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Effect of hands-on instruction on the science achievement of second grade students

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EFFECT OF HANDS-ON INSTRUCTION ON THE SCIENCE ACHIEVEMENT OF SECOND GRADE STUDENTS

by
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A Thesis

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Approved by

Professor

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ABSTRACT

Wendy S. Nardi. Effect of Hands-on Instruction on the Science Achievement of Second Grade Students. 1998. Dr. Randall S. Robinson. Master of Science in Teaching.

The purpose of this study was to examine the effect of hands-on methods of science instruction on low-level second grade students from a low-income community. Hands-on instruction actively engages students in exploratory activities using cognitive, manipulative and operational skills. According to a nonequivalent control group design, the nonstratified sample of 39 students was pretested and presented with either hands-on science instruction or more traditional strategies. Following posttest administration, a t test for nonindependent samples indicated a significant difference between the pretest and the posttest scores of both groups. However, a t test for independent samples revealed no significant difference between the science achievement of students instructed using hands-on learning strategies and the science achievement of those students exposed to more traditional methods.

MINI-ABSTRACT

Wendy S. Nardi. Effect of Hands-on Instruction on the Science Achievement of Second Grade Students. 1998. Dr. Randall S. Robinson. Master of Science in Teaching.

What effect do hands-on methods of instruction have on the science achievement of elementary school students? A t test for independent samples revealed no significant difference between the science achievement of students instructed using hands-on learning strategies and the science achievement of those students exposed to more traditional methods of instruction.

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Chapter I

The Scope of the Study

Introduction

Students across the country demonstrate low levels of interest in science education and display a poor attitude toward the subject of science in general. Students believe that science is a study reserved for the academically elite. Both parents and teachers support student beliefs that science is a challenging content area that may be mastered by few, while politicians of the past have viewed science as a study that is not essential to a thorough academic program (Collins, 1997).

As a result, American students are failing to achieve in the area of science. The 1990 National Assessment of Educational Progress Science Report Card revealed that only a third of fourth grade students displayed science knowledge beyond elementary facts, and that less than half of the high school seniors in this country were able to perform tasks requiring higher order thinking and scientific reasoning (Arambula-Greenfield & Feldman, 1997).

American politicians, educators and parents are becoming increasingly concerned about the scientific capabilities of future generations (Mergendoller, 1997). The recent reform of national science standards reflects a lack of confidence, among educators and legislators, in the traditional instruction of science education. Those who teach and develop standards for science education are no longer satisfied with an educational system that allows students to succeed through rote memorization and graduate high school with a less than functional knowledge of content material (Anderson, Holland, & Palincsar, 1997).

The National Science Education Standards were developed in response to the national goals proposed at the 1989 education summit. Science education was challenged in two of the six goals outlined by the summit, which was conducted by President George Bush and the National Governors Association. The fourth goal, regarding science and mathematics, reads, "By the year 2000, U.S. students will be first in the world in science and mathematics achievement" (Collins, 1997, p. 300).

Following the successful development of mathematical standards by the National Council of Teachers of Mathematics, national education standards were seen as the answer to achieving the goals designed by the summit. In the fall of 1991 the National Research Council initiated the development of voluntary national standards for science education. The National Science Education Standards was released in December of 1995 (Collins, 1997).

The national standards portray a "scientific literacy," in which students actively participate in scientific inquiry resulting in a functional understanding of science that extends to a world beyond the classroom. Research suggests that in order to meet the goals set by the standards, science education must become less centered on the coverage of a specified amount of content and focus more energy on students achieving an understanding of what is taught (Collins, 1997). The National Science Education Standards calls for a change in the traditional methods used to educate students, but it does not specify the means by which educators are to enhance student understanding and increase student achievement.

Purpose of the Study

A shift in methods of elementary science instruction has positively affected student interest levels, attitudes and student on-task behavior (Arambula-Greenfield & Feldman, 1997). Although these elements are likely to produce increased achievement, the research does not directly link achievement with hands-on methods of teaching. Hands-on instruction has been shown to be effective through actively engaging students in tasks that apply to their lives and the world around them (Zahorik, 1996). However, many students who lack structure in the home may not be able to function in an unstructured classroom, making the transition to hands-on methods a difficult one. In a school that serves a low-income housing community where the majority of students are below grade level, the concepts of science education may not be the subject of student curiosity or provide any significant connection to student life experiences. If the effects of hands-on instruction are not investigated in communities of varying socioeconomic levels with students of both high and low-level academic capabilities, educators will be unable to address the individual needs of young minds. As the academic community sets forth national standards of education, there is an increased need for the discovery of the most effective means of delivering curriculum content to students of differing backgrounds and capabilities. This study examined the effects of hands-on methods of science instruction on low-level second grade students from a low-income community.

Statement of the Problem

How does hands-on instruction affect the science achievement of elementary school students?

Statement of the Hypothesis

There is no significant difference between the science achievement of second grade students who were instructed using hands-on learning strategies and the science achievement of those second grade students who received traditional methods of science instruction.

Limitations

The design of this study contained limitations that affected the reliability and validity of test results.

The sample posed limitations to the generalization of test results in that the size was limited to 39 students from two intact classrooms, where the regular classroom teachers practiced varying degrees of hands-on science instruction. The nonstratified sample was composed of students from a low socioeconomic background, who had been characterized as low achievers.

The students were presented with a pretest, followed one week later by a lesson on the function of magnets and a posttest. The pretest-treatment interaction may also have been a threat to external validity.

Definition of Terms

The following terms were used in the development and analysis of this study:

Hands-on instruction - Hands-on instruction is instruction that actively engages students in inquiry and exploratory activities using cognitive, manipulative and operational skills. The hands-on instruction discussed in this study differs from other models of activity-based instruction that focus on abstract ideas, teacher-controlled procedures and anticipated results. This model was based on student discovery and centered around questions and answers relevant to life outside the classroom.

Traditional instruction - Traditional instruction is instruction that delivers content through lecture, worksheets and other means of passive student participation.

Science achievement - Science achievement is defined as the difference between students scores on a posttest following treatment and a pretest administered prior to the treatment.

Chapter II

Review of Related Literature

Introduction

This study investigated the effects of hands-on methods of science instruction on low-level second grade students from a low-income community. As the academic community increases its efforts to develop national and state standards of education, there is a growing need for effective methods of communicating curriculum content to students of differing backgrounds and capabilities. The hands-on instruction utilized for the purposes of this study actively engages students in inquiry and exploratory activities using cognitive, manipulative and operational skills. Research suggests that in order to meet the goals outlined in the National Science Education Standards, educators must focus more energy on students achieving an understanding of what is taught (Collins, 1997). The National Science Education Standards calls for a change in the traditional methods used to educate students, but it does not specify the means by which educators are to enhance student understanding and increase student achievement.

National Standards for "Scientific Literacy"

The National Science Education Standards emphasizes the importance of the development of a "scientific literacy," which involves active participation in scientific inquiry relevant to the lives of students. The goal of such activities is to encourage a functional understanding of science that can be applied to life experiences beyond the walls of the classroom (Collins, 1997). Leaders in science education reform believe that in "a post-industrial, information economy," future politicians, lawyers, laborers, builders, mothers and fathers will rely on core scientific concepts, problem solving and critical thinking to resolve the conflicts of everyday life (Marx, Blumenfeld, Krajcik & Soloway, 1997).

Collins (1997) points to an increase in the number of science classrooms where students are active participants in their own learning as a sign of progress toward the national goals for science achievement set at the education summit in 1989. The National Science Education Standards suggests that students work as individuals or in groups to complete at least one inquiry each year about a topic or question of student interest (Collins, 1997). Project-based science, an approach to science education similar to the hands-on method discussed in this study, is also defined as a method of instruction based on the concept that understanding is a result of active learner participation. Supporters of project-based science contend that learning is a "social enterprise," in which students draw on others in order to expand their knowledge and creativity (Marx et al., 1997).

The Effect of Reality-Based Learning Experiences

Hands-on instruction engages students by surrounding them with learning experiences that are connected to their lives and have meaning in their world. Research examining the effect of social context on the storage of information in memory reveals that when content is acquired through the memorization of unrelated facts, it will remain isolated and inactive in the memory. Students who receive content as an array of facts, unrelated to any social context or life experience, will have more difficulty recalling information and applying it to new learning situations (Marx et al., 1997).

The National Science Education Standards defines the functional understanding of science as the ability to apply scientific ideas to events and situations outside the classroom (Collins, 1997). When presented with learning experiences that are related to life experience, students are able to develop a sense of ownership of learning and approach tasks with greater intensity (Scott, 1994).

Research on informal science education examines science learning "that takes place outside the school walls" and deals with real world experiences (Ramey-Gassert, 1997). Ramey-Gassert (1997) notes that the primary difference between the informal setting and the traditional learning environment is that students are intrinsically motivated in an informal setting. They seek personal meaning in the informal learning experience that they can not obtain by memorizing facts or performing well on a test. The informal learning environment also provides students the opportunity to interact with tangible objects as opposed to the technological terms and symbols associated with traditional instruction (Ramey-Gassert, 1997). According to Ramey-Gassert (1997), successful classroom instructional methods are those that establish a connection between learning activities and life experience in order to help students find meaning in cognitive tasks.

Active Student Involvement and Retention

In her study of informal science education, Ramey-Gassert (1997) found that active involvement and interaction with learning materials increases the acquisition and retention of content information. The study also concluded that students could recall more information from presentations that required active mental and physical involvement than those that included only visual displays (Ramey-Gassert, 1997).

Hands-on Instruction, Student Interest and Achievement

Zahorik (1996) investigated how 65 classroom teachers made learning interesting for their students. During his study, he uncovered research that stated that instructional methods and materials that capture the interest of students largely determine student achievement. Hands-on instruction was the primary method used by the subjects, who viewed hands-on activities as "critical to establishing and maintaining student interest" (Zahorik, 1996, p. 555). Hands-on activities included tasks in which the student was "an active participant rather than a passive listener" (Zahorik, 1996, p.555). Zahorik (1996) found that all but two of the teachers studied claimed that "sedentary activities" resulted in disinterest and student antagonism.

The study also identified "practical tasks" as a method used by teachers to motivate student interest. Practical tasks were defined as those involving students in functional activities, resulting in the acquisition of knowledge related to real world experience. "Artificial tasks," defined as those having no practical use outside the classroom, were found to create disinterest (Zahorik, 1996).

Arambula-Greenfield and Feldman (1997) examined the effects of "discovery-centered learning" on the interest, attitude and active participation of 500 science students in grades K-8. The students were instructed through the use of hands-on activities related to student experiences and real world contexts. The researchers noted an improvement in the attitudes of treatment group students as a result of hands-on instruction. The attitudes of control group students declined. Results also demonstrated an increase in student on-task behavior and active participation as a result of experimental treatment. The researchers concluded that hands-on instruction may improve student interest, attitude and participation in science education (Arambula-Greenfield & Feldman, 1997).

According to Ramey-Gassert (1997), "In science, as in all learning, students must be engaged, attentive, and interested in an activity in order for learning to occur" (p. 434). She credits exploration and discovery with igniting a student's natural curiosity and laying the foundation for science learning (Ramey-Gassert, 1997). When hands-on science instruction was introduced to a fourth-grade class in Broward County, Florida, student achievement test scores increased significantly, especially in the areas of problem solving and critical thinking (Kepler, 1996). Proponents of instructional methods like the hands-on strategy defined in this study believe that a shift in science education toward actively engaging students in tasks related to their life experience is essential to the development of scientifically literate future generations (Zahorik, 1996).

Limitations to Scientific Literacy

However, research suggests that students who have been successful at memorization and more traditional learning strategies may have difficulty adapting to the changing methods of instruction which require an increased depth of thought and motivation. Students who are not accustomed to working in peer groups may also experience complication in adjusting to collaborative tasks that require negotiation and group discussion (Marx et al., 1997).

Research into science instruction that engages students in authentic scientific activity questions the effect of science education reform. Anderson et al. (1997) see scientific literacy as a concept that "embodies a peculiarly Western, middle-class way of understanding the world, a way that does not seem natural or satisfying to many students" (p. 381). After working with students in an urban school in a midwestern city, the researchers concluded that scientific exploration and discovery did not relate to all students' curiosity about the world. They determined that "all too often, the connection between natural curiosity and scientific literacy is made only by those students who were prepared to make it by their experiences at home" (Anderson et al., 1997, p. 381).

Chapter III

Procedure

Introduction

This study investigated the effects of hands-on methods of science instruction on low-level second grade students from a low-income community. As the academic community sets forth national standards of education, there is an increased need for the discovery of the most effective means of delivering curriculum content to students of differing backgrounds and capabilities. Hands-on instruction actively engages students in inquiry and exploratory activities using cognitive, manipulative and operational skills. Hands-on instruction has been shown to be effective through involving students in tasks that apply to their lives and the world around them (Zahorik, 1996). However, many students who lack structure in the home and a connection to the concepts of science education, may find the transition to hands-on methods a difficult one.

Subjects

The sample for this study consisted of 39 second grade students from two intact classrooms at an elementary school in southern New Jersey. The sample was nonstratified in that the majority of students were from a low socioeconomic background and had been characterized as low achievers. The subjects range in age from 7 to 9 years old. Information regarding the population is from the 1990 U.S. Census Data (see appendix A).

Experimental Design

The design used in this study was the nonequivalent control group design, a quasi-experimental design used in place of true experimental design when random sampling is beyond the control of the researcher. Although this type of design increased the sources of invalidity, it allowed the researcher to use intact classroom samples. The t test for nonindependent samples was administered to determine the relationship between the pretest and the posttest scores of subjects in both the treatment and control group. The t test for independent samples was administered to measure the relationship between the achievement of students receiving hands-on instruction and the achievement of those receiving traditional instruction in the same content area.

Procedure

The researcher administered a pretest to a sample of 39 second grade students from two intact classrooms. The pretest contained 15 questions regarding the science content to be taught through either hands-on strategies or traditional methods of instruction. One week following the pretest, the researcher presented the treatment group with a lesson on magnets (see appendix B), engaging students in meaningful tasks according to the principles of hands-on instruction. The researcher then taught the same lesson (see appendix C) to the control group in a traditional method, including a combination of lecture and other strategies related to the passive learner. After both lessons were completed, the researcher administered a posttest to all 39 students. The 15 posttest questions were identical to those on the pretest. Using the t test for independent samples, the researcher investigated the relationship between the science achievement of second grade students who were instructed using hands-on strategies and those who received traditional methods of instruction.

Instrument

The researcher developed a pretest and a posttest instrument (see appendix D) to be used as the measuring instrument for this study. The test contained 15 questions regarding the science content delivered through both traditional methods and hands-on strategies. Face validity was established through test readings by elementary science education teachers.

Chapter IV

Analysis of Findings

Introduction

In a country where national standards of education are dictating classroom curriculum, there is a growing need to discover the most effective means of delivering content to students of differing backgrounds and capabilities. This study examined the effects of hands-on methods of science instruction on low-level second grade students from a low-income community. Hands-on instruction is defined as instruction that actively engages students in inquiry and exploratory activities using cognitive, manipulative and operational skills. A treatment group participated in an interactive lesson involving the properties and use of magnets. A control group was exposed to similar content, but was not allowed the opportunity for discovery or interaction.

Tabulation of Raw Scores

For the purpose of establishing initial group equivalence, the researcher administered a pretest to both the treatment group and the control group. After instruction was completed, the researcher administered an identical posttest. The scores for both groups were computed for examination.

Nineteen of the twenty treatment group students scored higher on the posttest than the pretest, while one student demonstrated no change from pretest to posttest following instruction (see table 1).

table 1

Pretest/Posttest Scores for Treatment Group

Student	Pretest	Posttest
1	11	14
2	11	14
3	13	15
4	11	15
5	6	11
6	8	15
7	12	13
8	8	14
9	13	14
10	7	10
11	7	13
12	11	12
13	7	14
14	9	9
15	8	15
16	13	15
17	10	11
18	10	11
19	7	12
20	10	14

The control group students scored higher on the posttest than the pretest in seventeen out of nineteen cases, while the two remaining students showed a decrease in score following instruction (see table 2).

table 2

Pretest/Posttest Scores for Control Group

Student	Pretest	Posttest
1	13	15
2	11	14
3	11	12
4	14	13
5	10	15
6	7	14
7	10	12
8	11	14
9	11	13
10	11	14
11	12	14
12	11	12
13	11	14
14	10	15
15	13	14
16	12	14
17	5	10
18	14	12
19	11	15

The test contained 15 questions regarding the science content that was taught through either hands-on strategies or traditional methods of instruction. The possible range of scores included those from 0 to 15. The mean for the treatment group pretest was 9.60 as compared with a treatment group posttest mean of 13.05. The control group pretest scores represented a mean of 10.95, while the control group posttest mean was 13.47.

Tabulation of the t test

The data in this study was analyzed using both a t test for nonindependent samples and a t test for independent samples. The t test for nonindependent samples was used to determine whether there was a significant difference between the pretest scores and posttest scores of the treatment group at a probability level of .05. The analysis of the scores of subjects receiving hands-on instruction is presented in table 3.

table 3

t Test for Nonindependent Samples/Treatment Group

number of pairs of scores	20
sum of differences	69
mean of differences	3.45
sum of differences squared	341
t value	6.64
degrees of freedom	19

At a probability level of .05, the t value of 6.64 was significant. This analysis indicated a significant difference between the pretest scores prior to treatment and the posttest scores of the treatment group following hands-on instruction.

The t test for nonindependent samples was also used to determine whether there was a significant difference between the pretest scores and posttest scores of the control group at a probability level of .05. The analysis of the scores of the control group is presented in table 4.

table 4

t Test for Nonindependent Samples/Control Group

number of pairs of scores	19
sum of differences	48
mean of differences	2.53
sum of differences squared	204
t value	5.16
degrees of freedom	18

At a probability level of .05, the t value of 5.16 was significant. This analysis indicated a significant difference between the pretest scores and the posttest scores of the control group following traditional instruction.

The t test for independent samples was calculated to determine whether there was a significant difference between the posttest scores of the treatment group and the posttest scores of the control group at a probability level of .05. Analysis of the means of both sets of posttest scores and the t value calculated for the independent samples revealed no significant difference between the groups following instruction (see table 5).

table 5

t Test for Treatment Group and Control Group Posttest Scores

	Treatment Group	Control Group
mean	13.05	13.47
SD	1.80	1.31

t value = -.82

degrees of freedom = 37

At a probability level of .05, the posttest scores of the treatment group were not significantly different from the posttest scores of the control group. The mean scores for the treatment group and the control group were separated by less than one point. These findings indicate that there was no significant difference between the science achievement of students who were instructed using hands-on learning strategies and the science achievement of those who received traditional methods of science instruction.

Analysis Related to Particular Purpose of Hypothesis

This study investigated the effects of hands-on methods of science instruction on low-level second grade students from a low-income community. The purpose of this analysis was to test the research hypothesis, which states that there is no significant difference between the science achievement of second grade students who were instructed using hands-on strategies and the science achievement of second grade students who received traditional methods of science instruction.

A t test for nonindependent samples was used to determine the difference between the pretest scores and the posttest scores for both the treatment group and the control group. Significance was defined at a .05 level in each analysis. The t value of 6.64, which was determined for the treatment group, illustrated a significant difference between pretest and posttest scores. The t value for the control group was determined to be 5.16, illustrating a significant difference between the pretest and posttest scores of this group, who received traditional methods of instruction. The significant difference between test scores in both groups supports the research hypothesis.

A t test for independent samples was calculated to determine the difference between posttest scores of the treatment group and the control group. A t value of -.82 revealed no significant difference between posttest scores at a .05 level of probability. The data uncovered in this analysis supports the research hypothesis. There was no significant difference between the science achievement of the students instructed using hands-on learning strategies and those exposed to traditional methods of science instruction.

Chapter V

Summary, Conclusions and Recommendations

Introduction

This study investigated the effects of hands-on science instruction on low-level students from a low-income community. Hands-on instruction was defined as instruction that actively engages students in inquiry and exploratory activities using cognitive, manipulative and operational skills. This type of instruction has been shown to be effective by involving students in tasks that apply to their lives and the world around them (Zahorik, 1996). However, the author believes that many students who lack structure in the home and a connection to the concepts of science education, may find the transition to hands-on learning a difficult one.

Summary of the Problem

What effect do hands-on methods of instruction have on the science achievement of elementary school students?

Summary of the Hypothesis

There is no significant difference between the science achievement of second grade students who were instructed using hands-on learning strategies and the science achievement of second grade students who received traditional methods of science instruction.

Summary of the Procedure

The sample, consisting of 39 second grade students from two intact classrooms, was of a low socioeconomic background and had been characterized as below grade level. The researcher administered a pretest to both the treatment group and the control group. One week following the pretest, the treatment group was presented with a lesson on the properties and uses of magnets which engaged the students in meaningful tasks according to the principles of hands-on instruction. The researcher then taught the same lesson to the control group in a traditional method with an emphasis on the passive learner. Following instruction, the researcher administered a posttest to all subjects.

Summary of Findings

The majority of students in both the treatment group and the control group scored higher on the posttest than the pretest taken prior to instruction. The t test for nonindependent samples was calculated to determine if there was a significant difference between the pretest scores and posttest scores of both groups. At a probability level of .05, the test indicated a significant difference between the pretest score prior to treatment and the posttest scores of both groups following hands-on or traditional instruction.

The t test for independent samples revealed that at a .05 probability level, the posttest scores of the treatment group were not significantly different from the posttest scores of the control group.

Conclusions

The data in this study indicated that there was no significant difference between the science achievement of second grade students who were instructed using hands-on learning strategies and the science achievement of those who received traditional methods of science instruction.

The data analysis revealed a significant difference between the pretest and posttest scores of both the treatment group and the control group, but it did not uncover a difference between the test scores of the two groups following instruction. The mean for the treatment group posttest was 13.05, while the mean for the control group was 13.47. A difference of less than one point was not determined to be significant according to the t test for independent samples. The results of this study supported the research hypothesis.

Implications and Recommendations

Students across the country demonstrate low levels of interest in science education and display a poor attitude toward the subject of science in general. Recent changes in elementary science instruction have positively affected student interest levels, attitudes and student on-task behavior. Although these elements are likely to produce increased achievement, research does not directly link achievement with hands-on methods of teaching. Hands-on instruction actively engages students in tasks that apply to their lives and the world around them. These types of instructional methods have proven to be effective in the classroom. However many students who lack structure in the home may not be able to function in a less-structured classroom, making the transition to hands-on methods a difficult one.

This study revealed that there was no significant difference between the science achievement of second grade students instructed using hands-on learning strategies and the science achievement of those students who received traditional methods of science instruction. However, these results should not be generalized due to limitations present in this study. A limited number of students participated were available for study. The school in which this study took place serves a low-income housing community where the majority of students are below grade level. Students who receive little stimulation in the home may not be able to use previous knowledge and life experience to make a connection to certain classroom activities. Students with different life experiences may be better able to retain the knowledge gained through discovery learning and hands-on activities.

This study did determine traditional methods of instruction to be equally as effective as hands-on strategies, but research observation illustrated that the students who were allowed the opportunity to interact with magnets were more enthusiastic about instruction and remained on-task throughout more of the lesson than those taught through traditional means. Hands-on instruction, attitudes and student interest levels should be investigated in communities of varying socioeconomic levels with students of both high and low level academic abilities so that teachers will be able to identify the needs of students. As the academic community sets forth national standards of education, there remains a need for the discovery of the most effective means of delivering curriculum content to students of differing backgrounds and capabilities.

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Appendix A

Woodbury city: FIPS.STATE=34, FIPS.PLACE90=82120

PERSONS
Universe: Persons
Total....................10904

FAMILIES
Universe: Families
Total....................2736

HOUSEHOLDS
Universe: Households
Total....................4155

URBAN AND RURAL
Universe: Persons
Urban:
  Inside urbanized area....................0
  Outside urbanized area....................0
Rural....................0
Not defined for this file....................10904

SEX
Universe: Persons
Male....................5038
Female....................5866

RACE
Universe: Persons
White....................8542
Black....................2195
American Indian, Eskimo, or Aleut....................21
Asian or Pacific Islander....................74
Other race....................72

DETAILED RACE
Universe: Persons
White (800-869, 971)....................8542
Black (870-934, 972)....................2195
American Indian, Eskimo, or Aleut (000-599, 935-970, 973-975):
  American Indian (000-599, 973)....................21
  Eskimo (935-940, 974)....................0
  Aleut (941-970, 975)....................0
Asian or Pacific Islander (600-699, 976-985):
  Asian (600-652, 976, 977, 979-982, 985):
    Chinese (605-607, 976)....................9
    Filipino (608, 977)....................18
    Japanese (611, 981)....................6
    Asian Indian (600, 982)....................16
    Korean (612, 979)....................7
    Vietnamese (619, 980)....................2
    Cambodian (604)....................0
    Hmong (609)....................0
    Laotian (613)....................0
    Thai (618)....................0
    Other Asian (601-603, 610, 614-617, 620-652, 985)....................8
  Pacific Islander (653-699, 978, 983, 984):
    Polynesian (653-659, 978, 983):
      Hawaiian (653, 654, 978)....................1
      Samoan (655, 983)....................0

Tongan (657)..0
Other Polynesian (656, 658, 659)................................0
Micronesian (660-675, 984):
Guamanian (660, 984)..7
Other Micronesian (661-675).....................................0
Melanesian (676-680)..0
Pacific Islander, not specified (681-699).......................0
Other race (700-799, 986-999)..................................72

PERSONS OF HISPANIC ORIGIN

Universe: Persons of Hispanic origin

Total...184

HISPANIC ORIGIN

Universe: Persons

Not of Hispanic origin......................................10720
Hispanic origin:
Mexican..14
Puerto Rican..126
Cuban...5
Other Hispanic...39

HISPANIC ORIGIN BY RACE

Universe: Persons

Not of Hispanic origin
White..8454
Black..2167
American Indian, Eskimo, or Aleut..............................20
Asian or Pacific Islander......................................67
Other race...12
Hispanic origin:
White..88
Black..28
American Indian, Eskimo, or Aleut...............................1
Asian or Pacific Islander.......................................7
Other race...60

AGE

Universe: Persons

Under 1 year..145
1 and 2 years...375
3 and 4 years...332
5 years...167
6 years...208
7 to 9 years..447
10 and 11 years...314
12 and 13 years...276
14 years..133
15 years..117
16 years..104
17 years..108
18 years..113
19 years..121
20 years..140
21 years..120
22 to 24 years..475
25 to 29 years..979
30 to 34 years...1038
35 to 39 years..835
40 to 44 years..617
45 to 49 years..503
50 to 54 years..423
55 to 59 years..417
60 and 61 years...205
62 to 64 years..313
65 to 69 years..547
70 to 74 years..482

75 to 79 years..........362
80 to 84 years..........259
85 years and over..........229

SEX BY MARITAL STATUS

Universe: Persons 15 years and over

Male
- Never married..........1288
- Now married, except separated..........2010
- Separated..........106
- Widowed..........166
- Divorced..........251

Female
- Never married..........1151
- Now married, except separated..........1992
- Separated..........217
- Widowed..........874
- Divorced..........452

HOUSEHOLD TYPE AND RELATIONSHIP

Universe: Persons

In family households:
- Householder..........2736
- Spouse..........1903
- Child:
  - Natural-born or adopted..........3278
  - Step..........133
- Grandchild..........196
- Other relatives..........312
- Nonrelatives..........180

In nonfamily households:
- Householder living alone..........1249
- Householder not living alone..........170
- Nonrelatives..........238

In group quarters:
- Institutionalized persons..........465
- Other persons in group quarters..........44

Filler..........

HOUSEHOLD SIZE AND HOUSEHOLD TYPE

Universe: Households

1 person:
- Male householder..........361
- Female householder..........888

2 or more persons:
- Family households:
  - Married-couple family:
    - With related children..........881
    - No related children..........1022
  - Other family:
    - Male householder, no wife present:
      - With related children..........75
      - No related children..........82
    - Female householder, no husband present:
      - With related children..........480
      - No related children..........196
- Nonfamily households:
  - Male householder..........101
  - Female householder..........69

PERSONS IN FAMILIES

Universe: Persons in families

Total..........8558

PERSONS PER FAMILY

Universe: Families

Persons per family..........3.13

AGE OF HOUSEHOLD MEMBERS BY HOUSEHOLD TYPE

Universe: Households

Households with 1 or more persons under 18 years
Family households:
Married-couple family....................................884
Other family:
Male householder, no wife present....................................76
Female householder, no husband present....................................481
Nonfamily households:
Male householder....................................13
Female householder....................................3
Households with no persons under 18 years
Family households:
Married-couple family....................................1019
Other family:
Male householder, no wife present....................................81
Female householder, no husband present....................................195
Nonfamily households:
Male householder....................................449
Female householder....................................954

RACE OF HOUSEHOLDER BY HOUSEHOLD TYPE(8)

Universe: Households

White
Family households:
Married-couple family:
With related children....................................762
No related children....................................914
Other family:
Male householder, no wife present:
With related children....................................54
No related children....................................65
Female householder, no husband present:
With related children....................................263
No related children....................................135
Nonfamily households:
Householder living alone....................................1050
Householder not living alone....................................136
Black
Family households:
Married-couple family:
With related children....................................106
No related children....................................97
Other family:
Male householder, no wife present:
With related children....................................20
No related children....................................15
Female householder, no husband present:
With related children....................................214
No related children....................................60
Nonfamily households:
Householder living alone....................................184
Householder not living alone....................................32
American Indian, Eskimo, or Aleut
Family households:
Married-couple family:
With related children....................................2
No related children....................................3
Other family:
Male householder, no wife present:
With related children....................................0
No related children....................................0
Female householder, no husband present:
With related children....................................0
No related children....................................0
Nonfamily households:
Householder living alone....................................5

..........1
Householder not living alone..........
Asian or Pacific Islander
Family households:
Married-couple family:..........7
With related children..........5
No related children..........
Other family:
Male householder, no wife present:..........0
With related children..........2
No related children..........
Female householder, no husband present:..........1
With related children..........0
No related children..........
Nonfamily households:..........7
Householder living alone..........1
Householder not living alone..........
Other race
Family households:
Married-couple family:..........4
With related children..........3
No related children..........
Other family:
Male householder, no wife present:..........1
With related children..........0
No related children..........
Female householder, no husband present:..........2
With related children..........1
No related children..........
Nonfamily households:..........3
Householder living alone..........0
Householder not living alone..........

HOUSEHOLD TYPE(8)

Universe: Households with householder of Hispanic origin

Family households:
Married-couple family:..........13
With related children..........7
No related children..........
Other family:
Male householder, no wife present:..........3
With related children..........3
No related children..........
Female householder, no husband present:..........13
With related children..........2
No related children..........
Nonfamily households:..........10
Householder living alone..........2
Householder not living alone..........

HOUSEHOLD TYPE AND RELATIONSHIP

Universe: Persons under 18 years

In households:..........2
Householder or spouse..........
Own child:..........1603
In married-couple family..........
In other family:..........98
Male householder, no wife present..........743
Female householder, no husband present..........204
Other relatives..........49
Nonrelatives..........
In group quarters:..........1
Institutionalized persons..........26
Other persons in group quarters..........
Filler..........

RELATIONSHIP AND AGE

Universe: Persons under 18 years

In households:
Householder or spouse....2
Related child:
Own child:
Under 3 years....454
3 and 4 years....310
5 years....147
6 to 11 years....859
12 and 13 years....252
14 years....128
15 to 17 years....294
Other relatives:
Under 3 years....48
3 and 4 years....20
5 years....13
6 to 11 years....78
12 and 13 years....16
14 years....5
15 to 17 years....24
Nonrelatives:
Under 3 years....6
3 and 4 years....0
5 years....2
6 to 11 years....25
12 and 13 years....8
14 years....0
15 to 17 years....8
In group quarters:
Institutionalized persons:
Under 3 years....0
3 and 4 years....0
5 years....0
6 to 11 years....0
12 and 13 years....0
14 years....0
15 to 17 years....1
Other persons in group quarters:
Under 3 years....12
3 and 4 years....2
5 years....5
6 to 11 years....7
12 and 13 years....0
14 years....0
15 to 17 years....0
Filler....

HOUSEHOLD TYPE AND RELATIONSHIP

Universe: Persons 65 years and over

In family households:
Householder....499
Spouse....316
Other relatives....107
Nonrelatives....8
In nonfamily households:
Male householder:
Living alone....134
Not living alone....10
Female householder:
Living alone....566
Not living alone....13
Nonrelatives....26
In group quarters:
Institutionalized persons....200
Other persons in group quarters....0
Filler....

AGE OF HOUSEHOLD MEMBERS(2) BY HOUSEHOLD SIZE AND HOUSEHOLD TYPE
Universe: Households
Households with 1 or more persons 60 years and over
1 person..798
2 or more persons:
Family households..801
Nonfamily households..43
Households with no persons 60 years and over
1 person..451
2 or more persons:
Family households..1935
Nonfamily households..127
AGE OF HOUSEHOLD MEMBERS(3) BY HOUSEHOLD SIZE AND HOUSEHOLD TYPE
Universe: Households
Households with 1 or more persons 65 years and over
1 person..700
2 or more persons:
Family households..592
Nonfamily households..34
Households with no persons 65 years and over
1 person..549
2 or more persons:
Family households..2144
Nonfamily households..136
HOUSEHOLD TYPE
Universe: Households
Households with 1 or more nonrelatives......................................314
Households with no nonrelatives...3841
HOUSEHOLD TYPE AND HOUSEHOLD SIZE
Universe: Households
Family households:
2 persons...1079
3 persons...689
4 persons...559
5 persons...263
6 persons...99
7 or more persons..47
Nonfamily households:
1 person..1249
2 persons...132
3 persons...20
4 persons...10
5 persons...6
6 persons...1
7 or more persons..1
GROUP QUARTERS
Universe: Persons in group quarters
Institutionalized persons (00I-99I):
Correctional institutions (20I-24I, 27I, 28I, 95I).........................256
Nursing homes (60I-67I)...209
Mental (Psychiatric) hospitals (45I-48I)....................................0
Juvenile institutions (01I-05I, 10I-12I, 15I)...............................0
Other institutions (00I, 06I-09I, 13I, 14I, 16I-19I, 25I, 26I, 29.........0
Other persons in group quarters (00N-99N):
College dormitories (87N)...0
Military quarters (96N-98N)...0
Emergency shelters for homeless (82N, 83N)..................................0
Visible in street locations (84N, 85N)......................................0
Other noninstitutional group quarters (00N-81N, 86N, 88N-95N, 99N).......44
PERSONS SUBSTITUTED
Universe: Persons
Not substituted...10869
Substituted for:

Noninterview.......... 35
Count adjustment..........

IMPUTATION OF POPULATION ITEMS
Universe: Persons not substituted
No items allocated.......... 9064
One or more items allocated.......... 1805

IMPUTATION OF RELATIONSHIP
Universe: Persons not substituted
Allocated.......... 255
Not allocated.......... 10614

IMPUTATION OF SEX
Universe: Persons not substituted
Allocated.......... 156
Not allocated.......... 10713

IMPUTATION OF AGE
Universe: Persons not substituted
Allocated.......... 310
Not allocated.......... 10559

IMPUTATION OF RACE
Universe: Persons not substituted
Allocated.......... 137
Not allocated.......... 10732

IMPUTATION OF HISPANIC ORIGIN
Universe: Persons not substituted
Allocated.......... 1252
Not allocated.......... 9617

IMPUTATION OF MARITAL STATUS
Universe: Persons 15 years and over
Substituted.......... 25
Not substituted:
  Allocated.......... 183
  Not allocated.......... 8299

HOUSING UNITS
Universe: Housing units
Total.......... 4335

OCCUPANCY STATUS
Universe: Housing units
Occupied.......... 4155
Vacant.......... 180

TENURE
Universe: Occupied housing units
Owner occupied.......... 2514
Renter occupied.......... 1641

URBAN AND RURAL
Universe: Housing units
Urban:
  Inside urbanized area.......... 0
  Outside urbanized area.......... 0
Rural.......... 0
Not defined for this file.......... 4335

VACANCY STATUS
Universe: Vacant housing units
For rent.......... 60
For sale only.......... 55
Rented or sold, not occupied.......... 16
For seasonal, recreational, or occasional use.......... 5
For migrant workers.......... 0
Other vacant.......... 44

BOARDED-UP STATUS
Universe: Vacant housing units
Boarded up.......... 16
Not boarded up.......... 164

USUAL HOME ELSEWHERE

Universe: Vacant housing units	8
Vacant, usual home elsewhere	172
All other vacants	
RACE OF HOUSEHOLDER	
Universe: Occupied housing units	3379
White	728
Black	11
American Indian, Eskimo, or Aleut	23
Asian or Pacific Islander	14
Other race	
TENURE BY RACE OF HOUSEHOLDER	
Universe: Occupied housing units	
Owner occupied	2195
White	296
Black	4
American Indian, Eskimo, or Aleut	12
Asian or Pacific Islander	7
Other race	
Renter occupied	1184
White	432
Black	7
American Indian, Eskimo, or Aleut	11
Asian or Pacific Islander	7
Other race	
HISPANIC ORIGIN OF HOUSEHOLDER BY RACE OF HOUSEHOLDER	
Universe: Occupied housing units	
Not of Hispanic origin	3347
White	721
Black	11
American Indian, Eskimo, or Aleut	21
Asian or Pacific Islander	2
Other race	
Hispanic origin	32
White	7
Black	0
American Indian, Eskimo, or Aleut	2
Asian or Pacific Islander	12
Other race	
TENURE BY RACE OF HOUSEHOLDER	
Universe: Occupied housing units with householder of Hispanic origin	
Owner occupied	13
White	4
Black	0
American Indian, Eskimo, or Aleut	0
Asian or Pacific Islander	7
Other race	
Renter occupied	19
White	3
Black	0
American Indian, Eskimo, or Aleut	2
Asian or Pacific Islander	5
Other race	
TENURE BY AGE OF HOUSEHOLDER	
Universe: Occupied housing units	
Owner occupied	29
15 to 24 years	435
25 to 34 years	537
35 to 44 years	399
45 to 54 years	415
55 to 64 years	419
65 to 74 years	280
75 years and over	
Renter occupied	

15 to 24 years....120
25 to 34 years....466
35 to 44 years....239
45 to 54 years....148
55 to 64 years....145
65 to 74 years....276
75 years and over....247

ROOMS

Universe: Housing units

1 room....16
2 rooms....84
3 rooms....668
4 rooms....667
5 rooms....609
6 rooms....846
7 rooms....661
8 rooms....357
9 or more rooms....427

AGGREGATE ROOMS

Universe: Housing units

Total....24730

AGGREGATE ROOMS BY TENURE

Universe: Occupied housing units

Total
Owner occupied....17246
Renter occupied....6597

AGGREGATE ROOMS BY VACANCY STATUS

Universe: Vacant housing units

Total
For rent....247
For sale only....300
Rented or sold, not occupied....77
For seasonal, recreational, or occasional use....34
For migrant workers....0
Other vacant....229

PERSONS IN UNIT

Universe: Occupied housing units

1 person....1249
2 persons....1211
3 persons....709
4 persons....569
5 persons....269
6 persons....100
7 or more persons....48

PERSONS PER OCCUPIED HOUSING UNIT

Universe: Occupied housing units

Persons per occupied housing unit....2.50

TENURE BY PERSONS IN UNIT

Universe: Occupied housing units

Owner occupied
1 person....477
2 persons....824
3 persons....462
4 persons....446
5 persons....196
6 persons....73
7 or more persons....36
Renter occupied
1 person....772
2 persons....387
3 persons....247
4 persons....123
5 persons....73

6 persons....27
7 or more persons....12

PERSONS PER OCCUPIED HOUSING UNIT BY TENURE

Universe: Occupied housing units

Persons per occupied housing unit
Owner occupied....2.78
Renter occupied....2.07

AGGREGATE PERSONS

Universe: Persons in occupied housing units

Total....10395

AGGREGATE PERSONS BY TENURE

Universe: Persons in occupied housing units

Total
Owner occupied....7001
Renter occupied....3394

PERSONS PER ROOM

Universe: Occupied housing units

0.50 or less....2996
0.51 to 1.00....1068
1.01 to 1.50....74
1.51 to 2.00....14
2.01 or more....3

TENURE BY PERSONS PER ROOM

Universe: Occupied housing units

Owner occupied
0.50 or less....1902
0.51 to 1.00....576
1.01 to 1.50....30
1.51 to 2.00....6
2.01 or more....0
Renter occupied
0.50 or less....1094
0.51 to 1.00....492
1.01 to 1.50....44
1.51 to 2.00....8
2.01 or more....3

VALUE

Universe: Specified owner-occupied housing units

Less than $15,000....14
$15,000 to $19,999....4
$20,000 to $24,999....6
$25,000 to $29,999....17
$30,000 to $34,999....20
$35,000 to $39,999....29
$40,000 to $44,999....42
$45,000 to $49,999....37
$50,000 to $59,999....131
$60,000 to $74,999....325
$75,000 to $99,999....833
$100,000 to $124,999....392
$125,000 to $149,999....177
$150,000 to $174,999....92
$175,000 to $199,999....57
$200,000 to $249,999....55
$250,000 to $299,999....30
$300,000 to $399,999....19
$400,000 to $499,999....5
$500,000 or more....4

LOWER VALUE QUARTILE

Universe: Specified owner-occupied housing units

Lower value quartile....72600

Appendix B

Objective:
At the end of the lesson, the students will be able to explain the properties and uses of magnets by listing and demonstrating at least two uses of magnets and determining magnet strength.

Anticipatory Set:
- Demonstrate the power of magnets by putting a magnet on a toy car and pulling it across a table using another magnet

Input:
- Define magnet, north pole and south pole
- Assign students to determine where a magnet is strongest using bar magnets and paper clips: Where do most of the paper clips stick to the magnet?
- Assign students to investigate the results of placing north pole to north pole, south pole to south pole and north pole to south pole

Modeling:
- Distribute ten objects for groups of students to try to pick up with a magnet
- Lead students in predicting results
- Assign students to test predictions and sort objects attracted/not attracted to the magnet
- How are the attracted objects alike?

Guided Practice:
- Distribute paper, cardboard, plastic, wood and cloth
- Assign students to predict and investigate the results of placing the materials between the magnet and the paper clips
- Invite students to share results and draw conclusions

Checking for Understanding:
- Introduce bar, disc and horseshoe magnets
- Assign students to determine which magnet is the strongest
- Does the size of the magnet indicate strength?

Independent Practice:
- Assign students to list and demonstrate at least two uses of magnets

Appendix C

Objective:
At the end of the lesson, the students will be able to explain the properties and uses of magnets by writing a definition of magnet and listing at least two uses of magnets.

Anticipatory Set:
- Demonstrate the power of magnets by putting a magnet on a toy car and pulling it across a table using another magnet

Input:
- Define magnet, north pole and south pole
- Explain that a magnet is strongest at its ends or poles
- Demonstrate that a magnet is strongest at its poles using a bar magnet and paper clips
- Explain and demonstrate that like poles push apart while different poles attract

Modeling:
- Explain that magnets pick up metal objects
- Demonstrate the properties of magnets by attempting to pick up a series of metal and nonmetal objects

Guided Practice:
- Explain and demonstrate that magnets can attract through paper, plastic, cardboard and cloth, but not wood

Checking for Understanding:
- Introduce bar, disc and horseshoe magnets
- Explain and demonstrate that the disc magnet is strongest

Independent Practice:
- Assign students to write a definition of magnet and list at least two uses of magnets

Appendix D

Circle the word that completes each sentence.

1. Two __________ can push and pull each other.

   a. tables
   b. metals
   c. magnets

2. The ends of magnets are called north and south __________.

   a. poles
   b. pushes
   c. pulls

3. Two north poles held together will __________.

   a. push apart
   b. pull together
   c. not move

4. A magnet will pick up __________.

   a. a nail
   b. an eraser
   c. paper

5. A magnet will not pick up __________.

   a. nails
   b. scissors
   c. buttons

6. A magnet will move __________.

a. metal objects
b. plastic objects
c. wooden objects

7. A __________ might have a magnet.

a. towel
b. toy
c. newspaper

8. A magnet can not pull through __________.

a. paper
b. plastic
c. wood

9. A weak magnet will pick up __________ paper clips than a strong magnet.

a. more
b. heavier
c. fewer

10. Two south poles put next to each other will __________.

a. not move
b. push apart
c. pull together

11. A north pole and a south pole put close together will __________.

a. not move
b. push apart
c. pull together

12. A __________ contains a magnet.

a. bottle
b. telephone
c. book

13. A magnet can pull through __________.

a. wood
b. cloth
c. a book

14. A magnet pushes and pulls hardest at its __________.

a. ends
b. center
c. sides

15. The __________ magnet is the strongest type of magnet.

a. bar
b. disc
c. horseshoe

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