The Influence of Poor Handwriting on Students' Score Reliability in Mathematics

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Abstract

This study examined the influence of poor handwriting on students' score reliability in mathematics. The design of the study was survey research. A sample of 200 students and 150 teachers randomly selected from secondary schools in North Central Nigeria was used in this study. The instrument for data collection was a structured questionnaire. The reliability of the instrument using Cronbach alpha coefficient was 0.94. Four research questions were answered and three hypotheses were tested. The result indicated that when students find it difficult to write legibly, it affects their overall achievement in school mathematics and hence weakens their educational progress. It was revealed that even though many teachers see handwriting as a skill that students should be taught to enable students to do well in school mathematics, nevertheless, teachers' attitudes contribute significantly to student's poor handwriting habits in schools. The paper maintains that home is one of the factors that contribute to the incidence of poor handwriting and not school location as hitherto envisaged. Based on this finding, it is recommended that teachers should teach handwriting and also emphasize its importance in schools. School authority should organize seminars on how to teach handwriting. Moreover, parents need to create time to teach their children good handwriting at home so as to complement the teachers' efforts. Above all, word-processing programs and assistive technology is undeniably boons to students with writing problem in mathematics.

Keywords: Poor handwriting, students, score reliability, mathematics, perceptions.

1 Introduction

Education is a necessary factor in the economic development as it is indubitably regarded as the bedrock of sustainable development in any nation. It equips the individual with the information necessary for high level of human functioning. Education is expected to train the mind of its recipient for effective performance. Adequate and proper acquisition of relevant knowledge and skills in school subjects and disciplines of study are invariably functions of quality education (Okara, 2012). To be regarded as
educated person an individual needs to know how to read coherently and write legibly. Unfortunately, many students are not doing well in the school system especially in mathematics because of their poor handwriting which has to do with the problem of expressing thought in written form. Berninger (2008) refers to handwriting as language by hand, which is a useful reminder of its context and purpose. Handwriting is not an isolated activity; neither can it be seen solely as a motor activity. It is part of a language activity. There is handwriting that is clear and easy to read, and then there is handwriting that is hard to decipher. Bad handwriting sometimes includes sentences that are poorly punctuated, misuse of upper and lower case letters, words with incorrect spacing, and sentences that do not make sense. We write in order to remind ourselves of something we want to remember and to tell another person what we know as well as to let a person know what we want. For centuries learning to write joined-up letters has been an integral part of children's education, but that is now being threatened by the computer revolution. Writing with a pen is still the backbone for teaching students even in computer and cyber age of the 21st century. Good handwriting in all school subjects including mathematics is a skill that is highly valued in our society, even in this time of computer technology. In the past, handwriting was prized because it was a primary form of communication as people needed to get notes from one another that ought to be legible (Ediger, 2002). Most Christians are familiar with the 'popular handwriting on the wall story' as recorded in the Bible in the book of Daniel chapter five. For the benefit of non-Christians, in that story, Belshazzar the king of Babylon and son of Nebuchadnezzar, invited thousands of officers to a great feast where wine and women flowed freely. While he was drinking, he was reminded of the golden and silver cups taken from the temple in Jerusalem during his father's reign. He ordered that these sacred cups be brought to the feast, and when they arrived, he and his princes, wives, and concubines drank toasts from them to their gods. While they were busy having their full of wine in the arms of their women they saw fingers of a man's handwriting on the plaster of the wall opposite the lamp stand in the immaculate palace ballroom. Belshazzar saw the fingers as they wrote. The Bible recorded that his face blanched with fear, his drunken stupor was erased in a flash and his knees knocked together and his legs gave way beneath him. For the fact that the king could not comprehend the strange handwriting, he immediately summoned his magicians and astrologers to interpret the strange handwriting but none could. It took Daniel, a man the Bible described as being "filled with divine knowledge and understanding" to decode the strange handwriting which in summary meant that the king's days were numbered and his kingdom divided between the Medes and Persians. It happened just the way the Bible said it would and that night Belshazzar was killed and Darius; the Mede entered the city and began reigning at the age of 62. This attested to the fact that the issue of handwriting has been in existence long ago as reported in the Bible. Even though people utilize typewriters and computers to type information that is currently being used to communicate between individuals, handwriting has become a rare form of communication and is still a critical skill that is needed for many reasons that people may not readily recognize. Writing notes, recipes, prescription of medical message, checks, and filling out applications are among few reasons why the development and teaching of handwriting skills needs to be vigorously emphasized in schools and at home. Additionally, research has shown that explicit and supplemental instruction of handwriting in schools are important elements to prevent writing difficulties (Graham, Harris & Fink, 2009). The ability to communicate ones feelings and ideas effectively in written form is truly one of the most important factors in academic process (Graham, Weinstein & Berninger, 2007). Richards (2009) opined that poor handwriting can have negative impact on the success of the students in schools. Many students with poor handwriting are not able to write symbols well, and they cannot put their thought together coherently or write legibly in examination and as such it affects their overall performance in examination. A good handwriting skill is an essential part of teaching and learning of mathematics, however, this has been ignored in many schools currently in Nigeria. In fact, the neglect by school authority to properly supervise students' handwriting is one of the contributory factors to students' poor performance in school mathematics. In Nigeria, a large number of pupils complete primary school unable to write sufficiently well to meet the demands of secondary school. The reason is
that they are not taught appropriately on how to write good handwriting. A student who has difficulty with handwriting spends more time thinking about letter formation when he or she should be thinking of words or contents to be written. Handwriting difficulty becomes a serious problem for students as they will not be able to express themselves accurately and legibly in a written form. Poor handwriting can have a pervasive effect on school performance in mathematics because handwriting is a basic tool used in taking notes, doing classroom work and assignment. Lack of automatic recall may reduce the mental resources available for learning advanced computational algorithms in mathematics; labor handwriting creates a drain on mental resources needed for higher-level aspects of writing, such as attention to content, elaboration of details, and organization of ideas. When the same response to test item is written in different forms of handwriting it may likely affect the reliability of scores in mathematics awarded by different scorers. The reliability of an instrument or a test is the degree to which a test or an instrument is consistent in measuring whatever it purports to measure. In other words, it is the degree to which the test or the instrument measures the same thing time after time and item after item. The index of reliability is usually expressed as a coefficient reflecting the extent to which a test is free of error variance. It connotes the dependability, stability, reproducibility and consistency of test scores in subsequent measure (Nworgu, 2003; Emaikwu, 2012) [6,12]. When we talk about reliability, the following questions will come to mind:

(i) How consistent are the test scores?
(ii) Is the test trustworthy?
(iii) How accurate will the test scores be on replication time after time?
(iv) Is the test relatively free from the measurement error? If an individual maintains the same order of merit on each of the two administrations of a test, then the instrument is said to be reliable. Research evidence shows that school teachers spend less than 10 minutes a day on handwriting. The research also confirmed that many teachers have not been given adequate preparation in the teaching of handwriting (Graham, Harris & Fink, 2009) [8]. A good number of teachers teach handwriting, albeit to a very limited extent, a vast majority of them had no training in the subject, had no curricular materials for it and, for good measure, didn't enjoy it. The decline in the instruction of handwriting and its diminished use by students is not because handwriting has lost its purpose; it is due to a lack of teachers' preparation. Poor training in handwriting may result in common problems of mixture of capitals and lower case letters, illegible script, a mixture of cursive and poorly formed letters, sloping in multiple directions, joining letters incorrectly, not uniform in size and of course too large or too small letter formations. The effect of poor handwriting on students' performance could be summarized with the aid of the chart underneath in Fig.1.
A student who has poor handwriting in mathematics may experience any of the following problems: Studies well but not completing his or her examination as expected, able to read well but not able to write neatly and legibly, has good eye sight but is unable to copy from the blackboard fast, slow in writing, teacher is not able to decipher what the student writes, student's intelligent quotient is normal but he is still unable to get proper letter formation, the student writes with little or no space between words and letters, the student is getting less mark in examinations because of his illegible writing (Graham, Weinstein, & Berninger, 2007) [7]. If students cannot write mathematical signs well, it may ultimately result in their inability to copy information legibly in their notebooks and this could possibly slow down their academic progress. A noticeable slow academic progress can lead to disappointment in mathematics and low self-esteem which could trigger a feeling of unfriendliness with educational system. Handwriting difficulties can therefore disturb and interfere with educational progress of student. Poor handwriting can also affect students negatively in terms of completing daily academic assignment and the ability to take note during mathematics lessons and frequency of writing. In a conventional learning environment, time in school is spent up in writing notes and copying from board so that lack of legible handwriting could lead to a loss of motivation in mathematics and evading of school work. Poor handwriting can lead teachers to misunderstand what is written and prompt them to give low marks to students in examinations (Graham, Weinstein, & Berninger, 2007) [7]. Commenting on the impact of poor handwriting on educational achievement, Stainthorp (2008) maintained that unless children learn to write legibly and at a reasonable speed, their educational achievements may be reduced and their self-esteem affected. Even in an era when elementary school students are adept at 'mousing' and teenagers are fiends at 'text-messaging' some experts, say that writing with a pen is still the backbone for teaching people how to read and learn facts. Handwriting difficulties can therefore weaken educational progress and interfere with learning. The evidence from various studies suggested that handwriting quality and quantity are strongly associated with examination achievement (Cahill, 2010). Hence it is expedient on the parts of students to develop their
handwriting skills at elementary school before proceeding to high school to ensure they get better marks. A few marks more in mathematics due to good handwriting can catapult ones success rate in life. However, research indicates that handwriting is tied to academic achievement. Poor handwriting often frustrates teachers and results in lower grades. Everyone has their own handwriting style, some neat and others barely legible. Research has shown that different handwriting styles have effects on how a paper is graded and the mark a student receives. A teacher who is frustrated tends to be biased when marking essay scripts. Essays that are harder to decipher require more time and effort. Some essays may be misinterpreted entirely, simply because the teacher misunderstood a word or a sentence poorly written. Sometimes the teacher might even give up as he tries to understand what a student has written. Poor handwriting is considered to be a sign of a poor quality paper. Hence, it can be inferred that students achieving higher marks tend to write better handwriting style than those who perennially exhibit under achievement. From a teacher’s perspective, poor handwriting in mathematics may reflect a lack of interest or understanding. No teacher is entirely without bias when grading an essay work and this may emanate from the effect of poor handwriting. Numerous studies have investigated the relationship between the quality of handwriting and scores given to essays. These studies have consistently found that essays get higher grades when written in good handwriting than when written in poor handwriting (Connelly, Dockrell & Barnett, 2005). Markham (1999) investigated the influences of handwriting quality on teacher evaluation of written work and reported that papers with better handwriting consistently received higher scores than did those with poor handwriting regardless of quality of content. According to her, the analysis of variance indicated that the variation in scores explained by handwriting was significant. Moreover, multiple classification analysis indicated that neither the teacher characteristics of age, experience, level taught, and degrees held, nor the student teacher characteristic of level taught had a significant influence on the score given to a paper. A study by Stainthorp (2008), investigated the joint effect of marker expectation and handwriting quality on essay grades. Fabricated essay responses to questions on test theory were copied out in both very poor handwriting and very good handwriting. These responses were given to graduate students for scoring. It has been found that good handwriting ensured better scoring. This clearly establishes the fact that an interaction exists between writer's handwriting quality and achievement score. Commenting on the quality of handwriting on score reliability, Graves (2012) submitted thus: Make no mistake, if handwriting has a poor appearance, the writer is judged poorly by our culture and this won't end tomorrow. Surface features will always attract far more attention than underlying structures. For a person who has poor handwriting, the road ahead is difficult. In spite of the high quality of his ideas and information, the writer will bear a lifelong burden. But such a fate is unnecessary for those who know how writers develop their skill in handwriting (p. 23). Some of the poor handwritings often exhibited by students are wizard's toe handwriting that looks as if a 200-year old wizard has written it with his toes (John, 2007). Others include chicken scratch handwriting which accord to Prinkess (2009) is the type of handwriting that looks like something a chicken would scratch in the mud with its nails and is a learning disability where one has deficits in fine motor skills, visual special skills and social skills. In other words, chicken scratch handwriting is a nasty handwriting whereby the first letter of the word is 3-4 times bigger than the rest. According to Cocinella (2010), the people who can decipher this kind of handwriting are extremely rare. In spite of the favorable learning condition such as availability of resource materials, well equipped laboratory, and provision of enough teaching aids and instructional materials, there are yet no much improvement in the performance of students in mathematics and this problem has persisted over the years. Some of the short comings are attributed to the impact of poor handwriting of students at secondary school level. The problem of this study therefore is what is the brunt of poor handwriting on students' performance in secondary school in mathematics as perceived by some stakeholders? What are the causes of poor handwriting in schools?
2 Research Questions and Hypotheses

The following research questions were formulated to guide the study.
I) How does poor handwriting affect students’ achievement in school mathematics?
II) How do teachers’ attitudes contribute to students’ poor handwriting in mathematics?
III) To what extent do home factors contribute to students’ poor handwriting in mathematics?
IV) How does the nature of schools (private or public ownership) contribute to students’ poor handwriting in mathematics?

H1: There is no significant difference in the mean perception between teachers and students on the extent to which poor handwriting affects students’ achievement in mathematics.
H2: There is no significant difference in the mean perception between teachers and students on the extent to which teachers’ attitudes contribute to students’ poor handwriting in mathematics.
H3: There is no significant difference in the mean perception between teachers and students on the extent to which home factors contribute to students’ poor handwriting in mathematics.

3 Methodology

The design of this study is a survey research. The study was carried out in North Central Nigeria. The population of the study was made up of all the senior secondary three students of 2012/2013 academic session and their teachers. The sample for the study is made up of 350 respondents consisting of 150 teachers and 200 students randomly selected from secondary schools in the study area. The sampling technique used in this study was simple random sampling. The instrument for data collection was a five-point structured questionnaire anchored on a continuum of strongly agree (SA), agree (AG), undecided (UD), disagree (DA) and strongly disagree (SD). The instrument for data collection was validated by two mathematics educators from University of Agriculture, Makurdi in Benue State Nigeria. The specialists were asked to assess the brevity of the items. The comments given by the specialists were strictly adhered to and appropriate corrections effected. The reliability of the instrument was determined using Cronbach alpha reliability coefficient and the reliability coefficient estimated was 0.94. The copies of questionnaire were distributed to respondents in schools within the area of study by the researcher and a research assistant. The data collected from the respondents were analyzed according to the research questions and the research hypotheses. Descriptive statistics of mean, standard deviation were used to answer the research questions while t- test statistic was used to test the hypotheses at 5% level of significance.

4 Presentation of Results

4.1 Research Question 1

I) How does poor handwriting affect student’s achievement in school mathematics?

From Table 1, the mean of all the items responded to are more than the mean bench-mark of 3.50 and hence all the seven items listed were accepted as the possible effects of poor handwriting. Besides the fact that poor handwriting can weaken educational progress of students as it often interferes with learning, students with slow writing speed will not be able to complete mathematics examination even if they know all the answers. It can be shown that when students find it difficult to write legibly, it affects their overall performance in mathematics and hence weakens the educational progress of students as it often interferes with their learning.
Table 1: Respondents’ perception on the effects of poor handwriting on achievement in mathematics

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>AG</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most students find it difficult to write legibly and this often affects their performance in school mathematics.</td>
<td>190</td>
<td>90</td>
<td>22</td>
<td>30</td>
<td>18</td>
<td>350</td>
<td>4.15</td>
<td>1.18</td>
<td>Accepted</td>
</tr>
<tr>
<td>Poor handwriting could sometimes make teachers to mark a student's work in mathematics wrong even when it is right.</td>
<td>143</td>
<td>126</td>
<td>19</td>
<td>22</td>
<td>40</td>
<td>350</td>
<td>3.89</td>
<td>1.32</td>
<td>Accepted</td>
</tr>
<tr>
<td>Students with poor handwriting cannot write mathematical signs and symbols well; this could also affect the learning of the subject.</td>
<td>136</td>
<td>101</td>
<td>19</td>
<td>70</td>
<td>24</td>
<td>350</td>
<td>3.73</td>
<td>1.33</td>
<td>Accepted</td>
</tr>
<tr>
<td>Students with poor handwriting spend more time thinking of what to write and how to write even though they may be intelligent in mathematics.</td>
<td>150</td>
<td>120</td>
<td>30</td>
<td>23</td>
<td>27</td>
<td>350</td>
<td>3.98</td>
<td>1.21</td>
<td>Accepted</td>
</tr>
<tr>
<td>Poor handwriting can weaken educational progress of students as it often interferes with learning of mathematics.</td>
<td>180</td>
<td>100</td>
<td>19</td>
<td>21</td>
<td>30</td>
<td>350</td>
<td>4.08</td>
<td>1.25</td>
<td>Accepted</td>
</tr>
<tr>
<td>Handwriting fluency can affect ability to complete written assignments, take notes during mathematics lessons and frequency of writing.</td>
<td>200</td>
<td>100</td>
<td>10</td>
<td>18</td>
<td>22</td>
<td>350</td>
<td>4.25</td>
<td>1.31</td>
<td>Accepted</td>
</tr>
<tr>
<td>A fixed-time examination is used in mathematics and hence students with slow writing speed will not be able to complete the examination even if they know the answers.</td>
<td>120</td>
<td>130</td>
<td>50</td>
<td>30</td>
<td>20</td>
<td>350</td>
<td>3.86</td>
<td>1.15</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

4.2 Research Question 2

II) To what extent do home factors contribute to students’ poor handwriting in school mathematics?

In the Table 2, the means and standard deviations on the extent to which home factors contribute to students’ poor handwriting are presented. The mean of item 1 which is 3.05 is less than the bench mark of 3.50 and hence that item is rejected. This implies that many parents are concerned about the way their children write. Moreover, many parents don’t create time to teach their children good handwriting at home as observed from responses to item number 2. The response to item 3 shows that it is only the illiterate parents that do not bother about the way their children write in their mathematics books. It shows that, home is one of the factors that contributes to incidence of poor handwriting. The value of the standard deviation also shows that many respondents are more homogeneous on that item than any other one in that cluster.
Table 2: Respondents on the extent to which home factors contribute to students' poor handwriting

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>AG</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many parents are unconcerned about the way their children write mathematics and this contributes to poor handwriting habits of students.</td>
<td>60</td>
<td>80</td>
<td>70</td>
<td>100</td>
<td>40</td>
<td>350</td>
<td>3.06</td>
<td>1.29</td>
<td>Rejected</td>
</tr>
<tr>
<td>Many parents don't create time to teach their children good handwriting at home.</td>
<td>160</td>
<td>79</td>
<td>31</td>
<td>50</td>
<td>30</td>
<td>350</td>
<td>3.83</td>
<td>1.36</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many illiterate parents do not bother about the way their children write in their mathematics books.</td>
<td>130</td>
<td>150</td>
<td>29</td>
<td>25</td>
<td>16</td>
<td>350</td>
<td>4.01</td>
<td>1.07</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

4.3 Research Question 3

III) How do teacher's attitudes contribute to students' poor handwriting mathematics?

Table 3 shows the mean and standard deviation of how teacher's attitudes contribute to students' poor handwriting in mathematics. The mean scores of five items out of the six items on this sub heading are more than the mean benchmark of 3.50. Item 6 has a mean mark of 3.11 which means that even though many teachers see handwriting as a skill that students should be taught to enable them to do well in school mathematics, nevertheless, teacher's attitude contribute significantly to student's poor handwriting habits in schools. Beside the fact that handwriting is not reflected in the school timetable by many teachers as a subject, in addition, lack of proper supervision of student's work at early stage of schooling contributes to their poor handwriting formation and among other variables.
Table 3: Respondents on the extent to which teacher's attitudes contribute to students' poor handwriting in mathematics

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>AG</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers' uncaring attitude about the way students write in mathematics could contribute to their poor handwriting</td>
<td>143</td>
<td>127</td>
<td>26</td>
<td>30</td>
<td>24</td>
<td>350</td>
<td>3.96</td>
<td>0.91</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many teachers don't devote their time in teaching handwriting at secondary school level.</td>
<td>138</td>
<td>126</td>
<td>24</td>
<td>29</td>
<td>33</td>
<td>350</td>
<td>3.88</td>
<td>1.28</td>
<td>Accepted</td>
</tr>
<tr>
<td>Handwriting is not reflected in the school timetable by many teachers as a subject.</td>
<td>140</td>
<td>170</td>
<td>6</td>
<td>8</td>
<td>26</td>
<td>350</td>
<td>4.11</td>
<td>1.08</td>
<td>Accepted</td>
</tr>
<tr>
<td>Lack of proper supervision of student's work at early stage of schooling could contribute to their poor handwriting formation.</td>
<td>127</td>
<td>143</td>
<td>24</td>
<td>26</td>
<td>30</td>
<td>350</td>
<td>3.89</td>
<td>1.22</td>
<td>Accepted</td>
</tr>
<tr>
<td>Lack of trained teachers to teach handwriting could affect student's handwriting fluency in mathematics.</td>
<td>196</td>
<td>100</td>
<td>7</td>
<td>30</td>
<td>17</td>
<td>350</td>
<td>4.22</td>
<td>1.14</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many teachers do not see handwriting as a skill that students should be taught to enable them to do well in mathematics.</td>
<td>90</td>
<td>60</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>350</td>
<td>3.11</td>
<td>1.43</td>
<td>Rejected</td>
</tr>
</tbody>
</table>

4.4 Research Question 4

IV) How does the nature of schools (in terms of private or public ownership) and school location contribute to students' poor handwriting in mathematics?

From Table 4, item numbers 1, 2 and 6 have mean values of 2.41, 2.52 and 1.68 respectively which are invariably less than the bench mark of acceptance value of 3.50. Based on these obtained values, it is clear that these factors do not contribute to student's poor handwriting. In other words, location of school in terms of urban or rural does not contribute to student's poor handwriting formation. While many publicly owned schools do not teach handwriting as a separate subject in schools, many privately owned schools emphasize the teaching of handwriting in schools and are even apt to introduce better innovative policies to meet the current realities than government owned schools.
Table 4: Respondents on how the nature of school (private or public ownership) contribute to students’ poor handwriting in mathematics

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>AG</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>N</th>
<th>( \bar{X} )</th>
<th>SD</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of school in terms of urban or rural can contribute to student's poor handwriting formation in mathematics.</td>
<td>34</td>
<td>70</td>
<td>23</td>
<td>100</td>
<td>123</td>
<td>350</td>
<td>2.41</td>
<td>1.36</td>
<td>Rejected</td>
</tr>
<tr>
<td>Many Public schools teach handwriting as a separate subject.</td>
<td>50</td>
<td>60</td>
<td>20</td>
<td>112</td>
<td>108</td>
<td>350</td>
<td>2.52</td>
<td>1.44</td>
<td>Rejected</td>
</tr>
<tr>
<td>Many private schools emphasize the teaching of handwriting in schools.</td>
<td>193</td>
<td>113</td>
<td>5</td>
<td>15</td>
<td>24</td>
<td>350</td>
<td>4.25</td>
<td>1.10</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many privately owned schools introduced better innovative policies to meet the current realities than government owned schools.</td>
<td>200</td>
<td>76</td>
<td>4</td>
<td>30</td>
<td>40</td>
<td>350</td>
<td>4.05</td>
<td>1.40</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many private schools because of competition are more meticulous in teaching students good handwriting than public schools.</td>
<td>211</td>
<td>66</td>
<td>10</td>
<td>29</td>
<td>34</td>
<td>350</td>
<td>4.12</td>
<td>1.35</td>
<td>Accepted</td>
</tr>
<tr>
<td>Many public schools are more meticulous in teaching students good handwriting than private schools.</td>
<td>12</td>
<td>19</td>
<td>20</td>
<td>93</td>
<td>206</td>
<td>350</td>
<td>1.68</td>
<td>1.03</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

4.5 Research Hypothesis 1

H1) There is no significant difference in the mean perception of teachers and students on the impact of poor handwriting on students' achievement in mathematics.

Table 5 shows that teachers have a mean score of 3.98 and standard deviation of 1.03, while students have a mean score of 3.81 with a standard deviation of 1.11. Table 5 also shows that the t-calculated value is 1.48; using degree of freedom of 348 at 5% level of significance, the t-critical value of 1.96 is obtained. Since the t-calculated value of 1.48 is less than the t-tabulated value of 1.96, the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception between teachers and students on the impact of poor handwriting on students' achievement in secondary school mathematics. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. There is the need to calculate the 'effect size' for this independent sample t-test statistic which yielded a non-significant result. Effect size statistics provide an indication of the magnitude of the differences between the two groups being statistically compared. The procedure for calculating eta squared for the independent t-test statistic in Table 5 is provided by the formula:

\[
\text{Eta squared} = \frac{t^2}{t^2 + (n_1 + n_2 - 2)}
\]

From Table 5, the t-calculated is 1.48, \( n_1 = 150 \) and \( n_2 = 200 \), the eta squared could be calculated by replacing these values in the formula to get:
\[
\frac{t^2}{t^2 + (n_1 + n_2 - 2)} = \frac{(1.48)^2}{(1.48)^2 + (150 + 200 - 2)} = 0.00625488 \approx 0.0063
\]  

(2)

The guidelines for interpreting the values of eta squared are: 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect. In this hypothesis, we can see that the eta value of 0.0063 is a very small effect size. Expressed as a percentage, (i.e. multiply the effect size by 100), only 0.63 per cent of the variance in the teacher variable could be explained by the student variable. In other words, effect size statistics which provides an indication of the magnitude of the difference between the two groups being statistically compared is only 0.63 per cent.

### Table 5: T-test for H1

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Dev</th>
<th>N</th>
<th>DF</th>
<th>α</th>
<th>t-cal</th>
<th>t-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>3.98</td>
<td>1.03</td>
<td>150</td>
<td></td>
<td></td>
<td>1.48</td>
<td>1.96</td>
</tr>
<tr>
<td>Students</td>
<td>3.81</td>
<td>1.11</td>
<td>200</td>
<td>348</td>
<td>0.05</td>
<td>0.52</td>
<td>1.96</td>
</tr>
</tbody>
</table>

4.6 Research Hypothesis 2

H2) There is no significant difference in the mean perception between teachers and students on the extent to which teachers' attitudes contribute to students' poor handwriting in mathematics.

Table 6 shows that teachers have a mean score of 3.86 and standard deviation of 1.27, while students have a mean score of 3.79 with a standard deviation of 1.19. Table 6 also shows that the t-calculated value is 0.52; using degree of freedom of 348 at 5% level of significance, the t-critical value of 1.96 is obtained. Since the t-calculated value of 0.52 is less than the t-tabulated value of 1.96, the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception between teachers and students on the extent to which teachers' attitudes contribute to students' poor handwriting in mathematics. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. There is the need to calculate the 'effect size' for this independent sample t-test statistic which yielded a non-significant result. From Table 6, the t-calculated is 0.52, n₁=150 and n₂=200, the eta squared could be calculated by replacing these values in the formula to get:

\[
\frac{t^2}{t^2 + (n_1 + n_2 - 2)} = \frac{(0.52)^2}{(0.52)^2 + (150 + 200 - 2)} = 0.016327506 \approx 0.01632
\]  

(3)

In this hypothesis, we can see that the eta value of 0.0163 is a small effect size. Expressed as a percentage, (i.e. multiply the effect size by 100), only 1.63 per cent of the variance in the teacher variable could be explained by the student variable. In other words, effect size statistics which provides an indication of the magnitude of the difference between the two groups being statistically compared is 1.63 per cent.

### Table 6: T-test for H2

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Dev</th>
<th>N</th>
<th>DF</th>
<th>α</th>
<th>t-cal</th>
<th>t-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>3.86</td>
<td>1.27</td>
<td>150</td>
<td></td>
<td></td>
<td>0.52</td>
<td>1.96</td>
</tr>
<tr>
<td>Students</td>
<td>3.79</td>
<td>1.19</td>
<td>200</td>
<td>348</td>
<td>0.05</td>
<td>0.52</td>
<td>1.96</td>
</tr>
</tbody>
</table>

4.7 Research Hypothesis 3

H3) There is no significant difference in the mean perception between teachers and students on the extent to which home factors contribute to students' poor handwriting in mathematics.
Table 7 shows that teachers have a mean score of 3.69 and standard deviation of 1.02, while students have a mean score of 3.51 with a standard deviation of 1.12. Table 7 also shows that the t-calculated value is 1.57; using degree of freedom of 348 at 5% level of significance, the t-critical value of 1.96 is obtained. Since the t-calculated value of 1.57 is less than the t-tabulated value of 1.96, the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception between teachers and students on the extent to which home factors contribute to students’ poor handwriting. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. There is the need to calculate the ‘effect size’ for this independent sample t-test statistic which yielded a no statistical significant result. From Table 7, the t-calculated is 1.57, \( n_1 = 150 \) and \( n_2 = 200 \), the eta squared could be calculated by replacing these values in the formula to get:

\[
\eta^2 = \frac{t^2}{t^2 + (n_1 + n_2 - 2)} = \frac{(1.57)^2}{(1.57)^2 + (150 + 200 - 2)} = 0.007033229 \approx 0.00703
\]

(4)

In this hypothesis, we can see that the eta value of 0.00703 is a very small effect size. Expressed as a percentage, (i.e. multiply the effect size by 100), only 0.703 per cent of the variance in the teacher variable could be explained by the student variable. In other words, effect size statistics which provides an indication of the magnitude of the difference between the two groups being statistically compared is 0.703 per cent.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard dev.</th>
<th>( N )</th>
<th>DF</th>
<th>( \alpha )</th>
<th>t-cal</th>
<th>t-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>3.69</td>
<td>1.02</td>
<td>150</td>
<td></td>
<td></td>
<td>1.57</td>
<td>1.96</td>
</tr>
<tr>
<td>Students</td>
<td>3.51</td>
<td>1.12</td>
<td>200</td>
<td>348</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 Discussion of Findings

From Table 1, the mean of all the items responded to are more than the mean benchmark of 3.50 and hence all the seven items listed were accepted as the possible effects of poor handwriting. Table 5 shows that teachers have a mean score of 3.98 and standard deviation of 1.03, while students have a mean score of 3.81 with a standard deviation of 1.11. Table 5 also shows that the t-calculated value is 1.48; using degree of freedom of 348 at 5% level of significance, the t-critical value of 1.96 is obtained. Since the t-calculated value of 1.48 is less than the t-tabulated value of 1.96, the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception between teachers and students on the impact of poor handwriting on students’ achievement in secondary school in mathematics. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. The effect size statistic which provides an indication of the magnitude of the differences between the two groups being statistically compared is only 0.63 per cent. This therefore implies that besides the fact that poor handwriting can weaken educational progress of students as it often interferes with learning, students with slow writing speed will not be able to complete mathematics examination even if they know the answers. It can be shown that when students find it difficult to write legibly, it affects their overall performance in schools and hence weakens the educational progress of students as it often interferes with their learning. This result agrees with Richards (2009) who maintained that poor handwriting can have negative impact on the success of the students in schools. Many students with poor handwriting are not able to write symbols well, and they cannot put their thought together coherently or write legibly in
examination and as such it affects their overall achievement in examination. A student who has difficulty with handwriting spends more time thinking about letter formation when he or she should be thinking of words or contents to be written. Poor handwriting can have a pervasive effect on school performance because handwriting is a basic tool used in taking notes, doing classroom work and assignment in mathematics. Lack of automatic recall may reduce the mental resources available for learning advanced computational algorithms especially in mathematics. Connelly, Dockrell and Barnett (2005) submitted that unless children learn to write legibly and at a reasonable speed, their educational achievements may be reduced and their self-esteem affected. The result is similar to the findings of Stainthorp (2008), who investigated the joint effect of marker expectation and handwriting quality on essay grades. To carry out the study, fabricated essay responses to questions on test theory were copied out in both very poor handwriting and very good handwriting. These responses were given to graduate students for scoring and it was found that good handwriting ensured better scoring. This result equally confirms the works of Markham (1999) who investigated the influences of handwriting quality on teacher evaluation of written work and reported that papers with better handwriting consistently received higher scores than did those with poor handwriting regardless of quality of content. This result also corroborates the earlier assertion by Graves (2012) who establishes the fact that an interaction exists between writer's handwriting quality and achievement score. Commenting on the quality of handwriting on score reliability, he submitted that if handwriting has a poor appearance, the writer is judged poorly by our culture and this won't end tomorrow as surface features will always attract far more attention than underlying structures. In his view, for a person who has poor handwriting, the road ahead is difficult; and despite his high quality of ideas and information, he will definitely bear a lifelong burden. In the Table 2, the means and standard deviations on the extent to which home factors contribute to students' poor handwriting are presented. Table 7 shows that since the $t$-calculated value of 1.57 is less than the $t$-tabulated value of 1.96, the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception of teachers and students on the extent to which home factors contribute to students' poor handwriting. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. The effect size statistics which provides an indication of the magnitude of the difference between the two groups being statistically compared is 0.703 per cent. This shows that even though many parents are concerned about the way their children write nevertheless, many of them don't create time to teach their children good handwriting at home. It can be inferred from this study that it is only the illiterate parents that do not bother about the way their children write in their mathematics books. This therefore shows that home is one of the factors that contribute to the incidence of poor handwriting in schools. Table 3 shows the mean and standard deviation of how teacher's attitudes contribute to students' poor handwriting in school. Table 6 shows that the $t$-calculated value of 0.52 is less than the $t$-tabulated value of 1.96, and therefore the test statistic is not significant. Hence the null hypothesis is accepted. The result shows that there is no significant difference in the mean perception between teachers and students on the extent to which teachers' attitudes contribute to students' poor handwriting in mathematics. Any physical difference observed between the mean scores of teachers and students is such that might have arisen from sampling errors or any other variations in the research. In this hypothesis, the eta value of 0.0163 is a small effect size and the magnitude of the difference between the two groups being statistically compared is 1.63 per cent. The result shows that even though many teachers see handwriting as a skill that students should be taught to enable them to do well in school mathematics, nevertheless, teachers' attitudes contribute significantly to students' poor handwriting habits in schools. Beside the fact that handwriting is not reflected in the school timetable by many teachers as a subject, in addition, lack of proper supervision of student's work at early stage of schooling contributes to their poor handwriting formation and among other variables. Research evidence shows that school teachers spend less than 10 minutes a day on handwriting. The finding of this study also confirms the submission by other researchers that many teachers have not
been given adequate preparation in the teaching of handwriting (Graham, Harris & Fink, 2009). According to them, a good number of teachers teach handwriting, albeit to a very limited extent, a vast majority of them had no training in the subject, had no curricular materials for it and, for good measure, didn’t enjoy it. The decline in the instruction of handwriting and its diminished use by students is not because handwriting has lost its purpose; it is due to a lack of teachers’ preparation. This implies that poor training in handwriting may result in common problems of mixture of capitals and lower case letters, illegible script, a mixture of cursive and poorly formed letters.

6 Conclusion

It can be concluded that when students find it difficult to write legibly, it affects their overall achievement in school mathematics and hence weakens their educational progress as it often interferes with their learning. The result shows that there is no significant difference in the mean perception between teachers and students on the impact of poor handwriting on students' achievement in secondary school mathematics. There is no significant difference in the mean perception between teachers and students on the extent to which home factors contribute to students’ poor handwriting. Home is one of the factors that contribute to the incidence of poor handwriting. Even though many parents are concerned about the way their children write nevertheless, many parents don’t create time to teach their children good handwriting at home. It can be inferred that it is only the illiterate parents that do not bother about the way their children write in their books. Moreover, there is no significant difference in the mean perception between teachers and students on the extent to which teachers’ attitudes contribute to students' poor handwriting in mathematics. Even though many teachers see handwriting as a skill that students should be taught to enable them to do well in school mathematics, nevertheless, teacher’s attitude contribute significantly to student’s poor handwriting habits in schools. Beside the fact that handwriting is not reflected in the school timetable by many teachers as a subject, in addition, lack of proper supervision of student’s work at early stage of schooling contributes to their poor handwriting formation in mathematics and among other variables.

7 Recommendations

In view of this research finding, teachers in schools should improve in the teaching of handwriting and also emphasize its importance in schools. The management of schools should organize seminars for teachers and students on the necessity of good handwriting and students should be made to practice writing legibly to maximize their performance in schools. Parents need to create time at their leisure period to teach their children good handwriting at home so as to complement the teachers’ effort in schools. Students should improve their handwriting skills by looking at pictures of neat and excellent handwriting. They should learn about spacing and placement of letters on a line, working on the shape of letters, and working on the spacing of words in a sentence. Word-processing programs and assistive technology is undeniably boons to children with writing problems. Relatively modest investments of instructional time devoted to teaching of handwriting in the earliest classes may help to prevent later writing difficulties for many children. Teachers should teach children consistent formation of letters using a continuous stroke if possible. In other words, children should learn a highly consistent way to form a given letter every time they write it.

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