THE RELATION OF THE TEACHING OF CHECKING
IN ARITHMETIC TO ACCURACY IN SEVERAL
PHASES OF SCHOOL WORK

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PHASES OF SCHOOL WORK

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CHAPTER I

INTRODUCTION

Introductory Comments

According to Gertrude Hildreth,

The modern aim in arithmetic teaching is prompt and accurate solution of practical problems such as the average person encounters in his daily affairs.

It is fundamental, therefore, that with pupils of sufficient intelligence attention be given to the solution of practical problems to insure the correct solution under all circumstances.1

It is the duty of the teacher to try to create within the child such a desire for accuracy that he will use any tool furnished him for securing this accuracy.

Thorndike says that

Arithmetic makes a very strong appeal to two potent interests—the interest in mental activity and the interest in achievement. Many children like arithmetic in the same way and for much the same reasons that they like puzzles, riddles, checkers, chess, and other intellectual games. Almost all children like to have their tasks definite so that they know what they have to do and when it is done. . . .2

In solving problems it seems that checking is the best means there is for the child to know when the work is complete.

1Gertrude Hildreth, Learning the Three R's, pp. 157-163.
Statement of the Problem

The problem for this study is to determine whether or not teaching children to check arithmetic problems contributes to accuracy (1) in problem solving, (2) in forming the habit of checking, and (3) in several other phases of school work.

Need for the Study

The realization that there is a very great need for children to develop the ability to solve practical problems with a high degree of accuracy and to form the habit of checking all work to find and correct errors is the basis for this study. Observations and comments by some of the authorities in the field of arithmetic on the lack of accuracy among students furnished general evidence that such a need existed.

The National Education Association in 1908 passed a resolution asking that the cause of the criticism that children were inaccurate in their fundamental skills be removed. Practice exercises and tests have multiplied. Books on the teaching of arithmetic give detailed instructions for securing accuracy. Yet the degree of accuracy that is prevalent is not considered satisfactory.\(^5\)

Source of Data

The data for this study were obtained by conducting an experiment with two sixth-grade groups in Carrigan School in Wichita Falls, Texas.

\(^5\)E. A. Bond, Arithmetic for Teacher Training Institutions, p. 50.
Research on the Problem

Some investigation was made, before the experiment was undertaken, as to what had been written on the relation of checking to accuracy in problem solving, on methods of checking used by different teachers, and on conclusions reached by others who have conducted similar studies.

Relation of checking to accuracy.--R. L. Morton says:

The habit of checking results in all computation is of fundamental importance. This habit should be developed and fixed in the primary grades and practiced consistently in the intermediate grades.4

In regard to the relation of checking to accuracy,

Morton states also that

No solutions should be accepted by the teacher until they have been checked and proved to be correct. In the intermediate grades, the checking habit should be so well fixed that the pupil after doing an example will proceed to check it as a matter of course.5

According to Brueckner and Grossnickle,

Checking usually has been accepted as one of the most effective means for securing accuracy in computation. The authors believe that pupils should be taught to check, but they qualify the procedure used in checking. The use of the check and the reason for it must be taught just as any other algorithm must be taught. The necessity for accuracy must be realized before a pupil can understand the function of checking...

5Ibid., p. 71.
It is just as essential to understand a check as it is to understand a process. The two go together. In a drill program which stresses accuracy, but not understanding, checking will produce no greater accuracy in subtraction than will result if checking is not required. On the other hand, if the pupil understands the process of subtraction and if he realizes the need of accuracy, checking is a necessary and essential part of the process. Checking is usually ineffective because the example does not have social significance. When the pupil has to find the answer to a real problem met in his experience, he uses checking as an essential part of the solution.6

Methods of checking.--Buckingham,7 Morton,8 Bond,9 and Brueckner and Grossnickle10 agree in most instances as to the best methods of checking. They agree that adding in the opposite direction is a useful check in addition and that one may check by adding in the same direction. The desirability of the former method is summed up by Morton as follows:

It is better then to check by adding in the opposite direction. This combining of the digits in a different order gives different partial sums than those secured by the first adding and thus makes it improbable that a former error will be repeated.11

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7B. R. Buckingham, Elementary Arithmetic, pp. 107, 139, 185, 192.


9Bond, op. cit.

10Brueckner and Grossnickle, op. cit.

11Morton, op. cit., p. 29.
In his discussion on checking subtraction, Morton says that "The best check is, perhaps, the simple expedient of adding the difference or remainder to the subtrahend and comparing the resulting sum with the minuend."\(^{12}\) To the use of this method all of the above-mentioned authors agree.

In the early work in multiplication, checking may be done by reversing the multiplicand and multiplier, but after the two processes have been taught, Morton thinks that "the multiplication examples should be checked by dividing the product by the multiplier and comparing the resulting quotient with the multiplicand."\(^{13}\)

Buckingham seems to express the viewpoint of the other writers mentioned when he states that

Division may be checked by finding the product of the divisor and the quotient and adding the remainder if there is any. There is an advantage in letting the divisor be the multiplier, thus reversing the multiplication already done in the process of dividing.\(^{14}\)

**Conclusions reached from similar studies.**--Several experiments have been reported made to determine the relation of checking to accuracy. Clark and Vincent experimented with pupils in grades five and six to determine the effect of checking in single-column addition. The results from their study seem to be favorable to the use of checking for producing

\(^{12}\)Ibid., p. 51.
\(^{13}\)Ibid., p. 101.
\(^{14}\)Buckingham, op. cit., p. 192.
accuracy. Parts of the conclusions of their study are as follows:

Although the checking group has less speed, it has greater accuracy than the non-checking group. . . .

In a random sampling of over 2000 column additions the non-checking group was found to have an accuracy of 77.9 per cent. In a sampling which represented the same working time the checking group had added less than half as many columns, but with an accuracy of 90.1 per cent. 15

These investigators conclude that their results are very difficult to interpret, but their findings seem to indicate that checking produces greater accuracy.

Grossnickle has reported several experiments on the effectiveness of checking. He conducted a study with seven groups of third-grade pupils in compound subtraction. Subtraction was taught for a period of twelve weeks. Each practice example was checked by addition during this time, and then a final test was given. He concludes that

The results of this investigation indicate that teaching checking at the time of learning the subtraction algorithm is not beneficial in producing greater accuracy than could be obtained if checking were not used. Therefore the checking process should not be taught simultaneously with the algorithm. Checking should be taught when the pupil understands the significance and value of a check. The data in this investigation show that for abstract examples checking is of doubtful value. Teach a pupil therefore the value of a check and how to use a particular check so that he can apply it when a real and vital problem is confronted.

Otherwise checking is sure to be superficial and a mere appendage to a given algorithm.\(^{16}\)

In reporting an experiment with fourth-grade pupils in which children were taught long division with a one-figure divisor and required to check by multiplying, Grossnickle says:

This investigation has shown only that checking in long division with a one-figure divisor is of no value for obtaining or maintaining 100 percent accuracy when the process is taught in Grade IV. . . . The pedagogical implications of these findings are important. Since almost as much time is required to check an example as to work the example itself, a distinct economy of time would result if the division process were taught without reference to checking.\(^{17}\)

Setting Up the Experiment

Ninety sixth-grade pupils of Corrigan School, Wichita Falls, Texas, were given an Otis Quick-Scoring Mental Ability Test, Beta A and a Stanford Achievement Test, Intermediate Battery-Partial, Form D at the beginning of the school year. The battery of tests included tests in arithmetic, spelling, reading, and language usage. Two equated groups were set up according to the results of the intelligence test. The groups were designated as the control group and the experimental group.


\(^{17}\)Foster E. Grossnickle, "To Check Or Not to Check?" *Elementary School Journal*, XXXVI (September, 1935), 39.
During the next four months the control group was given the ordinary instruction in arithmetic as outlined in the Wichita Falls Course of Study with the usual instruction on the value of accuracy in problem solving, but the pupils were not required to check their problems. On the other hand, the experimental group was given special drill each day on the value and use of checking, and the pupils were required to check each problem solved in addition to the usual instruction in sixth-grade arithmetic.

At the end of the four and one-half months' testing period, the Stanford Achievement Test, Intermediate Battery-Partial, Form G was given. The results of this test, along with those of the first achievement test, were set up in tables so that a comparison could be made between the two groups of children. Analysis of the results of the tests was made to determine the relation between checking and accuracy in several other phases of school work.

For another four and one-half months the two groups were given the same instruction. During this period checking was not required in either group, though accuracy was stressed in both. At the end of this period a Stanford Achievement Test, Intermediate Battery-Partial, Form E was administered to the two groups, and the results were compared with those of the two previous tests to see what relation yet existed between the teaching of checking and accuracy in problem solving and
between the teaching of checking and accuracy in several other phases of school work.
CHAPTER II

THE INFLUENCE OF THE TEACHING OF CHECKING UPON
THE DEVELOPMENT OF ACCURACY IN ARITHMETIC

The results of all the Stanford Achievement Tests in
arithmetic and the results of the Otis Quick-Scoring Mental
Ability Tests are given in Tables 1 through 5. A comparison
of these results is also included.

The Beta Intelligence Quotients given in the following
tables show an almost perfect equation for the two groups.
The medians are 99 in each case; the means are 99.5 and 99.4,
respectively, and the range is 78 to 124 for the control
group, whereas the range is from 82 to 127 for the experi-
mental group.

Table 1 shows a comparison between the arithmetic scores
for September and those for January. The September median
score was 54 for each group. The range was 40 to 60 for the
control group and 40 to 61 for the experimental group. The
mean score for the control group was 52.5 and that for the
experimental group was 52.3. Therefore, the groups were very
well matched at the beginning of the term.

The January median scores are 56 for the control group
and 57 for the experimental group. The mean scores are 55.8
and 56.4, respectively, and the scores range in the control
group from 44 to 68 and in the experimental group from 38 to 70; therefore, the control group had a median score 2 points higher and a mean score 3.3 points higher. The experimental group had a median score 3 points higher and a mean score 3.6 points higher in January than it had been in September.

### TABLE 1

**COMPARATIVE SCORES OF THE EQUATED GROUPS ON THE OTIS-BETA TESTS AND THE ARITHMETIC TESTS FOR THE FIRST SEMESTER**

<table>
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<tr>
<td>2</td>
<td>109</td>
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<td>3</td>
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<td>5</td>
<td>101</td>
<td>53</td>
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<td>6</td>
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<td></td>
<td>82-127</td>
<td>40-61</td>
<td>38-70</td>
<td></td>
</tr>
</tbody>
</table>

Total gain in points 150 169

Table 1 further reveals that the total gain for the control group was 150 points for the semester, whereas the experimental group gained 169 points, or 19 points more than the control group.

Table 2 shows the results of a comparison to determine which group had the greater number of people who increased their scores in arithmetic.
TABLE 2
NUMBER PEOPLE MAKING A GAIN IN
ARITHMETIC SCORES

<table>
<thead>
<tr>
<th>Change</th>
<th>September-January</th>
<th>January-May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Experimental Group</td>
</tr>
<tr>
<td>Gain</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>No change</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Loss</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

The scores for the control group show that thirty-five people made a greater score in January than they did in September; there were seven people whose scores did not change, and there were three whose scores were lower than those of the first test. The scores for the experimental group show that forty people made a greater score on the second test; there were two whose scores did not change, and there were three whose scores were less than those of the first. Again the experimental group took the lead, since five more people of that group increased their scores on the second test than did those of the control group.

Table 3 is a comparative study of the effect of teaching checking in arithmetic upon children with different degrees of mental ability. This comparison reveals that the children of superior intelligence who did check showed the highest average with 6.2 points gained per pupil. The group with average intelligence shows the next greatest gain with an
average of 3.8 points gained per person, whereas the children with lowest intelligence quotients show the least gain.

**TABLE 3**

A COMPARATIVE STUDY OF THE EFFECT OF TEACHING CHECKING IN ARITHMETIC ON CHILDREN WITH DIFFERENT DEGREES OF MENTAL ABILITY

<table>
<thead>
<tr>
<th>I. Q.</th>
<th>Average Points Gained Per Pupil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
</tr>
<tr>
<td>110-127</td>
<td>3.0</td>
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<tr>
<td>90-110</td>
<td>3.7</td>
</tr>
<tr>
<td>78-90</td>
<td>1.3</td>
</tr>
</tbody>
</table>

In the control group, the children with intelligence quotients between 90 and 100 showed a slightly higher average with 3.7 points gained per pupil. The children with intelligence quotients between 110 and 127 made the next highest gain with an average of 3.0 points per pupil, whereas the children with lowest intelligence quotients show the least gain.

A summation of the gains made by each group shows that the group that was required to check had a median grade 1.0 point higher, a mean score 0.3 point higher, a total score 19 points higher, and five more people had made a gain in score. These figures seem to indicate that requiring children to check, in this case, did not have a great influence on
accuracy in problem solving. However, in working with the children through the year, it was noted that many children in the group that was not required to check did use some means of checking their problems for accuracy; therefore, it seems that teaching checking has a value in that some children will check as a matter of course when they understand the process.

Since one of the purposes of this study is to determine whether or not teaching children to check arithmetic problems contributes to accuracy in forming the habit of checking, Table 4 was set up to compare January scores with those made in May. During this period none of the children were required to check, though accuracy was stressed in both classes.

**Table 4**

Comparative Scores of the Equated Groups on the Otis-Beta Tests and the Arithmetic Tests for the Second Semester

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>109</td>
<td>68</td>
</tr>
<tr>
<td>2</td>
<td>109</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>108</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>94</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>101</td>
<td>56</td>
</tr>
<tr>
<td>6</td>
<td>102</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>99</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>101</td>
<td>63</td>
</tr>
<tr>
<td>9</td>
<td>85</td>
<td>49</td>
</tr>
<tr>
<td>10</td>
<td>91</td>
<td>55</td>
</tr>
<tr>
<td>11</td>
<td>89</td>
<td>51</td>
</tr>
<tr>
<td>Pupils</td>
<td>Control Group</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>12</td>
<td>109</td>
<td>63</td>
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<tr>
<td>13</td>
<td>85</td>
<td>47</td>
</tr>
<tr>
<td>14</td>
<td>102</td>
<td>54</td>
</tr>
<tr>
<td>15</td>
<td>73</td>
<td>44</td>
</tr>
<tr>
<td>16</td>
<td>116</td>
<td>59</td>
</tr>
<tr>
<td>17</td>
<td>97</td>
<td>63</td>
</tr>
<tr>
<td>18</td>
<td>101</td>
<td>56</td>
</tr>
<tr>
<td>19</td>
<td>110</td>
<td>57</td>
</tr>
<tr>
<td>20</td>
<td>108</td>
<td>57</td>
</tr>
<tr>
<td>21</td>
<td>91</td>
<td>50</td>
</tr>
<tr>
<td>22</td>
<td>101</td>
<td>60</td>
</tr>
<tr>
<td>23</td>
<td>124</td>
<td>56</td>
</tr>
<tr>
<td>24</td>
<td>93</td>
<td>51</td>
</tr>
<tr>
<td>25</td>
<td>94</td>
<td>57</td>
</tr>
<tr>
<td>26</td>
<td>95</td>
<td>57</td>
</tr>
<tr>
<td>27</td>
<td>99</td>
<td>54</td>
</tr>
<tr>
<td>28</td>
<td>105</td>
<td>54</td>
</tr>
<tr>
<td>29</td>
<td>99</td>
<td>56</td>
</tr>
<tr>
<td>30</td>
<td>98</td>
<td>46</td>
</tr>
<tr>
<td>31</td>
<td>97</td>
<td>57</td>
</tr>
<tr>
<td>32</td>
<td>88</td>
<td>54</td>
</tr>
<tr>
<td>33</td>
<td>101</td>
<td>61</td>
</tr>
<tr>
<td>34</td>
<td>82</td>
<td>51</td>
</tr>
<tr>
<td>35</td>
<td>105</td>
<td>56</td>
</tr>
<tr>
<td>36</td>
<td>103</td>
<td>60</td>
</tr>
<tr>
<td>37</td>
<td>100</td>
<td>62</td>
</tr>
<tr>
<td>38</td>
<td>96</td>
<td>47</td>
</tr>
<tr>
<td>39</td>
<td>100</td>
<td>47</td>
</tr>
<tr>
<td>40</td>
<td>96</td>
<td>65</td>
</tr>
<tr>
<td>41</td>
<td>91</td>
<td>63</td>
</tr>
<tr>
<td>42</td>
<td>121</td>
<td>68</td>
</tr>
<tr>
<td>43</td>
<td>99</td>
<td>52</td>
</tr>
<tr>
<td>44</td>
<td>115</td>
<td>59</td>
</tr>
<tr>
<td>45</td>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>Median</td>
<td>99</td>
<td>56</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>55.8</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>44-63</td>
</tr>
<tr>
<td>Total gain in points</td>
<td>152</td>
<td></td>
</tr>
</tbody>
</table>
A comparison of the May scores of the two groups shows that each group had a median score of 60, that the control group had a range of 46 to 74, and the experimental group had a range of 44 to 74. The experimental group had a mean score of 60.1, which is greater by 0.9 point than that of the control group. The experimental group also had an increase in mean score of 3.7 points since mid-term; whereas the control group had an increase in mean score of only 3.4 points. The total points gained by the control group were 152; whereas the experimental group showed a gain of 164 points, or 12 points more than the control group. Furthermore, Table 2 showed that during the last half of the school year, thirty-seven people in the control group made a gain; one did not change his score; and seven made a lower score. In the experimental group thirty-four people made a gain in score; five showed no gain; and six made a lower score. However, the results of Table 4 show that the thirty-seven people in the control group gained 178 points, which was an average of 4.8 points per person, and the thirty-four people in the experimental group gained 182 points, or 5.4 points per person. The seven people in the control group lost 24 points the last semester, which was an average loss of 3.4 points per person; whereas the six people in the experimental group lost only 18 points, or an average of 3.0 points per person.
Since the May scores for the experimental group show a greater mean score, and since they show a greater gain in mean score, and since the people in the experimental group who did show a gain made a greater average on points gained per person, it seems safe to assume that at least some of the children in the experimental group were more accurate because they had formed the habit of checking.

Table 5 is a summation of the work for the year and is intended to show the total gains made by the two groups.

**TABLE 5**

A COMPARISON OF THE EQUATED GROUPS AS TO TOTAL RESULTS FOR THE YEAR IN ARITHMETIC

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th></th>
<th>Experimental Group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sept.</td>
<td>May</td>
<td>Gain</td>
<td>Sept.</td>
<td>May</td>
<td>Gain</td>
</tr>
<tr>
<td>Median</td>
<td>54</td>
<td>60</td>
<td>6</td>
<td>54</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>Mean</td>
<td>52.5</td>
<td>59.2</td>
<td>6.7</td>
<td>52.8</td>
<td>60.1</td>
<td>7.3</td>
</tr>
<tr>
<td>Range</td>
<td>40-60</td>
<td>46-74</td>
<td>-3 to 17</td>
<td>40-61</td>
<td>44-74</td>
<td>-4 to 17</td>
</tr>
<tr>
<td>Points</td>
<td>2361</td>
<td>2663</td>
<td>302</td>
<td>2370</td>
<td>2703</td>
<td>333</td>
</tr>
</tbody>
</table>

The median gain for each group was 6 points; the mean gain for the control group was 6.7 points, whereas the mean gain for the experimental group was 7.3 points. The total gain for the control group was 302 points against 333 points for the experimental group.
Again these total gains seem to indicate that requiring children to check does not have any great influence on accuracy in problem solving. In observing the children throughout the year as they worked, however, it was noted that many of the children in the control group checked each solution of a problem, regardless of requirements. It was also noted that those children who realized the necessity of accuracy, and who understood the use of a check, used it as a matter of course. The most significant implication as to the value of teaching checking which was noted was that when the pupil had to find an answer to a real problem met in his experience, he was much more likely to use checking as an essential part of the solution.
CHAPTER III

THE INFLUENCE OF THE TEACHING OF CHECKING IN
ARITHMETIC UPON ACCURACY IN SEVERAL
OTHER PHASES OF SCHOOL WORK

The results of all the Stanford Achievement Tests administered in spelling, reading, and language usage, and the results of the Otis Mental Ability Tests are given in Tables 6 through 17. A comparison of these results is also included.

Influence on Spelling

Table 6 shows a comparison between the spelling scores for September and those for January.

TABLE 6

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE FIRST SEMESTER IN SPELLING

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th></th>
<th></th>
<th>Experimental Group</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>50</td>
<td>55</td>
<td>5</td>
<td>99</td>
<td>53</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>51.9</td>
<td>54.1</td>
<td>2.2</td>
<td>99.4</td>
<td>52.1</td>
<td>54.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>37-69</td>
<td>38-72</td>
<td>-5 to 11</td>
<td>82-127</td>
<td>40-74</td>
<td>34-75</td>
<td>-6 toll</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2337</td>
<td>2433</td>
<td>96</td>
<td>....</td>
<td>2346</td>
<td>2455</td>
<td>109</td>
</tr>
</tbody>
</table>

The September median score was 50 for the control group and 53 for the experimental group. The range was 37 to 69.
for the control group and 40 to 74 for the experimental group. The mean scores were 51.9 points and 52.1 points, respectively.

The January median scores were 55 for each group. The range was 38 to 72 for the control group and 34 to 75 for the experimental group. The mean scores were 54.1 for the control group and 54.6 for the experimental group; therefore, the control group had a median score 5 points higher and a mean score 2.2 points higher. The control group had a median score 2 points higher and a mean score 2.5 points higher. Table 6 further reveals that the control group's total gain was 96 points, and the experimental group's gain was 109 points, or 13 points more than that of the control group. These figures seem to indicate that requiring checking in arithmetic contributed very little, if any, to accuracy in spelling.

Table 7 shows the results of a comparison to determine which group had the greater number of people to increase their scores in spelling. The scores for the control group show thirty people making a greater score in January than in September, five people whose scores did not change, and ten people whose scores were lower than those of the first test. The scores for the experimental group show thirty-seven people making a greater score on the second test, four whose scores did not change, and four whose scores were less
than those of the first test. These results indicate that there were seven more people in the experimental group who made increased scores in January and six fewer who made losses in scores.

**TABLE 7**

A COMPARATIVE STUDY OF THE NUMBER OF PEOPLE MAKING A GAIN OR LOSS IN SPELLING SCORES FOR THE YEAR

<table>
<thead>
<tr>
<th>Change</th>
<th>September-January</th>
<th>January-May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Experimental Group</td>
</tr>
<tr>
<td>Gain</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>No change</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Loss</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

Summing up the gains made by each group, it is found that the control group had a mean score of 0.3 point higher, a total score 13 points higher, and seven more people had made a gain in score. These figures seem to indicate that requiring children to check arithmetic had little effect, if any, on their accuracy in spelling.

Table 8 was set up to compare January spelling scores with those made in May. In comparing the May scores of the two groups it is found that each group has a median score of 58, that the control group has a range of 44 to 77, and that the experimental group has a range of 43 to 82. But the control group had a mean score of 58.5 points, which was
greater than that of the experimental group by 0.5 point. Also, the control group had a mean score 4.4 points higher; whereas the experimental group had a mean score only 3.4 points higher; and the total points gained by the control group were 189. The experimental group gained only 153 points. Table 7 shows that during the last half of the school year, thirty-four people in the control group made a gain in score; four people showed no change in score; and seven people had a lower score.

TABLE 8

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE SECOND SEMESTER IN SPELLING

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>55</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>54.1</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>33-72</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2433</td>
</tr>
</tbody>
</table>

In the experimental group thirty-five people made a gain in score; two made no change in score; and eight people had a lower score. Again these figures seem to indicate that the teaching of checking in arithmetic did not influence accuracy in spelling to a very great degree.

A comparison of the two equated groups as to results in spelling for the year is given in Table 9. The median score
for the control group was 8 points higher at the end of the year; the mean score was 6.6 points higher; and the total score was 235 points more. The median score for the experimental group was 5 points higher at the end of the year; the mean score was 5.9 points higher; and the total score was 262 points more.

**TABLE 9**

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE YEAR IN SPELLING

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>50</td>
<td>58</td>
<td>8</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>51.9</td>
<td>58.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>37-69</td>
<td>44-77</td>
<td>-3 to 16</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2337</td>
<td>2632</td>
<td>285</td>
</tr>
</tbody>
</table>

Although the experimental group showed a slight gain over the control group the first semester, the control group made a greater gain for the last semester and for the entire year; therefore, the effect of requiring checking in arithmetic, according to this study, had very little influence, if any, on accuracy in spelling.

**Influence on Reading**

The following tables, Tables 10 through 13, are included to show the comparative results of the reading scores for the
two equated groups. Table 10 was set up to compare reading scores made in September with those made in January.

**TABLE 10**

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE FIRST SEMESTER IN READING

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>54</td>
<td>56</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>54.3</td>
<td>56.4</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>39-72</td>
<td>34-76</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2445</td>
<td>2540</td>
</tr>
</tbody>
</table>

The September median score was 54 for the control group and 52 for the experimental group. The range was 39 to 72 for the control group and 38 to 71 for the experimental group. A mean score of 54.3 points for the control group gave that group a lead of two points over the experimental group, whose mean score was only 52.3 points.

At the end of the first semester the control group had a median score of 56, a gain of two points; whereas the experimental group had a median score of 55, a gain of three points. The control group had a mean score of 56.4 points, a gain of 2.1 points; whereas the experimental group had a mean score of 54.1 points, or a gain of 1.8 points. The total gain for the control group was 95 points and for the
experimental group, 81 points. These figures show that, in this case, requiring checking in arithmetic had little, if any, influence on accuracy in reading.

Table 11 shows that during the first semester the control group had thirty people making a gain in score, four who made no gain, and eleven who made lower scores. The experimental group had twenty-nine people showing a gain in score, four showing no gain, and twelve showing a lower score.

**TABLE 11**

A COMPARATIVE STUDY OF THE NUMBER OF PEOPLE MAKING A GAIN OR LOSS IN READING SCORES FOR THE YEAR

<table>
<thead>
<tr>
<th>Change</th>
<th>September-January</th>
<th>January-May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Experimental</td>
</tr>
<tr>
<td>Gain</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>No change</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Loss</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

The results from this comparison are almost identical, with one person less in the experimental group showing a gain and one person more showing a loss in score. This fact again seems to indicate that the requiring of checking in arithmetic had very little influence, if any, on accuracy in reading.

Table 12 shows a comparison in reading scores for the two groups for the last semester of the year. The May scores
reveal that the control group had a median score of 61, a range of 42 to 76, and a mean score of 59.8 points. The experimental group had a median score of 60, a range of 34 to 73, and a mean score of 58.2 points.

**TABLE 12**

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE SECOND SEMESTER IN READING

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>56</td>
<td>61</td>
<td>5</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>56.4</td>
<td>59.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>34-76</td>
<td>42-76</td>
<td>-8 to 10</td>
</tr>
<tr>
<td>Points</td>
<td>...</td>
<td>2540</td>
<td>2692</td>
<td>152</td>
</tr>
</tbody>
</table>

Each group had a median score 5 points higher, but the experimental group had a mean score 4.1 points higher, whereas the control group had a mean score only 3.4 points higher. The experimental group had gained 183 total points, and the control group gained only 153 total points.

Table 11 showed that thirty-four people in the control group made a gain in score; seven made no change in score, and four made lower scores. In the experimental group thirty-eight people had a higher score, and seven people made no change in score. In the last semester, then, the experimental group took the lead in gain in reading scores. These
figures seem to indicate that requiring checking in arithmetic had a delayed influence, if any, on accuracy in reading.

Table 13 is a summation of the results of the test scores in reading for the entire year. This comparison shows that the control group had a median score seven points higher, a mean score 5.5 points higher, and a gain in total score of 247 points.

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>54</td>
<td>61</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>54.3</td>
<td>59.8</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>39-72</td>
<td>42-76</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2445</td>
<td>2692</td>
</tr>
</tbody>
</table>

The experimental group had a median score 8 points higher, a mean score 5.9 points higher, and a gain in total score of 264 points. Although the experimental group had a median score one point more, a mean score 0.4 point more, and a total score 17 points more, this gain was made during the last semester; therefore, if requiring checking in arithmetic had any influence on accuracy in reading, it was a delayed influence.
Influence on Language Usage

The following tables, Tables 14 through 17, are included to show the comparative results of the language usage scores for the two equated groups. Table 14 is a comparison between language scores taken from the tests given in September and those given in January. The September scores show that the control group had a median score of 59, a mean score of 58.2 points, and a range of 37 to 76 points. The experimental group had a median score of 55, a mean score of 55.2 points, and a range of 39 to 76 points. This comparison reveals that at the beginning of the semester the control group had a median score 4 points higher, and a mean score 2.7 points higher in language usage than did the experimental group.

**TABLE 14**

A COMPARISON OF THE EQUATED GROUPS AS TO RESULTS FOR THE FIRST SEMESTER IN LANGUAGE USAGE

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>59</td>
<td>55</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>58.2</td>
<td>55.2</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>37-76</td>
<td>38-75</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2621</td>
<td>2435</td>
</tr>
</tbody>
</table>

A look at the January scores shows a loss for each group rather than a gain. The control group had dropped from a
median score of 59 to a median score of 55 and had dropped from a mean score of 58.2 points to 55.2 points. The experimental group had dropped from a median score of 55 to a median score of 49 and had dropped from a mean score of 55.2 points to a mean score of 52.6 points. Table 14 further reveals that the control group had a loss of 136 points, whereas the experimental group had a loss of 132 points. This comparison of results seems to indicate that teaching checking in arithmetic had very little influence, if any, on accuracy in language usage.

Table 15 shows the total number of people who made gains and losses during the year in language usage scores.

### TABLE 15

A COMPARATIVE STUDY OF THE NUMBER OF PEOPLE MAKING A GAIN OR LOSS IN LANGUAGE USAGE SCORES FOR THE YEAR

<table>
<thead>
<tr>
<th>Change</th>
<th>September-January</th>
<th>January-May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Experimental Group</td>
</tr>
<tr>
<td>Gain</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>No change</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Loss</td>
<td>31</td>
<td>26</td>
</tr>
</tbody>
</table>

The control group had thirteen people who made a gain in score, one who made no change, and thirty-one people who made a loss in score. The experimental group had seventeen people
who made a gain in score, two people who showed no gain, and twenty-six people who showed a loss in score.

Again, there is very little difference between the two groups. The experimental group shows a very slight lead over the control group. No attempt will be made to explain the drop in scores, for there is no reason known.

Table 16 was set up to compare language usage scores for January and those for May. The May scores for the control group show a median of 65, a mean score of 61.0 points, and a range of 36 to 82 points. At the same time, the experimental group had a median score of 63, a mean score of 60.8 points, and a range in scores from 42 to 78.

![Table 16](image)

A COMPARISON OF THE EQUIATED GROUPS AS TO RESULTS FOR THE SECOND SEMESTER IN LANGUAGE USAGE

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>55</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>55.2</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>38-75</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2485</td>
</tr>
</tbody>
</table>

The experimental group had a median score 14 points higher and a mean score 8.2 points higher, whereas the control group had a median score only 10 points higher and a
mean score only 5.8 points higher. The experimental group had an increase in total score of 367 points, whereas the control group had an increase in total score of only 261 points, or 106 points less than the experimental group.

Table 15 showed that during the last semester of the year there were thirty-two people in the control group who made a gain in score and thirteen people who made a lower score. In the experimental group, thirty-four people made a gain in score; four showed no gain, and seven people made a lower score.

Table 17 is a summation of the scores for the year and is intended to show the total gains made in language usage by each group.

TABLE 17
A COMPARISON OF THE EQUIVED GROUPS AS TO RESULTS FOR THE YEAR IN LANGUAGE USAGE

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>99</td>
<td>59</td>
</tr>
<tr>
<td>Mean</td>
<td>99.5</td>
<td>53.2</td>
</tr>
<tr>
<td>Range</td>
<td>78-124</td>
<td>37-76</td>
</tr>
<tr>
<td>Points</td>
<td>....</td>
<td>2621</td>
</tr>
</tbody>
</table>

The median gain for the control group was 6 points; the mean gain was 2.8 points, and the total points gained, 125.
The experimental group had a median gain of 8 points, a mean gain of 5.3 points, and the total gain for the year was 235 points. Therefore, the experimental group made a considerable gain over the control group in accuracy in language usage. However, at the end of the year the experimental group had a median score 2 points lower and a mean score 0.2 point lower than the control group.

Again, if requiring checking in arithmetic had any influence on accuracy in language usage, it was a delayed influence, for the gain came during the last semester of the year.
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The findings of this study relative to the value of requiring checking in arithmetic are given in the following paragraphs.

A comparison of the arithmetic scores for the first semester showed small gains by the experimental group and also showed that the teaching of checking had the greatest influence on the children with superior intelligence. During the second semester the experimental group again showed slight gains over the control group.

In spelling, the experimental group took a slight lead over the control group the first semester, but during the second semester the control group showed a greater gain in spelling.

In reading the control group made a slight gain over the experimental group during the first semester, but during the last semester the experimental group made a greater gain.

In language usage both groups showed a loss during the first semester, but during the second semester the experimental group made a large gain over the control group.
Conclusions

The results of this experiment led to these tentative conclusions:

1. That the requiring of checking did not seem to have any great influence on accuracy.

2. That since some children in the control group did check, regardless of requirements, teaching checking has a value in that many children will check as a matter of course when they understand the process.

3. That the teaching of checking had the greatest influence on children with superior intelligence.

4. That since the experimental group made greater gains than did the control group during the last semester, at least some of the children in the experimental group were more accurate because they had formed the habit of checking.

5. That the requiring of checking in arithmetic had very little influence, if any, on accuracy in spelling.

6. That requiring checking in arithmetic had a delayed influence, if any, on accuracy in reading.

7. That the requiring of checking in arithmetic seemed to have some delayed influence in reading and a greater delayed influence in English.

Recommendations

1. It is recommended that accuracy be stressed so that the pupil will realize the necessity of checking.
2. It is recommended that checking be taught when the pupil understands the significance and value of a check.

3. It is recommended that the pupil be taught when and how to use a particular check so that he can apply it when a real and vital problem is met.
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