THE IMPACT OF PRIOR KNOWLEDGE ON STUDENTS PERFORMANCE IN SCIENCE IN THE SECOND GRADE AT ALTA E. BUTLER SCHOOL

by

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ABSTRACT

The purpose of this study was to determine how prior knowledge impacted students' performance in science in the second grade at Alta E. Butler Elementary School. Test results were compiled of students in one class taught with prior knowledge activities and students in another class taught without prior knowledge activities.

Current literature and research was reviewed on the subject of prior knowledge. The two main philosophies of education that were explained were objectivism and constructivism.

Constructivism was used in this study by comparing two second grade classes, using pretests and posttests, while providing prior knowledge activities as the treatment. The two classes were identified as Class A (with 20 students) and Class B (with 18 students). Both were ESL classes and four study units were prescribed and compared.

Each class received prior knowledge in two of the four units of study before the pretesting of those units. Class A received prior knowledge in units one and three; while class B received prior knowledge in units two and four.

After each unit the posttest was administered. The results of the tests were graphed to check the impact prior knowledge made on students' performance. The posttest results were also compared between the two classes to show the effect prior knowledge had on the students' retention of content material. The classes that received prior knowledge had higher grades not only on the pretests, but also on the posttests in four out of four unit tests.
Classes with prior knowledge averaged 15% higher on the pretests. Classes with prior knowledge also demonstrated a greater growth rate on the posttest. The difference ranged from 10.3% to 18.8% over classes that did not receive prior knowledge. It was clear that the ESL and bilingual students benefited from the use of constructivism in the classroom. The classes that received prior knowledge demonstrated a greater retention of content information over the nine-month duration of this study.

Prior knowledge impacted all students regardless of their first language background. This strategy was successful with all students, including the English speakers, Spanish speakers, and the ESL students. The results of this study support the constructivism theory and the theoretical application of prior knowledge.
DEDICATION

This thesis is dedicated to my parents, Andrew and Gloria Brown, who have been an inspiration to me all my life. My father graduated from Northern Arizona University with a Master’s degree in education in 1968, when few Hispanics graduated from college. My mother supported my father throughout his efforts. They have been an inspiration to me, my grown children, and the many students that my father has taught during his forty year career as an educator.
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CHAPTER 1
THE PROBLEM

Introduction

One of the greatest challenges in education today is addressing large number of students who are considered to be at risk of school failure. The highest percentage of students at risk is found in inner city schools where the worst social and economic conditions exist (Wang, Haertell, & Walberg, 1994). The high levels of crime, unemployment, drug dependency, broken families, illegitimacy and concentrated poverty describe the critical status of students who are currently living in America’s inner city neighborhoods (Waxman, & Huang, 1996).

These serious school, community and family problems present a challenge to educators to provide quality educational opportunities for all students. In order to provide these opportunities, educators must be aware of current educational methods and contemporary classroom environment research.

Understanding how students learn is a priority when planning lessons and setting up learning environments for the students. To better comprehend material, students need to be able to make connections between what they already know and the new material. Information already known is referred to as prior knowledge. This study investigated the impact of prior knowledge in the students’ performance in science at the second grade level.
Development of the Problem

The two main philosophies of education today are objectivism and constructivism. The philosophy of objectivism states that the mind constructs an accurate model of reality that reflect objects, properties, and relationships that exist independently in the world. The ultimate authority is nature, followed by the scientist or teacher who understands the nature of the content and determines there is no point in debating the scientific facts. The learner is the passive recipient of facts as introduced by the teacher. Knowledge is about facts and proven scientific theories. The objectivist teacher stands in front of the class and supplies facts (Adamson, 1993).

Objectivism has been challenged by constructivism, especially in the last two decades. Constructivists believe that knowledge is the result of individual construction of reality. Constructivism describes an internal psychological process in which the learner actively transfers information into something that is unique and personally meaningful (Brooks, 1990). The learners use their own personal experiences as the content for building new meaning and skills into that they have already learned. This is known as prior knowledge. Through this process of interaction between individuals and the environment, increasingly sophisticated and meaningful understandings and skills are developed. From the constructivist’s viewpoint, the teacher is the facilitator of learning. The teacher helps set up the environment so students engage in their own learning processes to discover and internalize what they have learned and make their own connections with their prior knowledge (Levin, 1996).
Prior knowledge can be explained as a combination of the learner’s pre-existing attitudes, experiences, and knowledge. All new information needs to be linked to the students’ prior knowledge. The link between what students already know and what they are to learn should be made explicit so that students understand that they are building on knowledge frameworks acquired through prior schooling and life experiences, even if these were acquired through another language and a different cultural context. Students need to make their own linkages between their prior knowledge and the topic being studied. (Chamot & O’Malley, 1992, p. 33)

Need for the Study

This researcher works in an inner city school in southwest Phoenix. The population of the school district consists of 7,577 students from preschool to eighth grade. Once a stable, middle income area, the neighborhoods feeding the school district have shifted from older established families to lower income, younger households. The population has grown at the rate of 7% per year. Fifty six percent of the students are limited English proficient and 46% of the limited English proficient population qualify under the Emergency Immigrant Education Program. The total enrollment is 93% minority and 90% of all the students in the school district receive free lunch (Cohen, 1999).

Two programs have been adopted to meet the needs of at-risk students. The Urban Systematic Initiative (USI) program and the Cognitively Guided Instruction (CGI) program are both programs that utilize cognitive strategies in teaching math and science. Those strategies begin with the use of prior knowledge principles and making connections with what the students already know to make learning meaningful.
In an interview with the Director of Professional Development and Assessment, data was shown that depicts gains in science and math scores since the implementation of the USI and CGI programs (Cohen, 1999).

**Purpose of the Study**

The purpose of this study was to determine how prior knowledge impacted students performance in science in the second grade at Alta E. Butler Elementary School.

**Research Question**

How does prior knowledge impact students’ performance in science in the second grade at Alta E. Butler Elementary School?

**Definition of Terms**

**Accommodation**: Where already existing structures of information are modified to adjust to the new information (Cook, 1996, p. 3).

**Assimilation**: Where the new information is transformed and incorporated into already existing structures (Cook, 1996, p. 3).

**Cognitive structures**: Patterns of physical or mental actions that underlie specific acts of intelligence and correspond to stages of child development (Harris & Pressley 1991, p. 392).

**Disequilibrium**: When the child is faced with an anomaly that requires a modification to his thinking (Cook, 1996, p. 3).

**Elaboration**: When students integrate new information to their existing knowledge structures or schemata (Jenson, 1998, p. 40).
Epistemology: The study of the origin, nature and limits of knowledge. (www.gwu.edu/~tip/piaget.html).

Equilibrium: Understanding occurs and mastery of the information is practiced. (Mallon, 1979, p. 30).

Prior knowledge: A combination of the learner’s pre-existing attitudes, experiences, and knowledge (Hixson & Tinsmann, 1990, p. 10).

Schemata: Units of organized information. A schema is fundamental element on which all information processing depends, it is a data structure for representing concepts stored in memory. For example the schema for restaurants contain information about waiter, cooks, customers, menus etc. and their relationships to each other (Bowens, M.R. & Dochy, 1990, p. 12).

Zone of Proximal Development: The area between what a learner can do independently (mastery level) and what can be accomplished with the help of an adult (instructional level). (Harris, & Pressley, 1991, p. 392).
CHAPTER 2
LITERATURE REVIEW

Introduction

Prior knowledge can be explained as a combination of the learner’s pre-existing attitudes, experiences, and knowledge.

Attitudes are beliefs the students have of themselves and the awareness of their individual interests and strengths as well as their own motivations. Experiences are the everyday activities and events in the students’ lives that provide background understanding. The student’s family and community experiences form the basic framework of learning. Knowledge is understanding content based on concepts, structures, and processes of information in all areas. (Knuth and Jones, 1991, p. 1)

According to Chamot and O’Malley (1992) all new information needs to be linked to students’ relevant prior knowledge. The link between what students already know and what they are to learn should be made explicit so that students understand that they are building on knowledge frameworks acquired through prior schooling and life experiences, even if these were acquired through another language and a different cultural context. “Students need to make their own linkages between their prior knowledge and the topic being studied” (Chamot and O’Malley, 1992, p. 33).

Learning is a dynamic process that is both social and mental. The learner acquires new knowledge and ideas and sees connections between ideas by actively forging mental representations, finding relationships, interpreting, retelling and making meaning. Children are the active transformers of their experiences with the world, picking and choosing what they need to recreate or to make their own world in their head. (Perez and Torres-Gusman, 1996, p. 26)
Literature is discussed in the following sections: Accessing Prior Knowledge, Learning Strategies, and Schemata.

**Accessing Prior Knowledge**

Chamot and O’Malley list three main areas to access prior knowledge. First, it is necessary to have information about and understanding of the cultural and experiential background of students. This is gleaned from school records, parental interaction, and asking colleagues who may have worked with the students.

The second way to identify students’ background knowledge is by asking them to assess their own prior knowledge. When the students reflect on how their prior knowledge relates to what they already know, the students realize the importance of elaboration as a learning strategy because it is easier to make connections they need for comprehension.

Five general strategies for accessing prior knowledge with diverse groups of children are:

1. The use of visuals which generate students’ prior knowledge.

2. Using multimedia and manipulatives such as posters, artifacts, realia (real objects) and videos will help the students make connections to what they already know.

3. Semantic maps and K-W-L (What you know, what you want to learn and what you have learned) help the teachers discover what the students
already know and helps link students’ prior knowledge to the new concepts and ideas.

4. Sharing experiences, such as music, poems and works of art with students from diverse backgrounds are other ways to include culture.

5. Writing experiences through brainstorming, quickwrites, brainwriting, journal entries and structured writing prompts also help students focus on what they know (Guillaume, 1998).

**Learning Strategies**

Elaboration is one of the most powerful cognitive learning strategies. It can be applied to language skills, such as reading, writing, speaking and listening. It can also be applied to all types of content material. “When students elaborate, they recall prior knowledge, consciously interrelate parts of what they are learning, and integrate new information to their existing knowledge structures or schemata.” (Richard-Amato, Snow, 1992, p. 52).

The key word in elaborating is extension. A novice’s knowledge is still limited, consisting of a set of concepts and their interrelations. Many times, activating prior knowledge has no links with the existing textual concepts and nodes in an associative net. “Elaborations, often based on knowledge from other domains, have to bridge these gaps” (Machiels-Bongaerts & Schmidt, 1995 p. 2).
As a student is learning to use strategies to control their own learning the internalization of the information is acquired much more effectively. This can happen when the student learns to use cognitive strategies. Cognitive strategies are strategies that the learner uses to interact with the material to be learned by manipulating it mentally (as in making mental images or relating new information to previously acquired concepts or skills) or physically (as in grouping items to be learned into meaningful categories or taking notes or making summaries of important information to be remembered). (Richard-Amato, 1992, p. 51)

Chamot and O’Malley (1992) have researched students who naturally achieve in academic areas and they have found that these students use learning strategies which help them learn new concepts both in learning second language skills and in learning new concepts in content areas. These three strategies are the metacognitive, cognitive and social-affective strategies. Prior knowledge is incorporated in all three areas, but mainly in the cognitive strategy.

The main areas of metacognitive strategies are planning, monitoring, and evaluating. Planning is where the students plan how to accomplish a learning task. Monitoring is where the students check their own comprehension during listening, reading, and writing activities. When the students evaluate, they keep learning logs, reflect on what they learned and judge how well they learned the new material. (Chamot, O’Malley, 1992, p. 62)

According to Chamot and O’Malley (1992), the social/affective strategies involve working together and asking questions for clarification. Students also use self-talk to reassure themselves through inner speech that they will be able perform the task successfully. Their self-talk will be more successful if they have prior successful experiences with tasks that are similar to the tasks they are required to do.
In using these strategies the student begins to understand his/her own learning processes. According to Burns (1992),

Children need to learn mathematical concepts and to see the relationships among these concepts. Because these concepts and relationships are constructed by people and exist only in their minds, to learn mathematics, children must construct these concepts and relationships in their own minds. Learning mathematics requires that children create and re-create mathematical relationships in their own minds. Children need direct and concrete interaction with mathematical ideas; ideas are not accessible solely from abstractions. Continuous interactions with the child’s mind and with mathematics in the real world is necessary. (Burns, M., 1992, p. 24)

According to Perez and Torres-Gusman (1996), there are several cognitive strategies which include resourcing, grouping, note-taking, elaboration of prior knowledge, summarizing, imagery, auditory representation, and making inferences. These strategies help the student be responsible for his or her own learning.

The cognitive model of learning indicates that learning is an active, dynamic process in which learner select information from their environment, organize the information, relate it to what they already know, retain what they consider to be important, use the information in appropriate contexts, and reflect on the success of their learning efforts. (Chamot and O’Malley, p.13)

**Schemata**

According to Perez and Torres-Guzman (1996), an individual uses schemata to adapt to and organize the environment intellectually. The information, conveyed verbally, visually, or in written form, does not, in and of itself, provide meaning. Meaning is construed by the observer, based on previous background knowledge structures. These previously acquired knowledge structures are called schemata.
Schemata are created through interaction with the environment as an individual actively seeks to organize experiences and information according to internally construed common characteristics. Schemata, then, are truly the building blocks of cognition. They are the fundamental elements upon which information processing depends. (Perez & Torres-Guzman, 1996, p. 27)

Adamson (1993) states that one uses schemata to organize information much like a computer does. One files information in schemas that one may use to retrieve information about new content material in order to make connections with what one already knows, which is prior knowledge.

A schema is any mental representation, typically of an object or an event that specifies general properties and shows how these properties are related to each other. Schemas, then are units of organized information. The schema for restaurants contain information about waiter, cooks, and customers and their relationships to each other. A schema for a bird contains information that a bird lays eggs and typically flies. (Adamson, H. D., 1993, p.44)

Prior knowledge has a central state in all of the schema theories. The starting point for the construction of a representation of what the learner already knows. Dochy and Bouwens (1990) state that learning is connecting new information to an existing representation.

What a learner knows provides the framework for the new knowledge. The schema accepts information as it becomes available at sensory surfaces and is changed by that information; it directs movements and exploratory activities that make more information available, by which the schema is further modified. (Dochy, & Bouwens, 1990 p. 4)

Dochy & Bouwens (1990) discuss the theories proposed by Minsky and Rumelhart. These theories state that schemata are modifiable information structures that represent the information available in human experiences, and the interrelationships
between objects, situations, events, and sequences that occur. Thus incoming
information can be fitted into slots. When enough slots are filled, the schema will become
active. The schema guides and seeks for information to fill the remaining slots and to
create a more complete interpretation. Missing information will be completed by
defaults or inferences of the subject on the basis of typical information for a particular
situation.

In research by Lawless and Brown (1997), the individual learners were given
control of the sequence of instructional material. With this control, individuals could
discover how to learn as they made instructional decisions and experience the results of
those decisions. The students were able to acquire strategies for learning in different
situations. They used schemata that provided the interpretation of meaning.

The use of schemata is constructed partially out of information previously known
and partially by the new information presented. It is the process of building and refining
this concept of meaning that allows comprehension to occur.

Meaning is not a property of the instructional environment or of the individual,
but arises out of the interaction of the two. Using a schema theory as a
framework, we view learning as an active, constructive process. It is affected not
only by the learners’ internal knowledge but by the external constraints of the
learning environment as well. (Lawless & Brown, 1997, p. 118)

**Constructivism**

A basic tenet of constructivism is that learning depends on using the students’
prior knowledge and experiences to build new cognitive structures.
Proponents of constructivism contend that students actively seek meaning from their environments and experiences, therefore the focus of the educational experience should be to facilitate students in their efforts to construct meaning by posing problems, emphasizing conceptual thinking and adapting the curriculum to address students' suppositions. (Ramos, Rodriguez & Ruiz, 1994, p. 72)

**Theories of Piaget and Vygotsky**

For more than sixty years, Jean Piaget conducted a program of naturalistic research that has profoundly affected the modern study of child development. He called his general theoretical framework, genetic epistemology. Epistemology is the study of the origin, nature, and limits of knowledge (Webb, 1980). Piaget was interested in how knowledge develops in the human organism. The concept of cognitive structure is central to his theory. Cognitive structures are patterns of physical or mental action that underlie specific acts of intelligence and correspond to stages of child development. There are four primary cognitive structures or developmental stages according to Piaget (Webb, p.95): sensorimotor, preoperations, concrete operations, and formal operations. In the sensorimotor stage (0-2 years), intelligence takes the form of motor actions. Intelligence in the preoperation period (3-7 years) is intuitive in nature. The cognitive structure during the concrete operational state (8-11 years) is logical but depends upon concrete referents. The final stage of formal operations (12-15 years), involves abstractions. (www.gwu.edu/~tip/piaget.html)

According to Piaget (Kamii, 1981), psychological adaptation has two components: Assimilation, which is where the new information is transformed and incorporated into already existing structures, and accommodation, where already existing structures are modified to adjust to new information.
In a mini lecture, Paul Cook (1995) stated that when a child is introduced to a new concept that does not fit into his structure of thinking, the child is faced with an anomaly that requires a modification to his thinking. Piaget labeled this process of modification as accomodation (Cook, 1996).

In summation, when a child faces an experience that matches his past experiences, no learning takes place, as the child assimilates the experiences into his current structures of thinking. When faced with a new experience that does not fit into his current schema of thinking, he must accommodate the new experience by modifying the structure. This is where Piaget says learning occurs. If the child has no need to restructure this schema, no growth or learning takes place. “These structures of thinking evolve into more sophisticated construction until finally the child reaches a certain point of development and abstract thought becomes possible. This is the basis of the theory of constructivism where the child constructs his or her own knowledge” (Cook, 1996, p. 4). By presenting a multitude of events to children, they are stimulated to construct more sophisticated structures earlier in their development.

According to Piaget, a constructivist, the processes of learning and mental development are independent of each other. Learning utilizes development but does not shape its course. He believed that maturation precedes learning. Educators who adhere to this idea emphasize that readiness principle. “A student must be exposed primarily to input that can be handled without difficulty. In other words, the input must be at the student’s actual level of development” (Richard-Amato, 1996, p. 38). Piaget did not believe that language is necessary for the development of intelligence. He did believe
that language provides a useful medium for symbolic functions. According to Piaget, language and thought are separate, and it is not until the period of formal operations that language plays a direct role in the acquisition of knowledge.

Another constructivist was Russian linguistic Lev Vygotsky, who saw an interactive relationship among language, thought and social conditions. He believed that although language and thought are distinct and develop independently, it is not until the two fuse together with the development of inner speech that logical reasoning develops.

He believed that young children use language to communicate, plan and guide their behavior in a self-regulatory manner within the context of their society. The interpretive rules of language use are acquired through social interaction at a very early age. (Perez & Torrez-Guzman, 1996, p. 29)

For Vygotsky, language initially serves a social function and the cognitive and communicative functions evolve from this general use of language. He refers to the zone of proximal development. “The zone refers to the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.” (Richard-Amato & Snow, 1992, p. 272)

Gradually children become more independent in their ability to solve problems even though their style of cognitive functioning continues to be influenced by the cultural group.

Vygotsky saw the individual as having two developmental levels that have interacted with learning since birth. In his theory, learning precedes maturation. The individual progresses from actual development level to a potential developmental level.
In between these two zones is the Zone of Proximal Development. "The potential developmental level through learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them. He believed that learning should always be one step ahead of development" (Richard-Amato, 1996, p. 38-39).

Richard-Amato (1996) compare the two theories of Piaget and Vygotsky. Piaget believed that the processes of learning and mental development are independent of each other, that maturation precedes learning, and that the input must be at the student’s actual level of development. Vygotsky believed that the individual has two developmental levels and that learning precedes maturation. Piaget stressed biology as the determiner in universal stages of development, and Vygotsky stressed society as the determiner of development. Vygotsky felt that the universal stages Piaget stressed were not universal because each person is different. Vygotsky was convinced that higher psychological functions entail new psychological systems. Vygotsky placed a great deal of importance on the play of a child because he saw that children played as though they were more advanced, creating their own zone of proximal development (Richard-Amato, 1996).

The Role of Children’s Play in Development and Learning

Many who argue the importance of play in the early years are constructivists. A constructivist’s view has its roots in cognitive development. This position argues that children build knowledge and skill through a slow and continuous process of construction. Children do not passively take in information from the world around them
and learn it; rather, they actively transform it into something that is unique and personally meaningful. They use their experience as the content for building new meanings and skills onto what they have already learned. Through this process of interaction between individuals and the environment, increasingly sophisticated and meaningful understandings and skills develop. “From a constructivist’s perspective, play is a vital part of the process of constructing knowledge. When children do not have adequate opportunities to play or do not develop adequate tools for play, there is cause for concern.” (Levin, D., 1996, p. 3)

According to studies done by Levin (1996) children who engage in a rich and creative play process are assimilating something new and unexpected. When the new information does not quite fit in their schema of experiences, they face disequilibrium and begin to accommodate the new content in their play by adjusting their current ideas to the new content. Once they learn a new idea, they reach equilibrium and immediately try out their new mastery. In this way, children’s play is a highly schematic process and provides children with a vital opportunity to experience the zone of proximal development (Levin, 1996).

When a child mimics actions he sees over and over again, such as violence on television, he shows little change of his activity over time. There is hardly any evidence that knowledge construction is taking place. The child is not experiencing disequilibrium and is not trying to master something a little higher that what he already knows thus, learning is not taking place according to the zone of proximal development theory of Vgotsky (Adamson, 1993).
Constructivists believe that knowledge is the result of individual constructions of reality. From their perspective, learning occurs when the student's perceptions of reality are thrown out of balance by disparities between conceptions and the new observations. It is a psychological process where the students are continuously checking new information against their prior knowledge, making modifications if necessary and reaching new understanding or constructions of reality. (Brooks, 1995, p. 71)

In psychological terms, the old rules are the existing cognitive structures. When the old rules of prior knowledge and the new information collide, the checking process generates cognitive disequilibrium. According to Piaget, the accommodation stage is when the student modifies his learning and reaches equilibrium until a new concept is introduced. (Cook, 1995)

**Objectivism versus Constructivism**

The two main philosophies of science and education are objectivism and constructivism. The objectivism philosophy states the mind constructs an accurate model of reality that reflects the objects, properties, and relationships that exist independently in the world. The objectivist believes that knowledge about facts and proven scientific theories are authoritative. The ultimate authority is nature and there is no point in debating scientific facts. The authoritative teacher stands in front of the class and supplies facts to the students (Adamson, 1993). The social constructivists believe that all knowledge, including scientific knowledge, is collaboratively constructed. They claim that knowledge is not firmly grounded in reality. Language and the mind do not reflect reality but rather create it. Social constructivism proposes a relativistic theory in which knowledge is based on the network of schemas created in the mind by the experiences of
the individuals of particular cultures at a particular time. "The teacher who believes in
constructivism is one who facilitates learning as the students construct their own
knowledge based on strategies they have learned" (Adamson, 1996, p. 56).

**Memory**

Using the schema theory as a framework, learning is viewed as an active,
constructive process. It is affected not only by the learners’ internal knowledge but by the
external constraints of the learning environment as well (Lawless & Scott, 1997).
This theory is based on three types of memory. Individuals have the long-term memory
that is derived from personal experiences and education. The short-term memory is the
memory, which is used to remember telephone numbers and other trivial information that
is easily forgotten.

The last type of memory we use to learn is the working memory in which we
manipulate information. The working memory is used to solve problems,
reorganize material, and use prior knowledge to compare new information and
elaborate upon it for new understanding. (Richard-Amato & Snow, 1992, p. 43)

In Anderson’s cognitive theory, information is stored in the memory in two
forms: declarative knowledge and procedural knowledge. Declarative knowledge
consists of what one knows or what one can declare. Procedural knowledge consists of
what one knows how to do. Declarative knowledge is stored in memory frameworks as
schemata or interconnected concepts and ideas. Depending on prior learning the
concepts are connected with varying strengths of association that can help one concept
recall others for better understanding (Chamot & O’Malley, 1994).
According to Jenson (1998) the number one way to elicit or trigger recall using these different types of memories is by association. This association is called prior knowledge, which gives connections between what is known and what is being learned.

Summary

In this chapter prior knowledge was defined and strategies were discussed that can be used to access prior knowledge. Learning strategies and schemata were discussed. According to the theories of Piaget and Vygotski, prior knowledge is a key factor in learning. Constructivism and Objectivism were compared in education today. The present day movement is using constructivism in the classroom. The three types of memory used to learn are long term, short term and the working memory. Brain research results have shown that the recalls of different types of memories are dependent on association, which is prior knowledge.
CHAPTER 3

METHODOLOGY

Purpose

The purpose of this study was to determine how prior knowledge impacted students' performance in science in the second grade at Alta E. Butler Elementary School.

Research Question

How does prior knowledge impact students' performance in science in the second grade at Alta E. Butler Elementary School?

Research Design

The research design chosen for this study is quasi-experimental in nature.

According to Merriam and Simpson,

Designs that do vary from the classical model are referred to as quasi-experimental methods. If research groups are unequal in number of participants, or in dimensions one wishes to study when an experiment is being planned, quasi-experimental designs are used to provide as much control as possible. (Merriam & Simpson, 1995, p. 54)

Population and Sample

The participants in this study were two second grade ESL (English as a Second Language) classes at Alta E. Butler Elementary School. Class A, which consisted of 25 students, was taught by this researcher. Class B was taught by another teacher and
consisted of 24 students. In order to categorize the students’ English or Spanish proficiency, the students were tested using the Idea Oral Proficiency Test (IPT). The range of proficiency is from A to F in English. If the student is evaluated in the range from A to the lower level of C, it means the student is Limited English Proficient (LEP). Identified LEP students need to be taught in their home language, if possible. These students are considered to be Transitional Bilingual Students (TBE). If the student falls in the range from the higher level of C to level E, the student is considered ESL and needs to be taught with ESL techniques that ESL teachers are trained in. When the student reaches the F range they are considered exited from the bilingual program and are to be taught in English.

Class A consisted of 8 girls and 17 boys, four students were being tested for placement in Resource, which is a program designed for small group instruction for students identified as having a learning disability. Class B consisted of 10 girls and 14 boys with one in Resource and four students being tested for Resource. The ages for both classes ranged from 7 to 9 years of age.

According to Cohen (1999) the classes represented typical classes in the school district. The school district consists of 56% LEP students. The number of LEP students in Isaac School District has grown tremendously from 1,137 students in 1990 to 4,425 students in 1998. This is a growth of 289% in just 8 years (Project Praise, 1998). This is an important consideration when hiring trained ESL and bilingual teachers in the school district.
A pre-test before each unit was administered to both classes before the units were taught. Class A received prior knowledge lessons before the first pre-test on insects. Class B received no prior knowledge activities. This was done alternately throughout the four units which were taken from the second grade curriculum. The units were on insects, balance and motion, weather and air exploration. Each class received two units with prior knowledge and two classes without prior knowledge.

After each unit the posttest was administered. The results of the tests were graphed to check the impact prior knowledge made on students’ performance (See charts A to P). The posttest results were also compared between the two classes to show the effect prior knowledge had on the students’ retention of content material.

Assumptions

In the process of this evaluation it was assumed that:

1. Two units with prior knowledge and two units without prior knowledge would be given to both classes.

2. The students were interested and motivated to learn hands on science activities.

3. The tests were appropriate for measuring the impact of prior knowledge, especially on the pre-tests.

4. The Spanish speakers would also have an equal chance in learning the science content material.

5. Many different types of strategies would be used to activate students’ prior
knowledge.

Limitations

1. Four science lessons would be taught, each class would receive two lessons using prior knowledge activities before the pre-tests and two lessons using no prior knowledge activities.

2. Lessons would be taught in both languages to assure comprehension of content material in both classes.

3. Only the two second grades would be used for this study

4. Pre-tests and post tests would be used to measure the effect of prior knowledge and also writing activities.

5. Science lessons would be used that were part of the second grade curriculum.

6. Assuming the transient nature of the classes a few students would move and not be able to finish the study.

Procedure

First, the students in class A were given prior knowledge activities. Strategies for accessing and building upon prior knowledge were used. Visuals, manipulatives, realia (using real objects), sharing orally, multimedia presentations, writing, reading non-fiction and fiction stories aloud and using KWL (Know, Want to learn, Learned) charts were used to build prior knowledge. This is especially important for the TBE and the
ESL students because many times the teachers take it for granted that students have had common experiences that other English-speaking students have had.

Deliberately activating students’ prior knowledge is important because teachers often think they know what the linkages are between students’ prior knowledge and the new topic, and provide what they believe is the prior knowledge students need. This approach misses the point, which is that students need to make their own linkages between their prior knowledge and the topic being studied. (Chamot and O’Malley, 1994, p. 33)

The students in class A were given prior knowledge activities. The students in class B were not given prior knowledge. This was done alternately throughout all 4 units. They were given a pretest over content material at the introduction of every unit and a posttest at the conclusion of every unit. The test was given in English to the English readers and in Spanish to the Spanish readers.

The students in class B were not given prior knowledge activities in the first unit. They were given a pretest at the introduction of every unit and a posttest at the conclusion of every unit. The test was given only in English to class B because the students had been learning to read in English all year. The posttest and the pretest were identical.

**Instrumentation**

Class A consisted of 8 TBE students, 10 ESL students and 7 monolingual English speakers. Class B consisted of 2 TBE students, 2 ESL students, and 2 monolingual English speakers. Instruction in class B was done mainly in English with some instruction in Spanish if necessary, because the class was listed as an ESL class and the teacher in class B spoke very little Spanish. The parents were aware of the distinctions
between the two classes but requested to have their TBE students placed in a class taught in English. This researcher's class is instructed in both languages to help assist the TBE students learn content material with comprehension.

Method of Analysis

The students were given a pre-test to establish a baseline in order to subsequently measure how much they had learned. After the units were completed, a post-test identical to the pre-test was given. The differences in the correct responses in both tests were then checked and compared. Writing samples were graded for content. Based on the researcher's ESL instructional experience, the writing was assessed for content knowledge and the students' ability to connect what they knew to the content material being presented.

Each unit was developed with planned pre-tests and post-tests with the use of prior knowledge activities. Both classes were given two units with prior knowledge and two units without prior knowledge. The results of the tests were graphed and compared. The impact of prior knowledge was measured after each unit. The class grades were compared to see if the classes with prior knowledge activities consistently scored higher than the classes with no prior knowledge activities.
CHAPTER 4

PRESENTATION AND ANALYSIS OF THE DATA

Demographics

Class A and Class B was given two units with prior knowledge activities and two units without prior knowledge activities. This was done alternately throughout the four units.

During unit 1, Class A was comprised of 23 students. 16 students took the tests in English and 7 students took the tests in Spanish. Class B was comprised of 20 students. All the students in this class took the tests in English. The tests were read aloud to students because of the variety of reading levels. Class A consisted of 17 boys and 6 girls. Class B consisted of 9 girls and 11 boys.

The numbers of students in each class did not stay constant because a new school was opened in the district and some students transferred to the new school. This explains the difference in the number of students in units 2, 3, and 4. Class A was then comprised of 20 students. 15 took the tests in English and 5 took the test in Spanish. Class B had 18 students and they all took the test in English. Only the students present for the pretests were given the posttests in order to make the comparisons equal in both tests.

Four units in science were presented to both classes A and B from January to May, 1999. The units were taken from the second grade curriculum. These units were
titled Insects, Balance and Motion, Weather, and Air Exploration. Each unit was approximately six weeks long.

The class receiving prior knowledge activities was given three prior knowledge activities before the pretests. These activities were brainstorming (listing what they already know about the content material), class discussions, reading non-fiction stories, and viewing videos to help them make connections. These connections helped them form the links between what they knew to what they were about to learn. Realia, or the use of real objects was also used in all units.

**Findings and Results of the tests**

After the prior knowledge activities, the class was given the pre test. The results were compared to the results of the class given no prior knowledge. The results were graphed individually and then compared after each unit. The classes that received prior knowledge had higher grades not only on the pre test, but also on the posttests in 4 out of 4 unit tests. The results and comparisons are shown in charts A through P.

In unit 1 on insects, the pretest average of Class A, with prior knowledge, was 57.9%. The posttest average for Class A was 79% (Chart A). Class B, without prior knowledge, had a average of 41.1% on the pretest and 60.2% on the posttest (Chart B). There was a 16.8% difference between the pretests of both classes (Chart C). Chart D represents the difference of the posttest scores of Class A, with prior knowledge, and Class B, without prior knowledge. The difference was 18.8%.

In unit 2 on balance and motion, Class B received prior knowledge and Class A
Unit 1 - Study of Insects
Class A -
Study done with prior knowledge

Chart A

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<th>Pretest</th>
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Chart A shows an average increase of 21.8% in the pretest and posttest scores of Class A, with prior knowledge. Chart B demonstrates the difference in pretest and posttest scores in Class B, without prior knowledge. The average increase was 18.8%

Unit 1 - Study of Insects
Class B -
Study done without prior knowledge

Chart B

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Unit 1 - Study of Insects
Comparison of Class A's and Class B's pretest scores

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Chart C demonstrates the comparison of the pretests scores in Class A (with prior knowledge) and Class B (without prior knowledge). The average increase of growth between Class A and Class B was 16.8%.
Unit 1 Study of Insects
Comparison of Class A's and Class B's pretest scores

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<tr>
<th>Class A</th>
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Chart D depicts the difference between the posttest scores of Class A (with prior knowledge) and Class B (without prior knowledge). The average increase of growth was 18.8%. The differences in population is attributable to attrition.
did not. The pretest average of Class B was 72.9%. The posttest average of Class B was 88.6% (Chart E). The pretest average of Class A, without prior knowledge, was 56.7%. The average of the posttests of Class A was 75.1% (Chart F). The difference between the pretest score of both classes was 16.2% (Chart G). The average posttest scores of Class B, with prior knowledge, was 88.6% and the average posttest score of Class A, without prior knowledge, was 75.1% (Chart H). The growth shown in the class with prior knowledge was 13.5%.

In unit 3 on weather, Class A, with prior knowledge, averaged 54% on their pretests. The posttest average in Class A was 78.3% (Chart I). There was a difference of 24.5%. Class B, without prior knowledge, averaged 52% on the pretest. The posttest average in Class B was 68%. The difference between the posttest scores of both classes was 16% (Chart J). The weather unit had many more complex concepts that were difficult for second grade students initially. The difference of pretest scores of Class A, with prior knowledge, and the pretest scores of Class B, without prior knowledge, was 2% (Chart K). The difference of posttest scores of Class A, with prior knowledge, and the posttest of Class B without prior knowledge was 10.3% (Chart L).

In unit 4 on air exploration, Class B, with prior knowledge, had an average score of 76.7% on pretests and an average score of 91.1% on the posttests. The difference in the scores was 14.3% (Chart M). The average of the pretests in Class A, without prior knowledge, was 55.5%. The average of the posttests in Class A was 79.5% (Chart N). The difference between the pretests in both classes was 11.2% (Chart O). The difference in posttests was 11.5% (Chart P).
Chart E shows an average increase of 15.7% in pretest and posttest scores in class B with prior knowledge. Chart F shows the differences in pretest and posttest scores in Class A, without prior knowledge. There was an average increase of 18.7%.
### Unit 2 Balance and Motion
#### Comparison of Class A's and Class B's pretest scores

**Chart G**

<table>
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<th>Class B Pretest</th>
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</table>

Charts G and H demonstrate the results of the pretests for Class B, with prior knowledge and Class A, without prior knowledge. Class B had an average increase of growth of 16.2%. Chart H demonstrated the results of the posttests. Class B had an increase of growth of 13.5%.

### Unit 2 Balance and Motion
#### Comparison of Class A's and Class B's posttest scores

**Chart H**

<table>
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<tr>
<th>Class B Posttest</th>
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</table>
Chart I shows the differences in pretest and posttest scores in Class A, with prior knowledge. Class A demonstrated an average growth of 24.3%. Chart J shows the differences in pretest and posttest scores in Class B, without prior knowledge. The average growth was 16%.
Unit 3 - Weather
Comparison of Class A’s and Class B’s pretest scores

Chart K

Charts K and L compare the results of pretests and posttests for Class A, with prior knowledge and Class B, without prior knowledge. Chart K showed only a 2% increase of growth. Chart L showed a difference of posttest scores. Class A, with prior knowledge, demonstrated an increased growth of 10.3%.
Chart M shows the differences in pretest and posttest scores in Class B, with prior knowledge. There was an average increase of 14.3%. Chart N shows the differences in pretest and posttest scores in Class A, without prior knowledge. There was an increase of 24%.
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<thead>
<tr>
<th>Class B Pretest</th>
<th>Class A Pretest</th>
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Charts O and P compare the results of both pretests and posttest for Class B, with prior knowledge and Class A, without prior knowledge. Class B demonstrated an average growth of 11.2% on pretests. Class B also demonstrated an increase of growth on the posttest of 11.5%. Class B, with prior knowledge, had 11 students who scored 100% on posttest. Class A, without prior knowledge, had only 4 students who scored 100%.

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<tr>
<th>Class B Posttest</th>
<th>Class A Posttest</th>
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There was not as much growth in the pretest and posttest averages in Class B, with prior knowledge, because the class started out with a much higher average than Class A who did not receive prior knowledge activities. This was a common pattern seen throughout the 4 units. The classes with prior knowledge started out with a higher average than the classes without prior knowledge in each unit.
CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine how prior knowledge impacted students’ performance in science in the second grade at Alta E. Butler Elementary School. This was demonstrated by comparing test results of students in one class taught with prior knowledge activities with students in another class taught without prior knowledge activities.

Current literature and research was reviewed on the subject of prior knowledge. The two main philosophies of education today are objectivism and constructivism. The philosophy of objectivism states that the mind constructs an accurate model of reality that reflect objects, properties, and relationships that exist independently in the world. The learner is the passive recipient of facts as introduced by the teacher. Knowledge is about facts and proven scientific theories. The objectivist teacher stands in front of the class and supplies facts (Adamson, 1993).

Constructivist’s believe that knowledge is the result of individual construction of reality. Constructivism describes an internal psychological process in which the learner actively transfers information into something that is unique and personally meaningful (Brooks, 1990). Constructivism was used in this study by comparing two second grade classes, using pretests and posttests, while providing prior knowledge activities as the treatment. The two classes were identified as Class A (with 20 students) and Class B
(with 18 students). Both were ESL classes and four study units were prescribed and compared.

Each class received prior knowledge in two of the four units of study before the pretesting of those units. Class A received prior knowledge in units one and three; while Class B received prior knowledge in units two and four. The units were on insects, balance and motion and weather and exploration. Each class received two units with prior knowledge and two units without prior knowledge.

After each unit the posttest was administered. The results of the tests were graphed to check the impact prior knowledge made on the students' performance. The posttest results were also compared between the two classes to show the effect prior knowledge had on the students' retention of content material.

The classes that received prior knowledge had higher grades not only on the pretest, but also on posttests in four out of four tests. The results and comparisons are shown in charts A through P.

Classes with prior knowledge averaged 15% higher on the pretests. Classes with prior knowledge also demonstrated a greater growth rate on the posttest. The difference ranged from 10.3 to 18.8% over the classes that did not received prior knowledge.

The results indicated that prior knowledge does impact student performance in science at Alta E. Butler Elementary School. The results were consistently higher in pretest and posttest grades for all classes taught with prior knowledge activities. It was also clear that the ESL and Bilingual students benefited from this type of teaching.
Conclusion

The classes that received prior knowledge demonstrated a higher level of understanding of content on the pretest scores. They also demonstrated a greater retention of content information over the nine-month duration of this study.

Prior knowledge impacted all students regardless of their first language background. Introducing prior knowledge was shown to be successful with all students, including the English speakers, Spanish speakers, and the ESL students. The results of this study support the constructivism theory and the theoretical application of prior knowledge.

Recommendations

Educators are beginning to use more techniques that help students develop learning strategies. Elaboration, which includes prior knowledge, is one of these important strategies. An educational change towards constructivism would help teachers ensure that their students were receiving prior knowledge. Prior knowledge in all subjects would help students make connections between what they know and what they are learning. Learning would then be more relevant to the students.

It is recommended that further studies be done with different grade levels and in different socio-economic areas. Studies in constructivism and the effects on student improvement would need to be introduced to the teaching staff in more schools.
REFERENCES


WWW.GWU.EDU/\^TIP/PIAGET.HTML
Appendix A

Unit 1 – The Study of Insects: Pretest and Posttest in Spanish and English
Unit test on Ants

Name: __________________________

Word Bank - antennas       four
    head                   six
    three                  abdomen
    colonies               queen
    insect                 drone
    thorax                 worker
    fifty                   pupae
    larva                  legs
    adult                  eggs
    ten thousand          one thousand

1. The _________________ ant lays eggs for the colony.

2. An insect has _________________ legs.

3. Ants live in groups called _________________.

4. List the three main body parts of the ant:
   ___________________________ and the ___________________________.

5. An ant is an _________________.

6. An insect has _________________ main body parts.

7. Ant rub their _________________ together to communicate.

8. The _________________ is the male ant.

9. Ants can carry _______times their own body weight.

10. The four stages of growth for the ant are:
    1. ___________________________ 2. ___________________________
3. __________________________ 4. __________________________

Name: ______________________________________

11. There are about __________________________ different kinds of ants in the world.

12. Draw a picture of an ant and label the three parts of the ant.

13. Write what you think is most interesting about ants and what you have learned. You need to write at least 5 sentences or more.
Unit 1 – Insectos

Nombre ___________________________________    Fecha __________

Banco de Palabras - antenas
cabeza          cuarto
tres            seis
hormiguero      abdomen
insecto         reina
torax           zangano
cincuenta       trabajador
larva           crisalida
adulto          patas
un mil          huevos
diez mil

diez mil

1. La hormiga___________ pone huevos para el hormiguero.

2. Un insecto tiene___________ patas.

3. Las hormigas viven en groups llamados _____________.

4. Las tres partes mas importantes del cuerpo son:

_________________________ , _________________________ , y _________________________.

5. La hormiga en us ________________.

6. Un insecto tiene __________ partes importantes.

7. Las hormigas se frontan sus ________________ para comicarse.

8. El ___________ es la hormiga macho.

9. Las hormigas cargan ________________ veces de su propio cuerpo.

10. Las cuatro etapas de crecimiento de la hormiga son: ____________,

______________________, _________________________, y _________________________.
11. Hay ________________ hormigas diferentes en todo el mundo.

Nombre ____________________

12. Dibuja una hormiga y enumera las tres partes más importantes.

13. Escribe lo que fue más interesante sobre las hormigas. Tienen que escribir cinco oraciones o más.
Appendix B

Unit 2 – Balance and Motion: Pretest and Posttest in English and Spanish
1. If an object wobbles back and forth if you touch it, but it does not fall it is ________.

2. ____________ is a force that pulls things down to the earth.

3. If you push an object and it falls down easily it is ____________.

4. The shape of a rainbow is called a ____________.

5. ____________ is when something moves.

6. When you put weight like a clothespin on an object to balance it, the weight is called a ____________ ____________

7. This word means that the weight is distributed equally on both sides ____________.

8. When you stand on one foot too long you will lose your ____________.

9. When an object is spinning, it is moving in a ____________

   ____________.
10. When an object is moving in a straight line it is moving in a

__________________________  ________________________

11. A toy that spins is called a ____________________.

12. A button that spins on a string is called a ____________________.

13. A ____________________ is a something that hangs on balanced rods and it has interesting shapes that hang from strings.

14. Draw a picture of something that shows balance, you may draw a counter balance also to help show that your object is balanced.
EQUILIBRIO Y MOVIMIENTO

NOMBRE: ________________________________
FECHA ______________________________

BANCO DE PALABRAS

equilibrio movil estable rotational motion
movimiento gravedad movimiento en linea
arco equilibrio contra peso zumbador
inestable trompo

1. Si un objeto se tambalea hacia atrás y hacia adelante y lo tocas, pero

no se cae es ____________________.

2. ____________________ es una fuerza que hala cosas hacia abajo en la
tierra.

3. Si tu empujas un objeto y este cae fácilmente es ________________.

4. La forma de un arco iris se llama ________________________________.

5. ________________ es cuando algo se mueve.

6. Cuando se pone peso como un gancho de ropa a un objeto para
equilibrio, el peso se llama___________________  ________________.

7. Esta palabra significa que el peso ha sido distribuido igualmente en
ambos lados:______________________________

8. Cuando un objeto esta girando, esta haciendo ____________________
______________________________

9. Cuando te paras en un solo pie por mucho tiempo puedes perder el
10. Cuando un objeto se esta moviendo en linea recta esta teniendo

_________________________  ________________________.

11. Un jugete que gira se llama un ___________________.

12. Un buton que gira en un hilo se llama un ____________________.

13. Un_____________________ es algo que cuelga en una barra equilibrada y tiene formas interesantes que cuelgan de hilos.

14. Haz un dibujo de algo que muestre equilibrio, puedes dibujar un contra peso que te ayude a demostrar que tu objeto tiene equilibrio.
Appendix C

Unit 3 – Weather: Pretest and Posttest in English and Spanish
1. Rain, wind, snow, or sunshine is called our _________________.

2. Air that surrounds the earth is called the _________________.

3. The first 9 miles of air around the earth where most of the weather happens is called the _________________.

4. The _________________ is the energy source that makes weather happen.

5. Moving air is called _________________.

6. _________________ is the moisture in the air.

7. A scientist who studies the weather is called a _________________.

8. _________________ clouds are high thin clouds.

9. _________________ clouds are big fluffy clouds.

10. _________________ clouds are layers of clouds that hang low in the sky.

11. A _________________ is a tool that measures temperature in degrees.
12. __________________ is how hot or cold something is.

13. When you put a thermometer in ice cold water the red line goes ________.

14. When you put a thermometer in hot water the red line goes ________.

15. Something that is all around you but you don’t see it is called ________.

16. List 4 facts that you know about air.

1. ____________________________________________________________________.

2. ____________________________________________________________________.

3. ____________________________________________________________________.

4. ____________________________________________________________________.

Draw a picture of your favorite activity in studying weather and air.
Nombre ___________________________ Fecha ___________________________

Banco de Palabras

tiempo  trosera  cumulo
abajo   viento   estrato
atmosfera  humedad  termometro
sol  metereologo  arriba
aire  cirros  temperatura

1. Lluvia, viento, nieve, o soleado es llamado nuestro ________________.

2. El aire que rodea la tierra es llamado ________________________.

3. Las primeras nueve millas de aire que rodean la tierra y en donde hay mas clima es llamado______________________.

4. El movimiento del aire se llama ________________________.

5. La fuente de energia que forma el clima es el ________________________.

6. ________________________ es humedad en el aire.

7. El cientifico que estudia el clima es un ________________________.

8. ________________________nubes son altas y delgadas.

9. ________________________nubes son grandes y esponjas.

10. ________________________nubes tienen capas de nubes que cuelgan en el cielo.

11. El ________________________ es una herramienta que mida los grados de la temperatura.
12. _________________ es que tan frío o caliente está algo.

13. Cuando colocas el termómetro en agua fría la línea roja va hacia _________________.

14. Cuando colocas el termómetro en agua caliente la línea roja va hacia _________________.

15. Algo que está alrededor tuyo pero que no se ve es llamado _________________.

16. Enumere 4 cosas importantes que conozcas del aire.

1. ___________________________________________________________________

2. ___________________________________________________________________

3. ___________________________________________________________________

4. ___________________________________________________________________

Dibuja lo que más te gusto estudiando del clima y del aire.
Appendix D

Unit 4 – Air Exploration: Pretest and Posttest in English and Spanish
Unit 4 – Air Exploration

Name_____________________________  Date________________

Word Bank

- glider
- propeller
- air resistance
- gravity
- air
- propulsion
- faster

1. When a parachute moves through the air it is slowed down by ___________________________.

2. The red wings you attached to the straw to push air backwards and cause a lift is called a ___________________________.

3. Escaping air that causes an object like a balloon to move forward quickly is called ___________________________.

4. The force that pulls a glider back down to the Earth is called ___________________________.

5. An airplane made of folded paper is called a ___________________________.

6. What has more air resistance a parachute or a small ball?

__________________________

7. The air from the blow dryer made the propeller

move________________ because of moving __________________.

8. Draw a picture of something that uses air to make it move.
Unit 4 – Usando Aire

Nombre________________________ Fecha____________________

Banco de Palabras

planeador aire
helice propulsion
resistencia del aire mas ligero
gravedad

1. Cuando una paracaídas se mueve a través del aire su caída es reducida por

__________________________  __________________

2. Las alas rojas que pusiste al popote para empujar el aire hacia atrás y causa un ascenso se llama ____________________.

3. El escape de aire que causa que un objeto como los globos que se mueven hacia adelante rápidamente se llama ____________________.

4. La fuerza que atrae hacia abajo en la Tierra a un planeador se llama ____________________.

5. Un aeroplano hecho de papel doblado se llama ____________________.

6. Que tiene más resistencia al aire: un paracaídas o una bola pequeña?

7. El aire del secador hace que la helice se mueve _____________

_________________________ por el movimiento del ________________.

8. Haz un dibujo de algo que use aire para moverse.