Correlation between Reading Comprehension Skills and Students' Performance in Mathematics

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Article Info	ABSTRACT
	The deteriorating performance of Filipino students in the national and international mathematics tests for the last decade has become a major challenge to Philippine education. The Department of Education attributed this problem to students' poor reading comprehension. Previous studies showed varied findings on the association between variables in reading and mathematics. The present study utilized the six elements of reading comprehension skills to determine their relationship to students' performance in mathematics. A total of 666 students belonging to the randomly selected first year classes from 18 public and private high schools were taken as sample. A correlation research design was used and a competency-based achievement tests in reading comprehension and mathematics were the research instruments. Students in private schools performed better in reading comprehension skills and mathematics than their counterparts. While reading comprehension skills were insignificantly correlated to private school students' mathematics performance, the case is different in public schools wherein three skills namely understanding vocabulary in context, getting main idea, and making inference surfaced to have connection with mathematics. The overall students' reading comprehension skills were not significantly correlated to mathematics performance. Hence, the poor mathematics performance could be explained by other factors not related to reading comprehension skills.

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1.   INTRODUCTION

Mathematics education in the Philippines is one of the priority concerns of the Department of Education (DepEd). The dismal state of mathematics achievement of high school students was evident in the results of international, national and regional mathematics tests. For instance, the performance of Filipino students in the 2003 Trends in International Mathematics and Science Study (TIMSS) in which the Filipino second year high school students ranked 41st in math out of 46 participants, stuck at the bottom while struggling at a passing level locally [1]. Students' performance in the National Achievement Test (NAT) was even more discouraging [2]. Some one million fourth year students' NAT in 2003-2005 had only ten percent mastery in mathematics [3]. Students' NAT for four succeeding years (2006-2009) in both elementary and secondary levels registered below mastery level of 75 percent.

Unfortunately, the international and national trend of Filipino students' poor performance is also reflected in both regional and local levels. This corroborates with Barton, Heidema and Jordan's [4] view that

mathematics, along with science content area texts, are identified as the most difficult to understand by elementary graders and high school students. Proof of the low performance was apparent based on 2006 NAT results wherein Region XII sank 2nd from the bottom among the 16 regions after Autonomous Region in Muslim Mindanao (ARMM). More seriously, Cotabato City Division for the last three school years (2006-2008) was placed at the bottom among nine (9) divisions in Region XII, with Mean Percentage Score (MPS) in English and Mathematics of below 50 percent. Likewise, private school students obtained similar performance of "below average" in the achievement tests conducted by Notre Dame Educational Association (NDEA) exclusively among its member-schools in Regions XII and ARMM [5]. Recently, the result of 2010 Regional Achievement Test given to second year students in both public and private schools in Cotabato City showed that they performed low mastery level with MPS ratings of 45.16% in mathematics. Hence, the alarming performance of the Filipino students in mathematics locally, nationally and internationally necessitates urgent decisions and actions from all education sectors.

Looking particularly into the NAT results, DepEd singled out low reading competence as a primary factor for the failure of public school students in mathematics [3]. Along this line, appropriate measures were undertaken to improve students' performance in English and mathematics. Some of these measures included implementing various reading programs of the DepEd, training of mathematics teachers, and strengthening the use of English language as a primary medium of instruction in all public institutions of learning at the secondary level [6]. Despite all these government efforts to improve the quality of mathematics performance as well as reading skills, the problem on these two areas still persist.

With this problematic condition, reading cannot be taken for granted if mathematics performance needs to be enhanced. Snow, Burns, and Griffin [7] point out that reading particularly in the early years of schooling paves way to achievement in other content areas like mathematics. Reading is regarded as an indispensable part of mathematics and "mathematical knowledge". Learning to love and value mathematics language requires a good foundation in reading [8], [9]. Fuentes [9] maintains that mathematics and reading go together, i.e. improving mathematics achievement necessitates enhancing students' reading. For him, it is also vital to recognize that young learners develop reading and mathematics skills at different rates.

Barton, et al. [4] stress that reading mathematics alone does not only involve comprehension of texts but also entails "special reading skills" which are not adopted in other subject areas. Thus, students are expected to possess an ability to decode and understand "scientific and mathematical signs, symbols and graphics", read mathematics texts arranged differently, and "interpret information" given in an unusual manner (p. 25). Fuentes [9] adds that mathematics deals with natural thought and language processes as well. As cited by Roe and Taube [10], Niss and Højgaard Jensen describe mathematical knowledge with eight competencies which includes competence of communication, i.e., the capacity to interpret and comprehend mathematical texts. In so doing, it illustrates that reading and reading comprehension could be more clearly incorporated in mathematics instruction, learning and examinations [8], [9].

The dramatic change on the theories of learning from behavioral to holistic approach in the turn of 20th century has also changed the thinking about reading comprehension from merely a static activity in the past into a dynamic process where readers create meaning from the written text [11].This reader-text interaction describes how reading comprehension takes place which provides impact to new learning situation such as understanding mathematics. When considering reading as a factor identified to have bearing on students' performance in mathematics achievement test [9], it is important to take a look at how both areas are related.

Since reading was established as a tool in learning other fields including mathematics [12], [13], various researches have been undertaken to examine the relationship of the two especially on the aspect of comprehension which is a critical skill to perform understanding of mathematical process [14]. Success in reading is seen as a significant measure achievement in mathematics. Previous studies reveal the existence of close relationship between mathematics performance and reading skills [15], reading ability and performance on mathematics items assessing higher level cognitive skills [16], language and test performance on mathematics word problems [17], and early reading skills and changes in mathematics [18]. The connection between language skills and mathematics has been supported by early developmental theory [19], [20], illustrating that language skills are believed to develop number concepts to have an association to numerical skills [19] although this link is affected by difficulty of learning language and mathematics.

2. RESEARCH METHOD

The study used correlation research design. It described the performance level of first year students in reading comprehension skills and performance in Mathematics and explained the significant difference between private and public high school students' overall performance in the two learning areas. It further investigated how related all the elements of reading skills to students' performance in Mathematics are.

The study had 666 student-respondents from public high schools (337) and private high schools (329) in the Division of Cotabato City. Majority of the respondents belonged to the Muslim group in the Southern part of the Philippines.

There were three stages of sampling procedure that were undertaken like selection of schools, selection of first year classes, and selection of student samples. In the selection of public schools, the study used complete enumeration. For private schools, the study employed simple random sampling to get nine (9) schools out of eighteen (18) to match the number of the public schools included in the study. Considering that only first year classes were target respondents, the study randomly selected one section among first year classes in all participating schools using lottery technique. Then, all students in the selected sections were taken as respondents using complete enumeration.

The instrument used in the study was adopted from the study of Imam [21] which is composed of 100-item multiple choice test in Reading Comprehension and Mathematics. The reading comprehension test covered the following areas: understanding vocabulary in context (7 items), identifying main ideas (6 items), noting details (11 items), making inference (8 items), predicting outcomes (6 items) and drawing conclusion (12 items). The test items were based on Restructured Basic Education Curriculum Learning Competencies (RBEC-LC) in reading for first year. With the use of Table of Specification (TOS), the items were distributed following the DepEd guidelines where total items are distributed as follows: 60 percent easy, 30 percent average, and 10 percent difficult. Mathematics achievement test was also based on the RBEC-LC covering competencies for first and second grading periods. The test was also constructed following the same DepEd guidelines as in the reading test and the TOS.

Validity and reliability testing of the research instrument were done. Experts in English and Mathematics validated the instruments with the use of four criteria: (a) conformity with the objectives, (b) clarity and construction, (c) level of difficulty, and (d) relevance and suitability [22]. Test items which failed to meet the criteria were rejected. Experts rejected four items in Reading Comprehension, and three items in mathematics. The rejected items were then modified to satisfy the validation criteria.

The instruments were tested for its reliability through the use of test-retest method. These were administered to 15 students from public schools and another 15 from private schools for pilot testing. With one month interval, the tests were given twice to the same students. The scores of students in the first and second tests were correlated using Pearson r correlation coefficient to test how consistent the scores are. The results showed that the scores are significantly correlated with the following correlation coefficient values: Reading Comprehension .670** and Mathematics .596. The test was set at 0.05 level of significance.

The data obtained were analyzed to address the specific problems of the study. Statistical tools such as frequency, mean and percentage were used to get the Mean Percentage Score (MPS) of students and the level of students' performance in reading comprehension skills and mathematics. Analysis of Variance (ANOVA) was used to find out the significant difference of the performance of students in reading skills and in mathematics in public and private schools. The Pearson product moment coefficient of correlation (r) was employed to establish the relationship between reading comprehension skills and students' performance in mathematics. All tests were set at 0.05 level of significance.

3.   RESULTS AND ANALYSIS
3.1. Level of Students' Performance and the Difference between the Performance of Public and Private School Students in Reading Comprehension Skills

Following the National Achievement Test's descriptive categorization to explain students' performance in reading comprehension skills, the level of performance is classified as mastery, near mastery, and low mastery. These categories of performance were based on students' overall Mean Percentage Score (MPS) that was computed using the following equation: MPS is equal to the product of Total Raw Score divided by the Product of N and Total No. of Items multiplied by 100. This categorization was derived as follows: MPS of 75% and above (mastery level), MPS of 50% to 74% (near mastery), and MPS of 49% and below (low mastery). In addition, the reading performance of students was also described using percentage to show the students' mastery level in each of the reading comprehension skills.

Data on Table 1 shows that students performed near mastery in two reading skills (getting main idea and making inference) and low mastery in another four skills (understanding vocabulary in context, noting details, predicting outcome, and drawing conclusion) which indexed the overall reading performance of most students (59 percent) at low mastery level in reading comprehension skills (with MPS of 47.3). It is surprising to note that students even performed low mastery in skills such as vocabulary and noting details which Calahan and Clark [12] considered as the easiest skills.

Table 1. Level of Reading Comprehension Skills of Students (N=666)

| | Performance Level in Six Reading Comprehension Skills | | | | | | |
	UVC	GMI	ND	MI	PO	DC	Overall
Public Schools							
Mastery	3.9	10.1	7.7	13.9	20.1	2.7	.6
Near Mastery	40.7	54.0	35.0	44.8	31.3	26.7	33.5
Low Mastery	55.5	35.9	57.3	41.2	48.6	70.6	65.9
MPS	45.49	48.66	47.53	48.66	44.61	39.14	45.20
Private Schools							
Mastery	10.0	15.8	14.3	24.0	20.1	6.1	5.8
Near Mastery	45.0	55.9	34.3	43.5	31.3	33.1	42.2
Low Mastery	45.0	28.3	51.4	32.5	48.6	60.8	52.0
MPS	52.37	53.93	50.68	54.14	48.28	42.48	49.59
Both Public and Private Schools							
Mastery	6.8	12.9	11.4	18.8	15.2	4.1	3.2
Near Mastery	42.8	54.5	34.1	44.4	35.9	30.2	37.8
Low Mastery	50.5	32.6	54.5	36.8	48.9	65.8	59.0
MPS	48.88	51.23	49.09	51.37	46.42	40.79	47.37

Legend:
Mastery -75% and above MPS   UVC – Understanding Vocabulary in Context   MI – Making Inference
Near Mastery - 50% to 74% MPS   GMI – Getting Main Idea   PO – Predicting Outcome
Low Mastery - 49% and below MPS   ND – Noting Details   DC – Drawing Conclusion

By comparison, students in private schools were above the overall mean and close to near mastery (49.59 MPS), while their counterpart in public schools scored below overall MPS (45.20 MPS). In addition, while the former gained near mastery level in four reading skills, the latter performed low mastery level in all skills. However, it is observed that predicting outcome and drawing conclusion were the two most difficult skills for students since even those in private high schools performed low mastery in these skills. This confirmed Calahan and Clark's [12] grouping of these skills to be at the third (highest) level.

The two MPS scores gave an overall difference of 4.39 percent between public and private schools. Results of the ANOVA (Table 2) rendered it statistically significant (F = 15.669, p<.05) in favor of the private schools. This implies that private school students had better reading comprehension skills than their counterparts in public schools. This also means that those students who utilized the benefits of having more adequate reading materials, and small number of students to handle during reading sessions, and more effective management of school programs [23], [24] performed better in reading test.

Table 2. ANOVA Result on Difference between Public and Private School Students' Performance in Reading Comprehension Skills

Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	803.508	1	803.508	15.669	.000
Within Groups	34050.276	664	51.281		
Total	37841.978	665			

The decline in performance of public school students in reading comprehension would make one to ponder the effect of various reading programs [21] and major education inputs like 1:1 textbook in key subject areas such as math, science and English, makabayan and Filipino [25], [1] which DepEd and other stakeholders poured into Philippine basic education. This only shows that these reading-related resources are not enough to improve reading competence of public high school students. On the other hand, the moderately extensive and well functioning library collections and services of private secondary schools as found out by Flores [24] seemed to have an effect on students' reading performance particularly on their four skills registered at near mastery level. However, it is observed in the data that even private high school students showed low mastery on skills categorized by Calahan and Clark [12] as belonging to the highest level like predicting outcome and drawing conclusion.

3.2. Level of Students' Performance and the Difference between the Performance of Public and Private School Students in Mathematics

Performance in mathematics is investigated in this study using the students' overall MPS similar to the reading comprehension skills. As presented in Table 3, results showed that 78.7 percent of students registered low mastery in mathematics (37.43 MPS) as both students in public (35.42) and private (39.49) schools performed in the same way which indicates that students are poor in this subject.

Table 3. Level of Students' Performance in Mathematics (N=666)

	Mastery	Near Mastery	Low Mastery	MPS
Public School	.6	15.7	83.7	35.42
Private School	2.7	23.7	73.6	39.49
Both Public and Private	1.7	19.7	78.7	37.43

Legend:
Mastery -75% and above MPS
Near Mastery - 50% to 74% MPS
Low Mastery - 49% and below MPS

The present finding runs consistent with the result of 2002 NAT given to first year students who obtained low level performance with an MPS of 32.09. Having same level of performance in 2005-2006 NAT, both fourth year male and female students had low mastery level with an MPS of 47.25 and 48.52, respectively [1] .This means that the mathematics performance of students has not improved and remained at low mastery level since the achievement test was given in 2002.

The students' poor performance in mathematics puts into question various supports given by government to both public and private schools aimed at improving quality of mathematics education [21] and this consistent low performance posts not only a problem to schools but also to the society as a whole which helps provide a positive attitude for mathematics like strong collaboration among stakeholders [26] .

Table 4. ANOVA Result on Difference between Mathematics Performance of Public and Private School Students

Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	689.741	1	689.741	13.342	.000
Within Groups	34328.055	664	51.669		
Total	35017.796	665			

Projected in Table 4 is the result of ANOVA test which answered the question on whether or not there is significant difference in students' math performance between public and private schools. The data shows that the difference of 4.07 in the performance of private school students over public schools students was statistically significant (F = 13.342, p<.05) which denotes that students in private schools had better mathematics education compared to those in public schools. This finding implies that private schools could be a significant asset of DepEd to contribute to overall students' mathematics performance in the national achievement test.

3.3. Correlation between Reading Comprehension Skills and Students' Performance in Mathematics

Literatures and studies cited earlier pointed out how reading plays a vital role in learning and subsequently projecting good performance in mathematics [12], [9], [27], [13]. It can be observed, however, that the findings also differed on the kind of reading skills related to mathematics. Table 5 presents data showing coefficient values between and among elements of reading comprehension skills and separate and combined mathematics performance of students in public and private schools.

As shown in Table 5, there is positive significant relationship between six reading skills and mathematics performance of students in public schools but the coefficient value shows weak relationship (r = .162**, p<.05) which means the students' poor performance in mathematics is not primarily caused by their poor reading skills. Although the study may support consistent findings indicating similar relationship between reading comprehension and mathematics achievement [28] for the past decades, it posits that such relationship can be ignored. This disagrees with DepEd claim factoring poor reading comprehension skill in the failure of public school students' mathematics performance in NAT [3], since the present finding showed reading as not strongly influencing students' scores in mathematics test.

Table 5. Correlation Coefficient of Reading Comprehension Skills and Students' Mathematics Performance in Public and Private Schools

Reading Comprehension Skills	Public (N=337)		Private (N=329)		Both Public and Private (N=666)	
	r Coefficient	Sig.	r Coefficient	Sig.	r Coefficient	Sig.
Understanding Vocabulary in Context	.129*	.018	-.003	.962	.074	.056
Getting Main Idea	.127*	.020	-.127*	.021	-.005	.893
Noting Details	.044	.259	-.031	.576	.044	.259
Making Inference	.145**	.008	-.023	.679	.071	.066
Predicating Outcome	.069	.209	-.036	.520	.018	.636
Drawing Conclusion	.050	.357	.002	.967	.036	.348
Overall r Coefficient	.162**	.003	-.043	.442	.059	.131

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

It is also observed in Table 5 that three reading skills namely understanding vocabulary in context (r = 129*, p<.05), getting main idea (r = .127**, p<.05), and making inference (r = .145**, p<.05) had positive significant correlation with mathematics performance. This finding is consistent with previous researches which found similar relationship between these reading skills and mathematics. For instance, Zepp [28] revealed that vocabulary knowledge is one of the skills which significantly correlated to algebra scores and various problem solving abilities in mathematics. As reported by Imam [5] Barnes found that finding main idea and making inference are needed skills to solve math problems. In another study by Bond as cited by Hollander [30], it found that making inference is among the reading skills which are necessary in mathematics. However, these studies failed to identify the strength of relationship which the present finding considered as weak.

In the case of students in private schools, reading skills were not significantly correlated to their mathematics performance (r = .043, p>.05) as reflected in Table 5. This means that students' performance in mathematics is independent of whatever level of reading skills they acquired. Moreover, this indicates that there may be other reading skills or factors which are more associated to achievement level in mathematics; hence, the findings made by DepEd-DOST-SEI studies did not hold true to students in private school. Moreover, it is significant to note that getting main idea had negative significant correlation with mathematics performance (r = -27**, p<.05) which implies that the use of this skill could even make negative impact to student's performance in mathematics as opposed to findings by Barnes as cited by Imam [5].

Table 5 further shows that the overall students' reading skills were not significantly correlated to their mathematics performance (r = .059, p>.05). This indicates that students' combined low mastery level in mathematics test (37.43) as shown in Table 3 was not generally attributed to any of their combined reading skills. Their combined scores in reading comprehension (47.37) in Table 1 which was higher than their mathematics scores were immaterial to project their mathematics performance. The present finding supports Villa's [29] finding of 58 students enrolled from six through eleventh grades using their scores in 2006 Stanford Achievement Test. The study reported that although reading skills were correlated to mathematics, these correlations were not strong as one may assume. It was also found that results from the student problem-solving sessions revealed that students may read and understand word problems with a high reading score but they may have difficulties on "decoding and setting them up". This further indicates that there may be another set of skills for student success in mathematics problem solving other than the reading skills. This implies that since DepEd has already included private schools in NAT for the last two years, other factors or reading skills, not included in the study, have to be examined to address the declining performance of students in Mathematics.

4. CONCLUSION

Based on the findings, the poor reading comprehension skills of students is consistent with their performance in mathematics. By comparison, however, students in private schools performed better in these two areas than students in public schools. The performance in mathematics of students in public schools may be attributed to their reading comprehension skills while that of students in private schools cannot be factored

in to their reading comprehension skills. On another account, reading comprehension skills of students had no direct bearing on their overall mathematics performance implying that other factors not related to reading should be explored to explain students' poor performance in mathematics.

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