***Original Research Article***

# Concurrent validity of Proficiency in English Language on Mathematics Performance Among Senior High School Students in Shama Senior High School

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## ABSTRACT

One source of evidence to validate assessment result is criterion-related evidence which states that two set scores on the same content should be able to be substituted. The study sought to determine how the students' performance in mathematical symbols test and predict their performance on mathematical word problem. The descriptive design was used for the study. The stratified random sampling technique was used to select two classes each from General Science and General Art. Sample of 144 students were used in the study. Pearson Moment correlation was used to analyze the data. It was found that there is a significant low positive correlation between students' performance in mathematical word problem and mathematics symbol problem due to gender and course of study. It was recommended that mathematics teachers need some professional development on how to help students understand the linguistic necessities of the subject (mathematics). This would be achieved as they go through in-service training.


**Key words**: Concurrent validity, English language proficiency, mathematics, academic performance

## Introduction

Language is a medium through which ideas are expressed. It is a verbal or nonverbal means of communication that allows the transmission of an unlimited range of subject matter (Yushau & Bokhari, 2005). According to Buba and Umar (2015), language plays a critical role in the learning process as it allows the learner to understand a certain subject. English, as a distinctive language, has left its mark as an influential, global medium of communication. It is widely used in various countries in a variety of settings (Kilpatrick, Swafford, &Findell, 2001). Its prevalent use as a lingua franca led to its wide implementation in schools and other academic institutions as a means of instruction. English proficiency is an essential component of performance when used as the medium of instruction in academic settings (Buba & Umar, 2015).

Mathematical learning is mediated through language. Mathematical worded problems are an example of how language is used to reign over different subject areas.

The aptitude to solve mathematical word problems is an important skill for students of all ages. This skill enables students to form a connection between what they learn inside the classroom and the real-life situations that they are bound to face. Teaching mathematics aims at helping students become critical thinkers who can apply their knowledge meaningfully in their daily lives (Yushau & Bokhari, 2005). Developing mathematical proficiency has been documented as a crucial issue for children and their education. Mathematical development which happens in the early years is extremely important for the students' success and achievement both in school and in life pursuits (Kilpatrick, Swafford, &Findell, 2001). Not only is mathematics important because of its application of basic numeracy skills, but it also functions as the main vehicle for developing student's logical thinking and higher- order cognitive skills. Many other scientific fields, such as physics, statistics and engineering depend on mathematics, so mathematical proficiency is a prerequisite for understanding other subject areas.

The difficulty of teaching and learning mathematics in a language that is not the learners' home language (e.g. English) is well documented Kilpatrick, Swafford, &Findell, 2001). It can be argued that underachievement by Ghanaian learners in most rural schools is due to a lack of opportunity to participate in meaningful and challenging learning experience (sometimes due to lack of proficiency in English) rather than to a lack of ability or potential. This study investigated how improvement of learners' English language proficiency enables or constrains the development of mathematical proficiency.

**Relationship between Language and Mathematical Learning**

Yushau and Bokhari, 2005). argued that mathematics symbolism is the mathematics itself and language serves to interpret the mathematics symbol. Brown (1997) and Setati (2005) viewed language as a medium through which mathematical ideas are expressed (Brown, 1997; Setati, 2005). Rotman (in Ernest, 1994) contended that mathematics is an activity which uses written inscription and language to create, record and justify its knowledge. According to Ernest (1994); and Setati and Adler (2001). language plays a vital role in the genesis, acquisition, communication, formulation and justification of mathematical knowledge – and certainly, knowledge in general. Setati and Adler (2001) argued that learners, who are studying in a language other than their mother tongue, have to learn mathematical concepts, as well as the

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language in which these concepts are rooted. Yushau and Bokhari, 2005). asserted that to know mathematics, a double aspect is required. The first aspect involves the acquisition of certain concepts and theorems, at a functional level, that can be used to solve problems and construe information, as well as being able to make new questions. The second aspect entails being able to recognize concepts and theorems as rudiments of a scientifically and socially recognised body of knowledge. It is also to be able to create definitions, and to state theorems belonging to this corpus and to prove them. The model shows the different roles language plays in mathematics instruction. When different mathematical concepts are being learnt, different linguistic activities serve various purposes. Substantial proficiency in both the students' first and second languages is required if they are to cope with the range of linguistic activities required for learning mathematics. According to Durán (1989), some of the factors that affect English language learners' performance in content-based areas include not being familiar with certain linguistic structures used in questions, not identifying vocabulary expressions, or misinterpreting an item literally. Tippeconnic and Faircloth (2002) contended the significance of language, as well as cultural factors in the testing of ELL students.

**Validity**

Validity is the bedding rock of all assessment theories and principles, in that, it underpins all assessment theories. It is the focus or the object of concern of every assessment process. The principle aim of validity is to ensure that outcomes of assessment are given their genuine use and interpretation.

According to Nitko (1996, pg 56), "validity is the soundness of the interpretation and use of assessment results". Messick (1989, pg.79) also defined "validity as an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of inferences and actions based on test scores or other modes of assessment and not the assessment instrument itself". Messick meant that for every use and interpretation made of assessment scores, there should be evidence to support the appropriateness of use and interpretation made and that assessment instrument cannot be ascribed as valid or invalid. Nitko (1996) also pointed that validity is the appropriateness of the use and interpretation of students' assessment results. That is evidences need to be provided in support on the use and interpretation of the results of the students. The APA (2014) stated that validity is the degree to which the interpretations and use of test scores could be supported by

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evidence and theory. This view is similar to the discussed views of validity. The underlying theme of validity is evidence to support any use and interpretation of assessment results.

The soundness or evidence in support of the use and interpretation of assessment score suggest that, the evidence may adequately or partially support the uses and interpretations of the assessment result. Messick (2001) stated that validity is a matter of degree and not all or none. This means that the evidence may support a particular use or interpretation but not all or none of the uses and interpretations of the assessment results and not the assessment instrument itself as stated earlier.

Nitko (2004) stated with regard to interpretation of assessment results, there are two ways; norm-reference and criterion reference interpretation. Norm – referencing is interpreting students results based on the norm or the group within which the students' results lies. In this case, there is nothing like standards. Examples are selection of students for award or position of students which all depend on the students' results within the group. Criterion reference interpretation is interpreting students results based on standards. It judges if a students' meets a standard or not. This is used for certification, placement and programme evaluation.

Validity therefore is the appropriateness of the use of students' assessment results for certification, placement or selection (Hamavandy & Kiany, 2014). Can the results be used for the proposed use? Can the results be interpreted using norm-reference or criterion reference? Is it appropriate to use or interpret assessment results as proposed? These are the questions that come to mind with regard to validity. Assessment results that are considered valid for a particular use may not necessary be a valid for another use. The degree, to which it is appropriate for these uses and interpretations to be made of the assessment results, is what is termed as validity.

According to (Drost, n.d), valid results are not bias. This is because, bias items do not produce results that are good for comparison or predictions or measuring students true standing on a construct. Also, that, it does not discriminate between students matched to the same ability level but to those of discriminate ability level. Also the items should be of equal difficulty to students matched to the same ability level. Estimation of these parameters lies in the domain of the item response theory.

**Concurrent validity of Criterion related evidence of Validity**

Criterion-related evidence of validity measures how well an assessment results can predict a future performance on similar content. It is established by comparing the assessment

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results with scores of one or more external variables (called criteria) which is considered to provide a direct measure of the trait of interest. There are two types of criterion related evidence of validity. The predictive validity of the criterion validity gives an indication of the extent to which an individual's future performance on the criterion is predicated from a previous performance. The purpose is to predict the future performance of a criterion variable. The concurrent validity also gives an indication of the degree to which the assessment results estimates individuals' present standing on the criterion. The purpose is to substitute the assessment results for the score of a related variable. The line of difference between the predictive and the concurrent validity then becomes the time of measure of the future (criterion) and present (predictor) standing on the criterion.

On the bases of concurrent validity, it is expected that it should be possible to substitute students' performance in mathematical word problem with performance in the mathematical symbol test. The uses and interpretation of the performance in the mathematical word problem is only valid to the degree that it could be substituted with the performance of the symbol test. This is because the two set of tests are alternate and measured almost at the same time.

To assess this evidence, the correlation coefficient of the criteria and predicator is estimated. The coefficient gives an indication as whether there is a relationship between the scores and how well the predictor predicts or relate with the criteria. Another approach to check predictive validity is by the use of the expectancy table. It is a two-way table that allows criteria to be predicted from a score.

**Factors that affect validity**

Asamoah-Gyimah and Anane (2018) listed the following as the factors that affect validity of assessment result:

1. Unclear directions
2. Too difficult vocabulary
3. Test being too short
4. Improper arrangement of items
5. Cheating
6. Unreliable scoring

**Research Hypotheses**

The following hypotheses were formulated to guide the study:

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1. $H_0$: There is no significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test

$H_1$: There is significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test

2. $H_0$: There is no significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test due to gender.

$H_1$: There is significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test due to gender.

3. $H_0$: There is no significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test due to course of study

$H_1$: There is no significant relationship between mathematics performance on the Word problem in Mathematics test and Mathematical symbol test due to course of study

7.

**Methodology**

The methodological approach adopted for the study was a quantitative one. Specifically, a descriptive research design was used. The target population for the study is Shama Senior High School Students. The population size is nine hundred and six (906) students, made up of five hundred and six (506) females and four hundred (400) males. A stratified random sampling was used to select two intact classes of General Art and General Science courses of Form Two students. A sample of 144 students were selected for the study. The General science and General Art classes were selected on the assumption that general science students perform better in mathematics than their counterparts and that general art students perform better in English language than their counterparts.

Two forms of mathematics tests; mathematical word problem solving test (Test A) and mathematics symbolic Test (Test B) were administered to the selected students. The two tests were of the alternate form. The tests were on the same content and hence require the same responses. Test A used mathematical symbols whiles test B used English language. Test A and Test B were administered to the same students on the same day at a setting. This was done to avoid diffusion which might affect performance of the second test. Pearson moment correlation was used to analyze the data.

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**Hypothesis one**

**There is no significant relationship between mathematics performance on word problem test and symbols test**.

Research hypothesis one sought to find out the relationship between students' performance on mathematical word problems (Test A) and symbols problems (Test B). Pearson correlation was used to analyze the results. This is because both scores are continuous in nature. The result of the relationship is presented in Table 1.

**Table 1**: *Descriptive statistics and correlation coefficient between the two test*

| Test Type | M | SD | N | r | sig |
|---|---|---|---|---|---|
| Test A | 2.39 | 2.718 | | | |
| Test B | 7.90 | 2.094 | 62 | 0.272 | 0.033 |

Source: Field study (2021)

Table 1 presents the descriptive statistics and the correlation coefficient of the total students selected for the study. The results showed that students' scores on test A, which is the mathematics test of word problems (M = 2.39, SD = 2.718) was lower than scores on test B which is the test of symbols (M = 7.90, SD = 2.094). But the results further showed a low positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on test B, made of mathematics symbols (r = 0.272,*p*= 0.033, p<0.05, (2-tailed). This implies that students' mathematics on test A does not necessarily influence their performance on test B. That is a student with low score on test A can obtain low score on the test B.

**Hypothesis two**

**There is no significant relationship between mathematics performance on word problem test and symbols test due to gender**

Hypothesis two sought to find out the relationship between students' performance on mathematical word problems (Test A) and symbols problems (Test B) due to gender. That is the hypothesis sought to find out if students' scores on mathematics symbols could be substituted for the scores on the word problem due to gender. In others words, can do students who perform well on the symbol test perform well on the word problem due to students' gender? Pearson

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correlation was used to analyze the data to establish the relationship. This is because both scores are continuous in nature. The result of the relationship is presented in Table 2.

**Table 2***: Descriptive statistics and correlation coefficient between the two test*

| Group/Test | M | SD | N | r | sig |
|---|---|---|---|---|---|
| Male Test A | 2.32 | 2.804 | 68 | 0.012 | 0.000 |
| Male Test B | 8.32 | 1.77 | | | |
| Female Test A | 2.18 | 2.468 | | | |
| Female Test B | 7.25 | 2.444 | 76 | 0.111 | 0.000 |

Source: Field study (2021)

Table 2 presents the descriptive statistics and the correlation coefficient between mathematical symbols test and word problem due to gender. The results showed that for males, students' scores on test A, which is the mathematics test of word problems (M = 2.32, SD = 2.804) was lower than scores on test B which is the test of symbols (M = 8.32, SD = 2.177). But the results further showed a low positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on test B, made of mathematics symbols (r = 0.012,*p*= 0.000, p<0.05, (2-tailed). This implies that students' mathematics on test A does not necessarily influence their performance on test B. That is a student with low score on test A would not necessarily obtain low score on the test B.

For females, students' scores on test A, which is the mathematics test of word problems (M = 2.18, SD = 2.468) was lower than scores on test B which is the test of symbols (M = 7.25, SD = 2.444). But the results further showed a low positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on test B, made of mathematics symbols (r = 0.111,*p*= 0.000, p<0.05, (2-tailed). This implies that students' mathematics on test A does not necessarily influence their performance on test B. That is a student with low score on test A would not necessarily obtain low score on the test B. in other words, scores on one set of the test cannot be substituted for the other due to gender even though the tests are alternate.

**Hypothesis three**

**There is no significant relationship between mathematics performance on word problem test and symbols test due to course of study**

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Hypothesis three sought to find out the relationship between students' performance on mathematical word problems (Test A) and symbols problems (Test B) due to course of study. That is the hypothesis sought to find out if students' scores on mathematics symbols could be substituted for the scores on the word problem due to course. In others words, can do students who perform well on the symbol test perform well on the word problem due to students course of study? Pearson correlation was used to analyze the data to establish the relationship. This is because both scores are continuous in nature. The result of the relationship is presented in Table 3.

**Table 3***: Descriptive statistics and correlation coefficient between the two test*

| **Group/Test** | **M** | **SD** | **N** | **r** | **sig** |
|---|---|---|---|---|---|
| Gen Art Test A | 1.74 | 2.533 | 76 | 0.112 | 0.000 |
| Gen Art Test B | 7.82 | 2.103 | | | |
| Gen Sci Test A | 3.08 | 2.636 | 68 | 0.404 | 0.000 |
| Gen Sci Test B | 7.88 | 2.271 | | | |

Source: Field study (2021)

Table 3 presents the descriptive statistics and the correlation coefficient between mathematical symbols test and word problem due to course of study. The results showed that for Gen Art, students' scores on test A, which is the mathematics test of word problems (M = 1.74, SD = 2.533) was lower than scores on test B which is the test of symbols (M = 7.82, SD = 2.103). But the results further showed a low positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on test B, made of mathematics symbols (r = 0.112,*p*= 0.000, p<0.05, (2-tailed). This implies that students' mathematics on test A does not necessarily influence their performance on test B. That is a student with low score on test A would not necessarily obtain low score on the test B.

For Gen Sci, students' scores on test A, which is the mathematics test of word problems (M = 3.08, SD = 2.636) was lower than scores on test B which is the test of symbols (M = 7.88, SD = 2.271). But the results further showed a moderate positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on

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test B, made of mathematics symbols (r = 0.404,*p*= 0.000, p<0.05, (2-tailed). This implies that students' mathematics on test A does not necessarily influence their performance on test B. That is a student with low score on test A would not necessarily obtain low score on the test B. In other words, scores on one set of the test cannot be substituted for the other due to gender even though the tests are alternate.

**Results and Discussion**

***There is no significant relationship between mathematics performance on word problem test and symbols test.***

Hypothesis One sought to find out the degree and direction of relationship between students' performance on the mathematics symbol test and word problem test. That is to find out if students who performed well on the symbol test would equally perform well on the word problem test. The results showed a low positive significant relationship between students' performance on test A, made of mathematics word problem and their performance on test B, made of mathematics symbols. This means that only few students who performed well on the symbol test equally performed well on the word problem test even though the two tests were alternate. This means that the student did a problem with one of the test. According to Setati and Adler (2001). language plays a vital role in the genesis, acquisition, communication, formulation and justification of mathematical knowledge – and certainly, knowledge in general. This could probably be the cause of the low relationship between the two tests. Neville-Barton and Barton (2005) also argued that mathematics symbolism is the mathematics itself and language serves to interpret the mathematics symbol. Brown and Setati viewed language as a medium through which mathematical ideas are expressed. The authors share the same view with the results of this study as far as relationship between students' performance on mathematics symbol test and word problem test is concern. The results of this is in line with the results of the study Buba and Umar (2015) which showed that there was a positive association between proficiency in mathematics and English.

The finding is in line with the submission of Aina (2013) that student who had problem in communication skill may likely not do well academically. This suggests low relationship between proficiency in English and students mathematics performance.

**There is no significant relationship between mathematics performance on word problem test and symbols test due to gender**

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The purpose of Hypothesis Three was to find out if female students performed better than girls on both mathematics tests as popularly perceived. The results showed that there is a significant low positive relationship between the mathematical word problem and symbol problem due to gender. Even that it assumed that males perform better in mathematics than girls, the boys could not transfer their level of mathematics performance on the symbol problems to the word problem so both scores cannot be substituted just like their female counterparts

Like the results of this study, Abedi and Lord (2001) that there is a significant difference in students' performance in mathematics as results of proficiency in English due to gender. This could implies that Abedi and Lord (2001) found a low relationship between proficiency in English with regard to mathematics and mathematical symbol problem. This means that both male and female students have the same problem with mathematics when it comes to mathematical word problems. The result of this study is in line with the results of the study of Abedi and Lord (2001).

The finding is in contrast to findings by Abubakar. (2005), that English language has strong positive relationship on all the other subjects of the curriculum at the secondary school level because it is the only language of instruction. There had been gender stereotyping in terms of academic abilities between male and female students.

The finding opposed several earlier findings that have unfolded the females to be the best in English language than the male students while it supported the notion that male students always perform better in science related courses. In light of the above summary of findings, it is clear that understanding and comprehension of English should not be yardstick for conceptualization of science literacy. Many countries do not utilize English as a language of instruction but they still prosper and advance in Mathematics, Science and Technology related activities.

**There is no significant relationship between mathematics performance on word problem test and symbols test due to course of study**

Hypothesis three sought to find out if Science students perceived to be good at mathematics performed equally on the two set of alternate mathematics test as their art counterparts. The results showed that there is a moderate positive relation between the two tests for the science students and a low positive relationship for the General Art students. That is the Science students who performed better than on the usual symbol test moderately perform better

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on the word problem. For the General Art counterparts, those who performed better on the symbol test had a low chance of performing better on the word problem. For both Science and Art students' scores on the symbol, test cannot be substituted for scores on the word problem. This is because scores on the symbol test does not necessarily predict scores on the word problem. The difference in the degree of relationship for science and Art students confirms the popular perception that science students are better than Art students in mathematics Adams (1990) description of discourse comprehension in mathematics places Art students in a better position to perform better on mathematical word problems than Science students which the results of this study failed to be confirmed.

**Conclusions and Recommendations**

A criterion related evidence of validity states that scores should be able to be substituted or predict scores of the same trait. That is scores on the mathematical symbol problem should be able to predict scores on word problem on the same content. However, the student found that students' score on the mathematical symbol problem could not predict and cannot be substituted for scores on the word problem even for science students who are perceived to good at mathematics than their counterpart. This may due to inadequate proficiency in English.

It is therefore recommended that students should be assessed by school authorities on arrival for both English and English proficiency on mathematics knowledge and placed them into class. Again, a glossary of basic technical mathematical terms in English preferably with visual aids, should be compiled and handed out at the start of the course. This could be supplemented by the teacher writing on the board the relevant items at the beginning of each session.. Specific support courses for English in mathematical discourse need to be established by educational authorities like the ministry of education for students in the mathematical sciences. These may include opportunities for using their first language provided that focus of assistance is on the bridge between this language and mathematics in English.

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