EFFECTS OF CARBOHYDRATES ON
PERFORMANCE OF FIFTH GRADE
MATHEMATICAL STUDENTS

MASTER'S PROJECT

Submitted to the School of Education,
University of Dayton, in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by

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Dayton, Ohio

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Approved by:
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ACKNOWLEDGMENTS

A special acknowledgment to my fifth graders for participating in this experimental project. Without their support and willingness to participate, it would have been impossible to have completed the project.

Also, a special acknowledgment to my fifth grade teaching team. Their flexibility in scheduling of mathematics and allowing their students to participate helped make the project a positive experience for all.
DEDICATION

I dedicate this project to my family for being patient while I met personal challenges that were important to me, but required much sacrifice from them.
CHAPTER I
INTRODUCTION TO THE PROBLEM

Purpose of the Study

American children are not measuring up with students from other countries in mathematical achievement (Brown, 1988). A study was conducted by the National Assessment of Educational Progress of Princeton, New Jersey, and based on tests given to 150,000 pupils from 1972 to 1986. Findings showed that more than one-fourth of those 13 year old middle schoolers surveyed could not handle elementary school arithmetic and that one-third of those eleventh graders said they generally did not understand what the mathematical teacher was talking about. The National Assessment of Educational Progress document noted that the average Japanese high schooler does better than the top five percent of Americans taking college-prep courses.

In researching why our students are failing to perform in mathematic and science competition, the writer reviewed literature that offers suggestions to be considered relating to student mathematical achievement.

A world-renowned authority on children's mental behavior, Conners, author of Feeding the brain: How foods affect children (1989), states:

Food has profound effects on higher mental functions, even in well-nourished amounts: Foods can enhance problem ability, optimize alertness, improve mood and behavior in normal children. Contrarily, foods can also impair children whose behavior and learning are already in trouble from other causes, hampering their
efforts to concentrate and maintain self-control. Over an extended period, food affects basic intelligence.

In the reviewing of literature pertaining to learning and nutrition, apparently food plays an important role in student academic performance. The writer also realizes that the study of nutrients involved a large field of study, so this project primarily focused on the importance of high and low carbohydrate foods in student diet.

Carbohydrates are the most efficient food source of energy there is. One’s body burns what it needs immediately and stores what is left as energy reserve. High carbohydrate foods include fruits, vegetables, cereals, legumes, and grains made up of both simple and complex carbohydrates (Hoppe, 1987).

Foods, such as honey, that are high in simple carbohydrates (sugar) are easily digested and provide quick energy followed by energy slump. Carbohydrates are digested slowly, offering a steady energy source (Hoppe, 1987).

Why are carbohydrates necessary in the first place? Simply speaking, carbohydrates are the most efficient fuel for most of the body’s functions. Only three other energy sources are available to the body: protein, fat, and alcohol. Protein rich foods are generally expensive and provide no advantage over carbohydrates when used as a fuel, and excess consumption has many negative side effects. Alcohol with its empty calories provides only energy with no nutritional value at all (Baird, 1989).

It was the writer’s intention to study carbohydrates and conduct an experimental project that would offer more insight into the role of carbohydrates in nutrition and the learning process.
Statement of the Problem

The purpose of this study was to determine whether there was a significant improvement in the mathematical scores of students given high carbohydrate and students given low carbohydrate snacks before mathematical instruction.

Hypotheses

There will be no significant difference between the mean pretest and posttest scores of students receiving high carbohydrate snacks before being instructed in mathematical concepts.

There will be no significant difference between the mean pretest and posttest scores of students receiving low carbohydrate snacks before being instructed in mathematical concepts.

Assumptions

To carry out this study the writer must have made the following assumptions. First, students will participate in a pre and posttesting that will measure achievement scores in mathematics. Furthermore, the writer assumed the pre and posttests would consistently measure achievement in mathematical concepts being taught. Lastly, the writer assumed that students would answer questions, follow up with activities assigned, and do their best on the pre and posttest.

Limitations

The writer found several limitations affecting this project. One limitation was that in dealing with different student reactions to foods, this could influence outcome of project. Another limitation could be the influence of parent support
with homework or follow-up to class instruction. Furthermore, the writer is limited to working with a small sample of the total mathematical population. Also, the writer realized the teaching of a concept improves as the teacher becomes familiar with the teaching approach needed. The remaining limitations would deal with factors of the internal and external validity of the design. Factors affecting internal validity include the effect of history, pretesting influences, and the change in instrumentation. Factors affecting external validity include confounding effects of pretesting and the interaction of effects of selection and treatment.
Definition of Terms

**Attention Deficit Disorder** — is the inability to focus without being easily distracted.

**Carbohydrates** (complex) — are made up of long strands of simple sugars. They are found in grains, fruits, legumes (peas and beans), and other vegetables. They include three types of dietary fiber — cellulose, hemicellulose, and gums — and starches.

**Carbohydrates** (simple) — are sugars that can be found in various foods. Glucose, the most important sugar in the body, is the primary form of energy.

**Dietary fiber** — like starches, are found abundantly in plants, especially in the outer layers of cereal grains and the fibrous parts of fruits, legumes, and other vegetables.

**Fat** — is any of the compounds of carbon, hydrogen, and oxygen that the glycerides of fatty acids, the chief constituents of plant and animal fat, and a major class of energy-rich food.

**Hyperactivity** — is excessive or abnormal activity.

**Hypoglycemia** — is the abnormal decrease of sugar in the blood.

**Malnutrition** — is inadequate nutrition.

**Nutrition** — is nutrients that nourish or promote growth.

**Protein** — is any group of complex nitrogenous organic compounds of high molecular weight that contain amino acids as their basic structure units and that occur in all living matter and are essential for the growth and repair of animal tissue.
Serotonin level — is one of the brain’s chemical messengers that is involved in sleep, pain perception, and motor activity.

Starch — is a white powdery complex carbohydrate that is the chief storage form of carbohydrates in plants.

Tryptophan — is an amino acid that increases the production of the calming neurotransmitter serotonin in the brain.
CHAPTER II
LITERATURE REVIEW

Effects of Nutrition Upon Academic Achievement

Adequate or inadequate nutrition affects children's cognitive development in academic achievement. Folland (1992) suggests that the issues to be considered are hunger and nutrition. First, children cannot concentrate, enjoy school, or truly learn if they are hungry. Secondly, it is well-documented that kids need adequate nutrients for their cognitive development. For example, severe iron deficiency can affect cognitive development two or three years later, even if the deficiency is corrected. Folland suggests that a good balanced lunch includes one cup milk, two ounces of protein, a fruit, a vegetable, and two portions of starches.

According to Pertz and Putnam (1982), undernourished children consistently have been found to have poor academic achievement and lower IQ's. Both agree that educators should develop and monitor nutrition education programs, stimulate children's awareness of good nutrition, and work with parents and school authorities to replace candy, sweets, and colas in vending machines with fruits, nuts, milk, and fruit juices.
A new report published by National Education Association Human and Civil Rights states clearly: Nutrition has a strong physical, emotional, and intellectual impact on a child’s ability to learn.

Weiss (1988) reported when children are undernourished or hungry, they are less attentive, less independent, less curious, less interested in their environments, less responsive socially, and less able to concentrate. They are also more apathetic, more irritable, more tired, and more anxious. None of these traits is conducive to learning. Folland and Weiss agree that a child who exercises often has a better control over appetite and exercise builds self-esteem and a healthy attitude.

Research also suggests that students who choose to eat a nutritious breakfast are affected by academic achievement gains over those who choose not to eat breakfast. Achievement scores of students choosing to eat breakfast were compared with those who chose not to. While achievement gains showed up in both those who ate breakfast and those who did not, the ones eating breakfast showed increases roughly two percent higher in mathematical, four percent higher in reading, and more than six percent higher in language skills (Raloff, 1989). Boston University pediatrician, Alan F. Meyers (1987), concludes differences of this magnitude may mean the difference between promotion and retention many times.

A psychologist (Benton) of University of College in Sivansea, Wales, co-authored a study showing a similar modest gain in nonverbal intelligence test scores for Welsh children receiving vitamin and mineral supplements. In data
from his unpublished follow-up involving one hundred sixty-nine Belgian students, Benton (1988) suggested: What we are measuring are effects of poor diets on a child's ability to concentrate (Raloff, 1989).

**Effects of High and Low Carbohydrate Foods on Learning**

Researcher Chollar (1988) acknowledges the growing catalogue of opinions about the effect of food on our moods, mental acuity, and behavior. When it comes to the complex realms of mood and mental performances, pieces of the carbohydrate puzzle are only just beginning to fall into place.

According to nutrition researcher Wurtman, most people can modulate their mental acuity moods and possibly even their appetites by intelligent food selection. Foods that she recommends be taken for calming and concentrating purposes include bread, crackers, rolls, bagels, pasta, potatoes, rice, corn, barley, oatmeal, and other cerebral.

Wurtman suggests people who have trouble concentrating, whose thoughts go off in all directions, should eat foods rich in carbohydrates, such as sweets, bread, or pasta. These foods help get the brain more tryptophan, an amino acid that increases the production of the calming neurotransmitter serotonin.

"Increased levels of serotonin help you concentrate," she said (Slovut, 1988).

Stein, Foucar-Szock, and Kauffman (1984) conducted a four month study to examine the effects of improved breakfast nutrition on reading achievement. The experimental group's daily breakfast menu provided variety, high-density carbohydrates, and protein, while the control group received fruit or juice, milk,
and packaged cereal. The experimental group showed a seven month gain in reading scores compared with 5.25 month gain for the control group.

A researcher (Conners) conducted a study with nine to eleven year old children. In this study, Conners tested the same children four times, at intervals of one week, twice after the children had eaten a standard breakfast, and twice after they had fasted for twelve hours. Each test day their performance on school-type tasks was assessed three times. Eating breakfast decreased errors on the tests. In addition, as the morning progressed, performance on mathematical tests done between these sessions was better if breakfast had been eaten.

Bryan and Bryan (1991) shared results of a study on the impact of positive affect on self-efficacy and mathematical performance of students at risk for school failure. Overall, the results of these studies conducted with children find that positive mood improves the amount of rate of learning. Happiness seems to have a positive effect on children’s learning, memory, and social behavior. Also, study showed that positive mood states induce higher levels of activation and faster and more efficient information processing strategies, whereas sad mood may cause children to become more withdrawn and inattentive (Isen/Means). Because children need to rely on past experiences and learning when making judgments, positive and negative affect may play an important role in their cognitive processes (Forgas, Burnham, & Trimboli, 1988).

Influence on Mathematical Achievement

Finally, Futrell, president of the National Education Association, links the difference in mathematical achievement between American and Japanese kids to
mother's attitude about mathematics. "The role of education in the Japanese home is very, very high," said Ms. Futrell, who agrees with the study that mathematical education in the U.S. needs to be revamped if Americans expect to stay competitive in the world.

Carbohydrates are the most efficient food source of energy there is. Our body burns what it needs immediately and stores what's left as an energy reserve. High carbohydrate foods including fruits, vegetables, cereals, legumes, and grains are made up of both simple and complex carbohydrates. Foods, such as honey, that are high in simple carbohydrates are easily digested and provide quick energy followed by an energy slump (Hoppe, 1987).

The effect of low carbohydrate foods on learning is very little other than its energy content. Examples of simple carbohydrates would be honey, corn syrup, jelly, fruit, maple sugar, or table sugar (Morgan, Brian, Dr., and Roberta Morgan, 1988).

An authority on children's mental behavior suggests that dietary patterns affect brain function. Even the content of a single meal can alter one's ability to think, learn, and communicate effectively with others. Conners (1989) has identified many important relations among food and a child's behavior and intelligence quotient (IQ).

It is the writer's opinion, after looking at this issue closely, that as educators we need to once again focus on the total needs of the child. Too often we assume learners come to us equally prepared both physically and academically.
Not until we work to make sure all children receive sufficient nutrition will we help them be truly ready to learn.
CHAPTER III
PROCEDURE

Subjects
The study was conducted with ten students who were selected based on similar criteria. All students scored between thirty and fifty percentile on mathematical pretest designated by school district where they attend. Students consisted of seven female and three male. All students were working out of the same mathematical text and were being instructed by the same teacher. All students attended the same school and were in the fifth grade. All students entered project on a free choice basis.

Setting

School. The writer's building is a traditional building where grades kindergarten through fifth grade attend. Classrooms are primarily self-contained with ability grouping within some of grade levels. There are approximately five hundred students attending this school.

Community. The school system is located in Central Ohio in an urban setting. The school where the project was conducted is located near several large universities. Students are influenced by multicultural experiences within the activities planned through cooperation between universities and school. Parent
involvement is an important part of school's daily activities, however, were not directly involved with the experimental project.

Data Collection

Construction of the Instrument. The writer administered a pre and posttest designated by the school district to test for mastery of mathematical concepts within each chapter of the selected text. Pre and posttests were prepared by district and items on test were based on state required objectives as well as those required by district where students attend. Test items were based on text Addison-Wesley mathematics currently being used in school district.

Administration of the Instrument. The pretest was administered to the entire population of the fifth grade math students attending school where project was conducted. Each student received a copy of the chapter test and adequate time to complete the test. Students received instruction for directions only. Those students with scores ranging from thirty to fifty percentile on the pretest were considered to be eligible to participate in experimental project. Students were then assigned to the experimental group of ten based on similar characteristics such as: pretest scores, sex, race, and desire to participate. From those ten a random selection was made to determine whether student would be in the high or low carbohydrate group. After conducting experiment and instruction of math concepts, students were given a posttest to help analysis results of experimental project and to determine if there had been academic gain.
Design

The writer used a classical design of two groups, E/E, pretest, posttest design. One group represented high carbohydrate snacks administered to it; the second group represented low carbohydrate foods being administered. T1 represented pretest given over Chapter Six carried out before administering of high carbohydrate foods forty-five minutes before mathematical instruction. The T2 represented posttesting carried out over math Chapter Six upon completion of instruction for chapter.

Treatment

Carbohydrate Snacks

The writer's independent variable for this experimental study was high and low carbohydrate food influences upon academic achievement of mathematical scores. The students participating in experiment were pretested and placed into experimental groups. There were two experimental groups of five students made up of both sexes. Both groups were made up of students with similar scores on pretest, same grade level, different racial backgrounds, boy/girl participation, desire to participate, and parental permission. Both groups ate school breakfast for each morning during the experiment. Students were encouraged to eat all of breakfast. Both groups were administered either a high or low carbohydrate snack forty-five minutes before mathematical instruction. Students were selected to be in either Group One (high carbohydrate snack) or Group Two (low carbohydrate snack) at random by teacher putting ten finalist names into hat and drawing out names in alternate manner (1,2, 1,2...). Both groups received snacks
at same time each morning and were encouraged to eat all of snack. Both groups were instructed in same mathematical concept during class period with same method of teaching used for all instruction. Students in both groups were instructed by the same teacher and at approximately the same time and location for the duration of the experimental project. The length of the project was twelve days which was within the guidelines of time designated by the district for Chapter Six instruction. Both groups took identical pre and posttests to determine results of experiment. Students in both groups took pre and posttests individually with their own test booklet and help with directions only.
Menu for Daily Project

**Day One**

**Breakfast (Everyone) 9:00**

- 1/2 pint milk
- 7/8 ounce Frosted Flakes
- Peanut butter wafer

Carbohydrate Content

- 11 grams
- 22 grams
- 14 grams

Total grams 47

**Mid-morning snack 10:00**

**Group One**

- Fruit Booster
- Six ounces apple juice

Carbohydrate Content

- 28 grams
- 20 grams

Total grams 48

**Group Two**

- Cracker with peanut butter
- 1/2 pint milk

Carbohydrate Content

- 15 grams
- 11 grams

Total grams 26

**Day Two**

**Breakfast (Everyone) 9:00**

- 1/2 pint milk
- 7/8 ounce Frosted Flakes
- Apple Turnovers
- Six ounces orange juice

Carbohydrate Content

- 11 grams
- 26 grams
- 29 grams
- 22 grams

Total grams 88

**Mid-morning snack 10:00**

**Group One**

- Fruit Booster
- Six ounces apple juice

Carbohydrate Content

- 28 grams
- 20 grams

Total grams 48
<table>
<thead>
<tr>
<th>Time</th>
<th>Group</th>
<th>Meal Type</th>
<th>Food Item(s)</th>
<th>Carbohydrate Content</th>
<th>Total grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day Three</td>
<td></td>
<td>Breakfast (Everyone)</td>
<td>1/2 pint milk, Doughnut</td>
<td>11 grams, 29 grams</td>
<td>26</td>
</tr>
<tr>
<td>Day Four</td>
<td></td>
<td>Breakfast (Everyone)</td>
<td>1/2 pint milk, 7/8 ounce Frosted Flakes, 1 package sunflower nuts</td>
<td>11 grams, 26 grams, 8 grams</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mid-morning snack</td>
<td>11 grams, 29 grams</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group One</td>
<td>Carbohydrate Content</td>
<td>1 and 1/2 ounces raisins, 1/2 pint milk</td>
<td>33 grams, 11 grams</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Group Two</td>
<td>Carbohydrate Content</td>
<td>Nutty bar, 1/2 pint milk</td>
<td>15 grams, 11 grams</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Group One</td>
<td>Carbohydrate Content</td>
<td>Fruit bar, Apple juice, 1/2 pint milk</td>
<td>28 grams, 20 grams, 11 grams</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Group Two</td>
<td>Carbohydrate Content</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Group Two
Peanut butter bar 14 grams
1/2 pint milk 11 grams

Day Five

Breakfast (Everyone) 9:00
1/2 pint milk 11 grams
7/8 ounce Rice Krispies 22 grams
8 ounces sunflower nuts 8 grams

Mid-morning snack 10:00

Group One
1/2 pint milk 11 grams
1 box raisins 33 grams

Group Two
1/2 pint milk 11 grams
1 peanut butter cracker 15 grams

Total grams 25
Total grams 41
Total grams 44
Total grams 26

(See Appendix A for remaining carbohydrate snack menu.)
Lesson Plans for Experimental Project

Day One: Introduction to Division: 1-Digit Divisors, Chapter 6 (page 131, Addison-Wesley Math). Explain project. Drill facts. Review place value to thousands.


Example: \[ \frac{\text{800}}{540} = \frac{800}{54,000} \]

Day Three: Grade page 133 together. Give quiz ditto over mental math to check accuracy. Assign page 134 for additional practice over estimating and mental math. Reteach those students not scoring mastery on quiz.

Example: \[
\begin{array}{ccc}
(150) & (160) & (1,200) \\
147 \div 3 &=& 163 \div 2 &=& 1243 \div 3 =
\end{array}
\]
Day Four: Go over page 134 in class together. Teach steps for dividing (Does Mom See Brian). Teach one digit division and complete page 138 together in class. Assign page 139 even for home practice.

\[
\begin{array}{c}
34 \\
-238 \\
\hline
66 \\
-66 \\
\hline
0
\end{array}
\]

Example:

Day Five: Go over page 139 in class. Introduce dividing 3-digit quotients. Do page 140 in class together. Assign page 141 for practice at home. Take students to the board who have not mastered what we’ve covered in division.

\[
\begin{array}{c}
27 \\
-18 \\
\hline
9 \\
-9 \\
\hline
0
\end{array}
\]

Example:

Day Six: Go over page 141 in class. Introduce larger division problems and assign page 143 even problems after going over page 142 together in class. Put examples on the board.

\[
\begin{array}{c}
237 \\
-189 \\
\hline
186 \\
-16 \\
\hline
26 \\
-24 \\
\hline
26
\end{array}
\]

Example:
Day Seven: Zeros in the Quotients — Page 144 & 145.

\[
\begin{array}{c}
  \begin{array}{c}
    120 \\
    7 \underline{\text{R6}}
  \end{array} \\
  \begin{array}{c}
    7846 \\
    -7
  \end{array}
\end{array}
\]

Example: \[
\begin{array}{c}
  \begin{array}{c}
    14 \\
    2
  \end{array} \\
  \begin{array}{c}
    6
  \end{array}
\end{array}
\]

Day Eight: Thought Problems.

Example: There are 195 school days in the school year. How many five day school weeks is this?

\[
\begin{array}{c}
  \begin{array}{c}
    39 \\
    15
  \end{array} \\
  \begin{array}{c}
    15
  \end{array}
\end{array}
\]

Day Nine: Dollar and Cents Pages 148 & 149.

Example: $20.85 divided by 5.

\[
\begin{array}{c}
  \begin{array}{c}
    4.17 \\
    5 \underline{\text{R0.85}}
  \end{array} \\
  \begin{array}{c}
    20
  \end{array}
\end{array}
\]

Day Ten: Larger Numbers and Averages

Example: Here are the temperatures for five days. What is the average temperature for this week? Monday: 65 degrees, Tuesday 77 degrees, Wednesday 75 degrees, Thursday 68 degrees, Friday 72 degrees, Saturday 78 degrees, and Sunday 80 degrees.

Day Eleven: Posttesting — Chapter Six.

Day Twelve: Posttesting — Chapter Six if extra time is needed.
CHAPTER IV

RESULTS

Presentation of Results

The writer computed the mean as measure of central tendency and the standard deviation as measure of variance for pre and posttest scores on the achievement test. Finally, the writer computed the t test to determine a significant difference between two sample means for a two-tailed test.

Tables I and II are summaries of pre and post scores used to determine if groups were basically starting out on the same level. Students were identified alphabetically as A, B, C, D, E, F, G, H, I, and J. Table III is the summary of the gain observed in the achievement scores of both groups. Included in Table III shows the t score using a .05 critical score.

Table I

Results of Low Carbohydrates Snacks on Mathematical Achievement Scores

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>5</td>
<td>36.2</td>
<td>2.64</td>
</tr>
<tr>
<td>T2</td>
<td>5</td>
<td>86.6</td>
<td>10.58</td>
</tr>
</tbody>
</table>
Table II
Results of High Carbohydrate Snacks on Mathematical Achievement Scores

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>5</td>
<td>35</td>
<td>2.45</td>
</tr>
<tr>
<td>T2</td>
<td>5</td>
<td>69.2</td>
<td>15.7</td>
</tr>
</tbody>
</table>

Table III
Results of Achievement Gain Scores of Mathematical Scores For High/Low Carbohydrate Groups

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>5</td>
<td>45.4</td>
<td>10.48</td>
</tr>
<tr>
<td>T2</td>
<td>5</td>
<td>34.2</td>
<td>14.88</td>
</tr>
</tbody>
</table>

$t = 1.23$  \hspace{1cm} .05 \text{ critical value 2.306}
\hspace{1cm} df = 8 \hspace{1cm} p < .05 \hspace{1cm} \text{n.s.}

Discussion of Results

Table I and II scores for students participating in the project indicate both groups receiving either high or low carbohydrate snacks began project at basically the same testing level and both showed gain in the posttest scores when mean and standard deviation were computed.

Table III scores for students participating in the project indicate results between the two groups on pre-post mathematical test gain showed no significant difference. After the mean score and standard deviation on mathematical gain scores, the writer computer a t test and the computed value of 1.23 was less than the critical or table value of 2.306 based on a two-tailed test with a df of 8. Both
groups showed substantial gain in mathematical scores, but when compared the group gain was not significant and the writer accepts the null hypothesis.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The writer of this paper has reflected on the achievement gains of mathematical students participating in research project and will make observations that have been observed as research project was conducted.

First, the purpose of the study was to determine whether there would be a significant gain in the mathematical achievement scores of students being given high carbohydrate foods snacks versus students being given low carbohydrate snacks prior to instruction in mathematical concept.

The hypothesis was that there would be no significant difference in the mean achievement gain for pretest and the posttest scores of students receiving high or low carbohydrate snacks prior to being instructed in mathematical concept.

The project was carried out over a period of twelve school days in which students received forty-five minutes of daily mathematical instruction within the experimental group. Students were placed in the groups based on similar pretest scores from Chapter Eight of their mathematical text which covered single digit division.
Although students were selected for the project group by pretest scores, they were selected for Group I (high carbohydrate) or Group II (low carbohydrate) at random by teacher drawing "names from hat" from those already selected for project group.

Students then received a mid-morning snack for twelve school days of either high or low carbohydrate content based on their group selection. This snack was given at the same time to both groups forty-five minutes prior to their mathematical instruction. Both groups were also encouraged to eat breakfast at school in an attempt to keep morning carbohydrate intake of students within the groups similar. Students were also encouraged to attend each day.

At the end of the twelve days of instruction, students were given a posttest over a period of two forty-five minute mathematical periods. Students continued to take snacks during the two test days.

Data was then analyzed using means, standard deviation, and t scores to determine if any significant gain could be determined from the test score data.

The results of the pretest scores did determine the students within the project to be at similar stages in the understanding of single digit division mathematical computation at beginning of project.

The posttest did reflect substantial growth for both groups over a period of ten days of instruction. The writer realized that it could be a reflection of influence of pretesting, effects of maturation, and selection of participants.
Conclusions

In computing the t test the writer observed that the t-score was 1.23 which fell below the critical value of 2.306 on a two-tailed test. This could seemingly contradict research done by Chollar that carbohydrates could be a missing puzzle link in our study of the complex realms of mood and mental performances. It would also seem to contradict research by Hoppe that carbohydrates can increase students' ability to focus and sustain energy to counteract the "mid-morning slump" so often witnessed by teachers when students become restless and begin to anticipate lunchtime.

On the contrary, the writer observed substantial gains in test scores at the culmination of the project. The writer also noted outside variables that could influence students' achievement gain to a point that it is difficult to separate the nutritional influences upon students from other outside variables.

For instance, within the high carbohydrate group, there were four absences during the ten days of instruction while the low carbohydrate group only had one absence.

Another variable that seemed to surface was students bringing back completed homework showed significant gain. Those who did not return completed assignment lacked the practice needed to master those concepts being taught.

Student histories also seemed to determine score gains, as those having mastered the multiplication and division facts prior to the instruction seemed to grasp more quickly the concept being taught.
Recommendations

Folland's (1992) research of the importance of food pertaining to learning and nutrition must not be overlooked. This research suggests that children cannot concentrate, enjoy school, or truly learn if they are hungry, and that students need adequate nutrients for the cognitive development. During the project students receiving snacks all showed progress in the mastering of mathematical skills introduced. This would certainly substantiate research that nutrition plays an important role in learning.

During the project the writer observed the contents of our school breakfast to determine carbohydrate content for project. Choices given our students seemingly contradict any nutritional research done by Stein, Foucar-Szock, and Kauffman on effects of improved breakfast nutrition on reading achievement. In their research of breakfast consisting of high-density carbohydrates and protein, students showed a seven month gain in reading scores compared to the controlled group receiving juice, milk, and packaged cereal that showed only a 5.25 month gain. Research such as this challenged us to look more closely at what we are offering our students. Doughnuts and sugar-coated cereals continue to give our students empty calories with quick but short-term energy that cannot sustain them through a busy and high energy consuming morning of instruction.

The writer also observed that foods that are nutritionally valuable often are those most expensive and difficult to come by for those students needing them the most to focus and sustain energy throughout a morning of activities and instruction. Research conducted by Hoppe shows our body burns what is needed
from the high carbohydrate foods and stores what is left as an energy reserve, while low carbohydrate foods provide quick energy followed by an energy slump. As educators we should be constantly aware and teaching students and parents the importance of choosing foods that will give students those nutrients needed to succeed. Teachers have opportunity through curriculum to offer students the information to help them make valuable choices.

Carbohydrates can give students that long-lasting energy needed but must be done along with other important factors such as rest, parent support, and self-motivation. Bryan and Bryan (1991) shared results of a study on the impact of positive effect on self-efficacy and mathematical performance of students at risk for school failure. As well as Futrell, president of the National Education Association, links the difference in mathematical achievement between American and Japanese kids to mother's attitude.

Educators must educate parents as well as students concerning these links to success. When parents are involved in the educating of their child, then they will begin to recognize the important role nutrition plays. Through parent involvement in the classroom and training of these parents to understand the link between nutrition, self-esteem, and home intervention, we will begin to see the nutritional puzzle come together.
It is the writer's intention to continue researching the area of nutrition and learning in order to gain more understanding of the important role food can play in student academic performance. It is only with a better understanding of all the variables that influence a student's learning, that we as educators can hope to meet the academic needs of our students.
### Day Six

**Breakfast (Everyone) 9:00**

<table>
<thead>
<tr>
<th>Item</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 box Fruit Loops</td>
<td>19 grams</td>
</tr>
<tr>
<td>1 doughnut</td>
<td>29 grams</td>
</tr>
<tr>
<td>Six ounces apple juice</td>
<td>20 grams</td>
</tr>
</tbody>
</table>

Total grams 79

**Mid-morning snack 10:00**

<table>
<thead>
<tr>
<th>Group One</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six ounces apple juice</td>
<td>20 grams</td>
</tr>
<tr>
<td>1 box French fries</td>
<td>38 grams</td>
</tr>
</tbody>
</table>

Total grams 58

<table>
<thead>
<tr>
<th>Group Two</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 Hostess Twinkie</td>
<td>24 grams</td>
</tr>
</tbody>
</table>

Total grams 35

### Day Seven

**Breakfast (Everyone) 9:00**

<table>
<thead>
<tr>
<th>Item</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 package sunflower nuts</td>
<td>8 grams</td>
</tr>
<tr>
<td>1 box Frosted Flakes</td>
<td>26 grams</td>
</tr>
<tr>
<td>Six ounces juice</td>
<td>20 grams</td>
</tr>
</tbody>
</table>

Total grams 65

**Mid-morning snack 10:00**

<table>
<thead>
<tr>
<th>Group One</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six ounces apple juice</td>
<td>20 grams</td>
</tr>
<tr>
<td>1 fruit bar</td>
<td>28 grams</td>
</tr>
</tbody>
</table>

Total grams 48
<table>
<thead>
<tr>
<th>Group</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td></td>
</tr>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 Little Debbie Nutty Bar</td>
<td>15 grams</td>
</tr>
</tbody>
</table>

**Day Eight**

**Breakfast (Everyone) 9:00**

<table>
<thead>
<tr>
<th>Item</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 box Rice Krispies</td>
<td>26 grams</td>
</tr>
<tr>
<td>1 doughnut</td>
<td>29 grams</td>
</tr>
<tr>
<td>Six ounces juice</td>
<td>20 grams</td>
</tr>
</tbody>
</table>

Total grams 86

**Mid-morning snack 10:00**

<table>
<thead>
<tr>
<th>Group</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
</tr>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 box raisins</td>
<td>38 grams</td>
</tr>
</tbody>
</table>

Total grams 49

<table>
<thead>
<tr>
<th>Group</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td></td>
</tr>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 Swiss cake</td>
<td>19 grams</td>
</tr>
</tbody>
</table>

Total grams 30

**Day Nine**

**Breakfast (Everyone) 9:00**

<table>
<thead>
<tr>
<th>Item</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>Six ounces juice</td>
<td>20 grams</td>
</tr>
<tr>
<td>1 doughnut</td>
<td>29 grams</td>
</tr>
<tr>
<td>1 box Fruit Loops</td>
<td>19 grams</td>
</tr>
</tbody>
</table>

Total grams 79

<table>
<thead>
<tr>
<th>Group</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
</tr>
<tr>
<td>1 fruit bar</td>
<td>33 grams</td>
</tr>
<tr>
<td>Six ounces juice</td>
<td>20 grams</td>
</tr>
</tbody>
</table>

Total grams 53
Group Two          Carbohydrate Content

1 Swiss cake roll  19 grams
1/2 pint milk      11 grams

Total grams 30

Day Ten            Carbohydrate Content

Breakfast (Everyone) 9:00

1/2 pint milk       11 grams
1 package sunflower nuts  8 grams
1 box Frosted Flakes  26 grams
Six ounces juice    20 grams

Total grams 65

Mid-morning snack 10:00

Group One          Carbohydrate Content

Oatmeal cookie     29 grams
1/2 pint milk      11 grams
One package sunflower nuts  8 grams

Total grams 48

Group Two          Carbohydrate Content

One peanut cookie bar  22 grams
1/2 pint milk        11 grams

Total grams 33

Day Eleven (Testing Day) Carbohydrate Content

Breakfast (Everyone) 9:00

1/2 pint milk       11 grams
1 box Frosted Flakes 26 grams
1 doughnut           29 grams

Total grams 66
**Mid-morning snack (10:00)**

<table>
<thead>
<tr>
<th>Group One</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six ounces juice</td>
<td>20 grams</td>
</tr>
<tr>
<td>1 box French fries</td>
<td>39 grams</td>
</tr>
</tbody>
</table>

**Group Two**

<table>
<thead>
<tr>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
</tr>
<tr>
<td>1 peanut butter bar</td>
</tr>
</tbody>
</table>

**Day Twelve (Testing Day)**

**Breakfast (Everyone) 9:00**

<table>
<thead>
<tr>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
</tr>
<tr>
<td>1 package sunflower nuts</td>
</tr>
<tr>
<td>1 box Fruit Loops</td>
</tr>
<tr>
<td>Six ounces juice</td>
</tr>
</tbody>
</table>

**Mid-morning snack (10:00)**

<table>
<thead>
<tr>
<th>Group One</th>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
<td>11 grams</td>
</tr>
<tr>
<td>1 box raisins</td>
<td>39 grams</td>
</tr>
</tbody>
</table>

**Group Two**

<table>
<thead>
<tr>
<th>Carbohydrate Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 pint milk</td>
</tr>
<tr>
<td>Peanut butter cracker</td>
</tr>
</tbody>
</table>

Total grams 59

Total grams 25

Total grams 58

Total grams 50

Total grams 25
February 4, 1993

Dear Parents,

To complete my graduate work for my Master's Degree, I am currently involved in a research project establishing the relationship between a student's achievement and the food they eat.

The project will be set up as follows:

a. Students will be pretested for Chapter 6 from our fifth grade Addison-Wesley Mathematics textbook.

b. Twelve students scoring in the range of thirty to fifty percentile on the pretest will participate in the project.

c. The twelve students will be asked to eat breakfast at school for the two week project beginning Monday, February 8, 1993. I will be glad to pay for their breakfast during the project.

d. At 10:00 o'clock each morning (for two weeks) these students will receive a midmorning snack of either high or low carbohydrate foods such as: cereal, pasta, rice, potatoes, bread, jelly, honey, jam or fruit.

e. At 10:45 students will be given their regular math instruction for that day. No extra work will be required of them other than the usual time spent on homework.

f. At the end of the two week period, students will be posted tested over Chapter 6 to determine gains.

I would be glad to call and answer any further questions pertaining to the above project. You can reach me at home (846-2310) or school (365-6532). If at anytime your child chooses not to participate, I understand. However, I feel your child will benefit from the individual attention, and I will greatly appreciate their help.

Please fill out permission form attached and return tomorrow.

Thank you,

Mrs. Jennifer Dunn
Fifth Grade Teacher
Appendix C  
Permission Form

February 4, 1993

I give permission for ___________________________ to participate in research project dealing with relationship between student’s achievement and food they eat. I understand Mrs. Dunn will be responsible to pay for their school breakfast during the two weeks, and that she will be giving my child a high or low carbohydrate snack each day at 10:00 for two weeks beginning February 8, 1993.

Parent Signature ________________________________

Date ________________________________

Approved by _____________________________ Principal
Appendix D  
Computation Worksheet for Achievement Gains Scores of Both Groups High and Low Carbohydrate

<table>
<thead>
<tr>
<th>Gain Score</th>
<th>Low Carbohydrate Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td>A</td>
<td>46</td>
</tr>
<tr>
<td>B</td>
<td>42</td>
</tr>
<tr>
<td>C</td>
<td>41</td>
</tr>
<tr>
<td>D</td>
<td>37</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ \Sigma 171 \]
\[ \bar{X} 34.2 \]
\[ \bar{X} 34.2 \]

<table>
<thead>
<tr>
<th>Gain Score</th>
<th>Low Carbohydrate Group Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td>F</td>
<td>63</td>
</tr>
<tr>
<td>G</td>
<td>45</td>
</tr>
<tr>
<td>H</td>
<td>45</td>
</tr>
<tr>
<td>I</td>
<td>44</td>
</tr>
<tr>
<td>J</td>
<td>30</td>
</tr>
</tbody>
</table>

\[ \Sigma 227 \]
\[ \bar{X} 45.4 \]
\[ \bar{X} 45.4 \]

\[ \Sigma 549.2 \]
\[ \Sigma 549.2 \]
\[ \Sigma 549.2 \]
\[ \Sigma 549.2 \]
\[ \Sigma 549.2 \]
\[ \Sigma 549.2 \]
Appendix E
Computation for t test for Two-Tailed Test
With df 8 and Critical Value of 2.306

<table>
<thead>
<tr>
<th>Method A (Low Carbo)</th>
<th>Method B (High Carbo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( N_1 ) 5</td>
<td>( N_2 ) 5</td>
</tr>
<tr>
<td>( M_1 ) 45.40</td>
<td>( M_2 ) 34.2</td>
</tr>
<tr>
<td>( \Sigma d^2 ) 549.2</td>
<td>( \Sigma d^2 ) 1106.8</td>
</tr>
</tbody>
</table>

\[
t = \frac{11.2}{\sqrt{\frac{1656}{8}} \left(\frac{10}{25}\right)}
\]

\[
t = \frac{11.2}{\sqrt{207} \cdot (.4)}
\]

\[
t = \frac{11.2}{\sqrt{82.8}}
\]

\[
t = \frac{11.2}{9.10} = 1.23t
\]

If the computed value is less than the critical or table value, I did not reject the null hypothesis of no difference. I concluded that there is no difference between the two means or methods. The result is probably due to chance or sampling error.
95%
Area of Acceptance
of the Null Hypothesis

Area of Rejection of the Null Hypothesis

Area of the Rejection of the Null Hypothesis
BIBLIOGRAPHY


