Wilk (S-W) tests as shown in Table 1.

Table 1: Tests of Normality of data

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Practical Exams	.061	100	.200*	.980	100	.060
Theory Exams	.070	100	.200*	.988	100	.327

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The calculated values for the normality test was then tested for significance using p< 0.05 level of significance. Since the p-value is greater than 0.05, we conclude that our data is normally distributed.

The actual data set consisted of 128 students but 28 were eliminated because their scores fell outside the range of the rest of the scores on the scatter plot as shown in Fig 1 and Fig 2. The 28 students were eliminated using the Interquartile Range Rule (IQR) which is a well-known method where lower and upper quartiles are determined, inner and outer fences are located and outliers (all data that are not within the inner fence) are removed (Seo, 2002). The outliers were removed in this research because Pearson correlation is very sensitive to them especially when dealing with a small data set like ours (Mukaka, 2012) (statstutor, n.d.). The exam scores of the outliers were so low that we believed their occurrence were suspicious. The remaining data set of 100 students was what was used for the analysis.

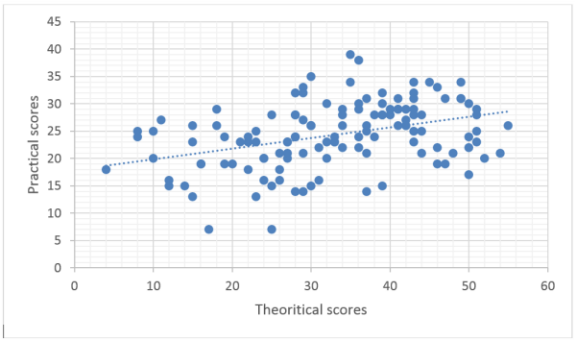

Fig 1: Scatter plot showing 128 students

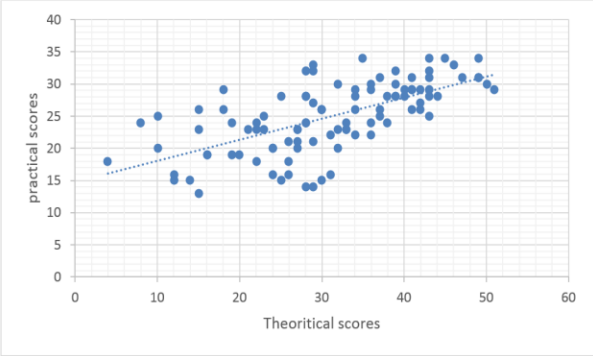

Fig 2: Scatter plot showing 100 students

In determining the relationships, the calculated correlation coefficients (r) are tested for significance using p< 0.05 level of significance. The p value is taken from similar projects (Ajayi & Omole, 1999), (Mohammad, 2011) and (Ebuoh, 2014). It determines whether or not the null hypotheses would be accepted or rejected. The correlation coefficient (r) was assigned qualitative interpretation based on Table 1 below:

Table 2: Correlation coefficient interpretation

Correlation coefficient	Interpretation
.00 - .19	Very weak
.20 - .39	Weak
.40 - .59	moderate
.60 - .79	Strong
.80 – 1.0	Very strong

Adapted from Beaumont (2012) and Hauke and Kossowski (2011).

The following research questions were used in this study:
RQ1: What is the correlation between students' theoretical and practical examination scores in the Computer Application Packages courses?
RQ2: What is the correlation between the students' overall performance in the Computer Applications Packages I course and the Computer Applications Packages II course?
RQ3: What is the correlation between students' practical scores in Computer Application Packages I course and their practical scores in Computer Application Packages II course?
RQ4: What is the correlation between students' theoretical scores in Computer Application Packages I course and their theoretical score s in Computer Application Packages II course?
Based on these questions, the following null hypotheses were formulated for this study:
H1. There is no correlation between students' theoretical scores and practical scores in the Computer Applications Packages course.
H2. There is no correlation between students' overall performance in the Computer Applications Packages I course and the Computer Applications Packages II course.
H3. There is no correlation between students' practical scores in Computer Application Packages I course and their practical scores in Computer Application Packages II course.
H4. There is no correlation between students' theoretical scores in Computer Application Packages I course and their theoretical score s in Computer Application Packages II course.
These null hypotheses resulted in the following alternate hypotheses for this study:
AH1. There is a correlation between students' theoretical scores and practical scores in computer application packages.
AH2. There is a correlation between students' overall performance in the Computer Applications Packages I course and the Computer Applications Packages II course.
AH3. There is a correlation between students' practical scores in Computer Application Packages I course and their practical scores in Computer Application Packages II course.
AH4. There is a correlation between students' theoretical scores in Computer Application Packages I course and their theoretical score s in Computer Application Packages II course.

RESULTS
The results for this study are shown in Tables 3, 4, 5, 6, 7 and 8 below. In Table 3, the analysis is for all the students for both courses and r= 0.644, at p=0.01. Since the p-value is less than the alpha value of 0.05, the null hypothesis is rejected and we conclude that there is a statistically significant positive relationship between a student's theoretical and practical examination scores.

Table 3: Correlation between students' theoretical and practical scores in Computer Application Packages

Examination Score	Sample size	Pearson Correlation Coefficient	P_Value
Computer Application Packages I and II	100	0.644	0.01

In Table 4, the analysis is only for the Computer Applications Packages I course and r=0.560, at p=0.01 showing that the strength of the correlation is only moderate and less than that for Table 3. However, when the same analysis is done for the Computer Applications Packages II course, as shown in Table 4. r=0.718, at p=0.01. Since the p-value in both Table 4 and Table 5 is less than the alpha value of 0.05, the null hypothesis is rejected and we conclude that the strength of the correlation is again strong meaning that the relationship between the theoretical and practical examination scores is stronger for Computer Applications Packages II course than it is in the Computer Applications Packages I course.

Table 4: Correlation between students' overall performance in the Computer Applications Packages I

Examination Score	Sample size	Pearson Coefficient	P_Value
Computer Application Packages I	50	0.560	0.01

Table 5: Correlation between students' overall performance in the Computer Applications Packages II

Examination Score	Sample size	Pearson Correlation Coefficient	P_Value
Computer Application Packages II	50	0.718	0.01

In Table 6, the analysis is again repeated but this time it is to test the relationship between the overall examination results for the Computer Applications packages I course and those for the Computer Applications packages II course. The results show that r = 0.919, at p = 0.01. From Table 2, this indicates that the correlation between the overall examination scores in the Computer Applications packages I course and the scores in the

Computer Applications packages II course is very strong; thus since the p-value is less than the alpha value of 0.05, the null hypothesis is rejected and we conclude that there is a statistically significant positive relationship between a student's theoretical and practical examination scores.

Table 6: Correlation between students' overall performance (theoretical plus practical) in Computer Application Packages

Examination Score	Sample size	Pearson Correlation Coefficient	P_Value
Computer Application Packages I and II	50	0.909	0.01

In Table 7, the analysis is to investigate the correlation between practical scores in Computer Application Packages I course and the practical scores in Computer Application packages II course, The results show that r=0.843, at p=0.01. From Table 2, this indicates that the correlation between the practical scores in the Computer Applications packages I course and practical scores in the Computer Applications packages II course is very strong; thus since the p-value is less than the alpha value of 0.05, the null hypothesis is rejected and we conclude that there is a statistically significant positive relationship between a student's theoretical and practical examination scores.

Table 7: Correlation between students' practical scores in Computer Application Packages I course and their practical scores in Computer Application Packages II course.

Examination Score	Sample size	Pearson Correlation Coefficient	P_Value
Computer Application Packages I and II (Practical Scores)	50	0.843	0.01

In Table 8, the analysis is to test the correlation between theoretical scores in Computer Application Packages I course and the theoretical scores in Computer Application packages II course. The results show that r=0.454, at p=0.01. From Table 2, this indicates that the correlation between the theoretical scores in the Computer Applications packages I course and theoretical scores in the Computer Applications packages II course is moderate; thus since the p-value is less than the alpha value of 0.05, the null hypothesis is rejected and we conclude that there is a statistically significant positive relationship between a student's theoretical and practical examination scores.

Table 8: Correlation between students' theoretical scores in Computer Application Packages I course and their theoretical scores in Computer Application Packages II course

Examination Score	Sample size	Pearson Correlation Coefficient	P_Value
Computer Application Packages I and II (Theory Scores)	50	0.454	0.01

RESULTS AND DISCUSSION

The results showed a statistically significant positive correlation between the students' achievements in theoretical and practical examinations. The correlation obtained for all the students that have taken the two courses is strong which suggests that there is a strong relationship between the results of the two types of examinations because they are on the same subject matter and both examinations are being done at the same time. This result is in conformity with earlier findings (Ajayi & Omole, 1999) (Uwaifo, 2012) which means that the score obtained by a student in the theoretical aspect of an examination can be used to predict his/her score in the practical examination of the same course. The fact that both the practical and theoretical examinations are being done together at the same time may explain the high correlation values compared to the other related studies such as (Mohammad, 2011) , (Nawaz et al., 2013) and (Jaishree et al., 2014) where the examinations were likely not done at the same time. It is also interesting to note that in the Computer Applications Packages I course which is taken by the students in their first year, the correlation between students' performance in theoretical and practical examination is less than for the Computer Applications Packages II course that is taken when the students are in their second year. This may well be because first year students are not familiar with this kind of practical examinations but it is seen that as the students become more familiar with practical examinations and take the Computer Applications Packages II course in their second year, the correlation becomes stronger.

The results depicted in Tables 3, 4 and 5 do not come as a surprise but what is perhaps puzzling is the result obtained in Table 6 where the overall examination results obtained in the first course, Computer Applications Packages I, exhibit a very strong correlation with the results of the second course, Computer Applications Packages II, that is even greater than the correlation observed between the theoretical and practical examination scores of either of the Computer Applications Packages courses. What is instructive here is that the higher correlation is for two examinations that are taken about one year apart compared to the correlation between examinations that are taken on the same day, indeed at the same time. This may however be because the contents of both courses are similar as earlier explained which would mean that the second simply strengthens the understanding of the first course.

The results of the study become even more interesting when the practical and the theoretical examination results are separately grouped together and the correlations between each of the groups are measured. The practical examination results of the two courses have a much higher correlation than those of the theoretical examinations. This is an important finding pointing to the fact that two practical examinations on similar subject matters are likely to be more co-related to their corresponding theoretical examinations because the practicals are more likely to be retained in memory and one is more likely to strengthen the other one over and above the theoretical that are less likely to be retained in memory.

CONCLUSION

This paper has investigated the correlation between students' theoretical and practical examination scores in two computer applications packages courses taken by university students. To accomplish this, recorded scores of two sets of students were analyzed using Pearson correlation coefficient (r) at $p < 0.05$ significant level. The correlation was measured from four different dimensions. The first was measured between the theoretical and the practical examinations and was found to be strong (r=0.644 at p=0.01). The second was measured between the overall results in

the first course and those of the second course and was established to be very strong (r=0.919, at p=0.01). The third was measured for the two practical examinations and was also found to be very strong (r=0.843, at p=0.01) but the fourth measured for the two theoretical examinations was established to be only moderate (r=0.454, at p=0.01). An attempt has been made to explain the differences in these correlation values.

While this paper may have started to answer the reason for the diversity in the correlation results between theoretical and practical examination scores of students, there is clearly the need to carry out more studies. First, it is necessary to investigate more thoroughly on a subject by subject basis. What is the difference for example between Woodwork and Computer Applications? Secondly, there is the need to do these studies at the primary, secondary and tertiary levels and identify the differences, if any, amongst the various levels. Thirdly, and this is probably the most interesting part, there must be more research on how to set practical and theoretical examinations that would exactly test the knowledge and skill sets of students that are being prepared to optimally operate in our increasingly complex knowledge society of today. This paper has investigated the correlation between students' theoretical and practical examination scores in two computer applications packages courses taken by university students. To accomplish this, recorded scores of two sets of students were analyzed using Pearson correlation coefficient (r) at p <0.05 significant level. The correlation was measured from four different dimensions. The first was measured between the theoretical and the practical examinations and was found to be strong (r=0.644 at p=0.01). The second was measured between the overall results in the first course and those of the second course and was established to be very strong (r=0.919, at p=0.01). The third was measured for the two practical examinations and was also found to be very strong (r=0.843, at p=0.01) but the fourth measured for the two theoretical examinations was established to be only moderate (r=0.454, at p=0.01). An attempt has been made to explain the differences in these correlation values.

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