

Effect of Peer Assessment Skills on Ghanaian Senior High School Students' Achievement in Mathematics

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Abstract

The study investigated the effect of peer-assessment skill training on students' achievement in Mathematics. The non-equivalent pre-test and post-test control group 2x2x2 factorial quasi-experimental design was adopted for the study. Two public senior high schools were randomly sampled to participate in the study and a total of eighty-seven (87) students made up of forty-five (45) in the experimental groups and forty-two (42) in the control group were selected from Central Region of Ghana. Students participated in the study as intact classes. Two Mathematics achievement tests, with acceptable reliability coefficients of 0.79 and 0.83 were developed by the researcher for data collection. Again a peer-assessment module was developed by the researchers for the intervention. The module was content validated by three experts using percentage of agreement. ANCOVA and independent t- test were used to test the hypotheses at 0.05 level of significance. The findings of the study were that: there was significant effect of peer-assessment skill training on students' achievement in Mathematics. Again, there was no significant sex and age influence on students' peer-assessment skill training group. Based on the findings, it was recommended that teachers should use peer-assessment skill strategy in teaching Mathematics lessons to bring about the much needed improvement in students' performance in Mathematics.

Key Words: Peer-assessment, Students achievement, gender, age and core mathematics

Introduction

Peer-Assessment is the process in which learners assess, critique, make value judgment and express their views on the quality and standard of work of other learners, and providing feedback to peers to enhance their performance. Peer-assessment is conceptualized as an educational arrangement where students judge peers' performance by providing grades and / or offering written or oral feedback (Topping, 1998). Sadler and Good (2006), concluded in a study that, the use of scoring rubrics as peer-assessment tool for learning contributes to the excellent performance among secondary school students. There is growing rhetoric in research on the question of

whether to involve students in classroom assessment through self- and peer-assessment. Black (1998) opined that peer- assessment by students is motivated by benefits gained from their meta-cognitive reflections in relation to their work. Andrade and Valtcheva (2009) opined that within the global assessment for learning movement peer-and self-assessment have been promoted as strategies that actively involve pupils in the process of assessment. Peer and self- assessment in primary and secondary schools have been shown to engage and empower students to develop pupil's self-regulation and meta-cognition. Again, the two skills help to improve students' communication skills and create better students understanding of the criteria used to evaluate their work (Topping, 2003). Aronson (2000) opined that no student could succeed unless they worked well together as a team. This team work facilitates interaction among all students in class, leading to value each other as contributors to their common tasks. Cho and Cho (2011) stated that positive peer-assessment is beneficial only if it incorporates task-related information rather than just affective comments.

Black and Williams (1998b) posited that peer- assessment processes involve; establishing rapport and creating awareness of the key processes, giving out samples of students work from another class, distributing instructional rubrics (success criteria), and explaining how to grade students work to all participants. It also allows students to assess sample work using instructional rubrics as training and plenary discussion of the sample work on approaches and change. Peer-assessment is also built on the notion of collaboration, which assumes that learning emerges through shared understandings by multiple learners and that learning effectively occurs within interactive peer groups (Leidner & Jarvenpaa, 1995). Topping (2003) stated that there are complexities in the form of peer- assessment format in that it requires understanding of the goals of the tasks, the criteria for success and the ability to make judgement about the relationship of the product or achievement. He attributed these complexities to the fact that the peer-assessment skills comprised a set of constituents' skills that a student must have in order to be able to implement assessment effectively. Peer-assessment is much more than students' marking their own or each other's work.

To improve learning, it must be activity that engaged students with the quality of their work and helped them reflect on how to improve it. Peer-assessment enabled students to give each other valuable feedback so that they can learn from and support each other to improve their achievement (Ryan, Marshall, Porter & Jia 2004). Despite numerous advantages of peer- assessment mentioned within the pedagogical discourse, studies have reported that its success that is, the extent to which students utilise feedback to improve their work and ultimately their learning is conditioned to a number of interrelated factors including, the type of feedback, the source of feedback and students' perceptions of the usefulness and importance of the feedback (Van Zundert, Sluijsmans and Van Merriënboer ,2010). However, Lu and Law (2012) stated that the learning effects of positive and negative feedback varied depending on the level of students' tasks commitment. Students who had high task commitment are more likely to learn from positive feedback for self- confirmation than students who had low task commitment are more likely to learn from negative feedback as a motivation factor to improve them. Goodrich and Boulay (2003), concluded a study on writing performance when students were supported by rubrics and self-assessment. They reported positive effects only for some groups investigated and the results sometimes differed between gender and age differences.

There is wide spread view that, students' achievements (e.g. in mathematics) generally is poor. A number of researchers have also attributed this to the teaching strategies employed by teachers. Therefore, the teachers' correct understanding of appropriate teaching methods and effective factors influence many motivational variables of learners for example the tendency to peer assessed fellow students. Adesoji (2008) advocated the use of discovery method in the teaching and learning process which motivates students to make self-discovery and be as self-reliance as possible.

Other teaching methods which as well can motivate students to make self-discovery and be as self-reliance include, mastery learning, peer-assessment skill and critical thinking skill among others. This study however, focuses on the use of peer-assessment as a method of teaching which helps students to follow the teacher in

solving mathematical problems and mastery of the subject. Cobbinah (2011), stated that the performance of students in core mathematics has been poor and attributed it to the teaching methods employed in the various classrooms. The researcher opined that the type of teaching that goes on in the classrooms was more of teacher centered and this did not promote innovation and self-discovery which are necessary for an improved performance by students. Again, the results of the examination conducted by West African Examinations Council have consistently revealed poor students' performance in mathematics (WAEC, 2011). As a result, many students enrolled for private tuition to better their grades in either Mathematics or English Language as this has been the order of the day after their unsuccessful normal three years of their senior high school education. This situation has made researchers and other stakeholders in education to ask whether teachers use the appropriate teaching methodology during mathematics lessons. Do they also consider if the use of appropriate teaching methods could ensure success and make room for effective teaching and learning? Generally, reviewed literature indicated that research findings on the effects of age, sex, and peer-assessment skills on students' achievement were inconclusive. Therefore, there is the need for further research in this study to establish their veracity or otherwise in Ghana. On peer-assessment, Sadler and Good (2006), concluded in a study that, the use of scoring rubrics as peer-assessment tool for learning contributes to the excellent performance among secondary school students.

Goodrich and Boulay (2003), on the other hand, concluded a study on writing performance when students were supported by rubrics and self-assessment. They reported positive effects only for some groups investigated and the results sometimes differed between sex and age. It appears to the best of the researcher's knowledge that not much research of this nature has been done in Ghana. This therefore motivated the researcher to undertake the study to investigate the effect of peer-assessment skill training on Ghanaian senior high school students' achievement in mathematics.

Purpose of the study

The purposes of the study were to identify the effect of peer-assessment skill training on students’ mathematics achievement as well as to investigate whether there is a significant effect of mathematics achievement of Ghanaian senior high school students based on sex and age.

Research Hypotheses

1. There is no significant effect of peer-assessment skill training on Ghanaian senior high school students’ achievement in mathematics.
2. There is no significant effect of sex on Ghanaian senior high school students’ achievement in mathematics in the treatment group.
3. There is no significant effect of age on Ghanaian senior high school students’ achievement in mathematics in the treatment group.

Methodology

The research design for this study was a 2x2x2 factorial quasi-experimental design. The independent variable in the study was peer-assessment skill training, age and sex are intervening variables and achievement in mathematics is the dependent variable. Two intact classes were used for the study. In this design the dependent variable was measured before and after the treatment or intervention as depicted below:

Assignment	Group	Pre-test	Treatment	Post-test
(Peer-assessment)	1	O ₁	X ₁ (Sex, Age)	O ₃
.....				
(Control)	2	O ₂	---	O ₄

Figure 1: 2 x 2 x 2 Factorial Quasi-Experimental Design

Group 1 = Peer- assessment, O₁ = first observation for PA, X₁ = treatment for PA
 O₃ = second observation for PA

Group 2 = control, O_2 = first observation for control, O_4 = second observation for control

--- = intact groups no randomization

Gender and age = intervening variables

The population for this study comprised all senior high school students in the Central Region of Ghana. The target population consisted of all male and female senior high school form two students. Purposive sampling technique was used to select Cape Coast Metropolis from the twenty districts in the selected region. This was done against the background that Cape Coast Metropolis had similar student characteristics like the other 19 districts in the Central Region. There are 52 public senior high schools in the Central Region, out of which 10 are located in the Cape Coast Metropolis. Senior high schools in Cape Coast Metropolis consisted of three groups namely co-educational, boys only and girls' only. This is made up of 5 co-educational senior, 3 boys and 2 girls' single sex schools. From the list of schools, the co-educational schools were purposively chosen because both the male and female students received tuition in the same classroom.

Using simple random sampling technique, two schools were sampled from the co-educational senior high schools and one was exposed to experimental treatments while the second constituted the control group. The two intact classes chosen from the senior high schools used for the study do the same programme and it was to ensure uniformity and fairness. A total of 87 students were sampled from two schools namely Ghana National College and Christ the King Senior High School. The instrument for data collection had both multiple choice and essay sections. Kuder-Richardson formula 20 was used to estimate for the internal consistency of the multiple mathematics achievement tests because of its appropriateness for dichotomously scored homogeneity of the items. The inter-rater reliability was used for the essay section of the instrument. Reliability coefficients of 0.79 and 0.83 for pre-test and post-test respectively

were obtained for the two instruments and are deemed reliable for use in this study. The validity of the module was done using the percentage of agreement. Three senior lecturers in mathematics education from the University of Cape Coast were used to validate the module for its content relevance and its suitability for soliciting the relevant information. This yielded 87% of the validity using the percentage of agreement. The data collection was done in two sessions. During the first session the participants were administered with the Mathematics Achievement Test, MAT (Pre-test). The participants in the experimental group were exposed to peer-assessment skill training and the control group only received the normal classroom teaching using some selected topics. The participants that received the treatment were those in the experimental group. There were 16 sessions for each of the treatment groups (peer- assessment group) as well as the control group. An outline of each session's activities for both experimental and control groups were done. At the end of the training programme, the instrument, MAT (post-test) was administered to the training and control groups during the second session. This was done to find out if training had any effect on the achievement of participants. The test statistic adopted for the analysis of the research hypotheses were ANCOVA and independent sample t-test. All the hypotheses were tested at 0.05 level of significant.

Results and Discussion

Hypothesis 1: *There is no significant effect of peer-assessment skill training on senior high school students' achievement in Mathematics.*

Table 1: ANCOVA Test of Difference in Post-test Mathematics Performance between Peer-assessment Skill Training group and Control Group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8534.925	2	4267.462	41.646	.000	.498
Intercept	7169.223	1	7169.223	69.964	.000	.454
Pretest	1160.954	1	1160.954	11.330	.001	.119
Group	2253.762	1	2253.762	21.994	.000	.208
Error	8607.489	84	102.470			
Total	291657.000	87				
Corrected Total	17142.414	86				

a. R Squared = .498 (Adjusted R Squared = .486)

A one-way between group analyses of covariance was conducted to find the effect of peer-assessment skill training on senior high school students' mathematics achievement. Preliminary checks were conducted to ensure that there was no violation of the assumption of normality, linearity, homogeneity of variances, homogeneity of regression slopes and reliable measurement of the covariate. After adjusting for pre-intervention scores, there was significant difference between peer-assessment group and the control group on post -intervention scores on the mathematics achievement test, $F(1, 84) = 21.99$, $p 0.000$. This suggests that the peer-assessment skill training was very effective in improving the mathematics performance of students. This seems to support the finding on peer -assessment by Sadler and Good (2006) who concluded in a study that, the use of scoring rubrics as peer-assessment tool for learning contributes to the excellent performance among secondary school students. The current finding

possibly may be as a result of team work and commitment exhibited by the students during the intervention.

Hypothesis 2: *There is no significant effect of gender on senior high school students' achievement in mathematics in the treatment group*

Table 2: Independent Sample t-test for Differences between Males and Females in the Post-test Scores of the Peer-assessment Group

Group	N	Mean	SD	df	t- value	p- value
Male	18	65.50	11.137			
				43	0.195	0.846
Female	27	64.78	12.804			

An independent sample t- test was conducted to compare the post mathematics achievement test scores of males and females. There was no significant difference in scores for males (M = 65.50, SD = 11.14) and females (M= 64.78, SD = 12.80; t (43) = 0.195, p = 0.846, two tailed). Since $p > 0.05$ there is no significant difference in the performance of males and females' students when exposed to peer-assessment skill training

Hypothesis 3. *There is no significant effect of age on senior high school students' achievement in Mathematics in the treatment group.*

Table 3: Independent Sample t-test for Differences between Age (14-16yrs) and (17-19yrs) in the Post-test Scores of the Peer-assessment Group

Group	N	Mean	SD	Df	t- value	p- value
14- 16 yrs	29	65.59	10.82			
				43	0.386	0.701
17- 19 yrs	16	64.13	14.33			

An independent sample t- test was conducted to compare the post mathematics achievement test scores of students' age 14 -16yrs and 17 - 19yrs. There was no

significant difference in scores for 14 -16years ($M = 65.59$, $SD = 10.82$) and 17 -19years ($M = 64.13$, $SD = 14.33$; $t(43) = 0.386$, $p = 0.701$, two tailed). Since $p > 0.05$ there is no significant differences in the performance of students age 14- 16years and 17 - 19 years' when exposed to peer-assessment skill training.

This finding contradicts Goodrich and Boulay (2003) study on writing performance when students were supported by rubrics and self-assessment. They reported positive effects only for some groups investigated and the results sometimes differed between gender and age differences. However, this study confirms the finding of Aronson (2010) that no student could succeed unless they worked well together as a team. Again, Sabba et al., (2008) in their study provided no evidence to support a particular age ability or ethnic group. More possibly in this study the team work facilitated interaction among all students in class leading to see each other as contributors to their success.

Conclusions

Based on the findings, it is concluded that peer-assessment is an effective teaching strategy that could help to improve in the teaching and learning of mathematics. It was also established that this strategy contributes almost equally to students' performances irrespective of sex and age differences of the students.

Recommendations

Based on these findings it is recommended that more efforts be made by the Ministry of Education and Ghana Education Service to incorporate peer-assessment teaching strategy in the mathematics syllabus. Teachers also must make the necessary efforts to apply this strategy in the teaching and learning of mathematics so as to help improve the performances of the students.

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