EASY WAY TO AN A: AN INSTRUCTIONAL PHONE APP FOR ELEMENTARY STUDENTS

A graduate project submitted in partial fulfillment of the requirements
For the degree of Master of Arts in Education,
Educational Psychology

By
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December 2015
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Acknowledgements

I would like to thank my Chair Dr. Carolyn Jeffries, for showing me the right of the wrong, and helping me constantly develop and revise my ideas and thoughts. It has been a great privilege to have a professor like Dr. Carolyn Jeffries who cares about her students and helps them achieve the best. I would also like to thank my committee members, Dr. Brian Foley and Dr. Pete Goldschmidt, for sharing their time and expertise with me; they provided me with valuable comments and suggestions that helped me through my schooling experience.

I would like to thank my parents for their endless guidance and support. They are my hidden soldiers who are always encouraging me to be a good person and to never give up in order to achieve the best. Although they currently reside far from me, their unlimited support has helped me become who I am today. I am so thankful to have them in my life.

I would like to thank my husband for his endless love and support during my Masters program. He always encourages me to study, listen, and communicate my ideas and thoughts. He continuously shows me how all the challenges I face will one day lead to happiness. During our visit to the United States, we have shared unforgettable memories. I am also very thankful to have adorable children with him, and I pray to make them as happy and knowledgeable as possible.
# Table of Contents

Signature Page ............................................................................................................. iii

Acknowledgements...................................................................................................... iv

Abstract..................................................................................................................... vii

Chapter 1: Introduction

Introduction .................................................................................................................. 1

Statement of Need/Problem......................................................................................... 2

Purpose of Graduate Project ....................................................................................... 4

Description of the Proposed Project ........................................................................... 5

Terminology .................................................................................................................. 6

Chapter 2: Literature Review

Introduction .................................................................................................................. 9

Review of the Research ............................................................................................... 9

Synthesis of Literature Review .................................................................................. 34

Chapter 3: Project Design and Development

Introduction ................................................................................................................ 36

Development of Project .............................................................................................. 36

Intended Audiences ..................................................................................................... 44

Environment and Equipment ..................................................................................... 46

Product Outline .......................................................................................................... 46

Chapter 4: Conclusion

Summary ....................................................................................................................... 49

Evaluation .................................................................................................................... 49
Discussion .................................................................................................................. 53
Future Work .................................................................................................................. 53
Conclusion ................................................................................................................... 55
References ................................................................................................................... 56
Appendix A: Formative Evaluation Questionnaire ...................................................... 61
Appendix B: Screenshots of the Application ............................................................... 63
Appendix C: Fourth Grade Common Core Math Standards ..................................... 71
Abstract

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By

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This paper describes the design and development of a new educational application named Easy Way To An A. Easy Way To An A: An instructional phone application to help students, between grades four and eight, understand what learning styles are (visual, auditory, and kinesthetic), and how study strategies vary within these styles. The primary goal of the application is to provide easy interesting ways to enable young students to understand their own personal learning styles, and the corresponding study strategies that are most applicable to them. The current resources pertaining to learning styles are mainly intended for teacher or adult use, and not for elementary school students. They are also typically found in forms, such as books or articles, which are generally unappealing to this age group. The limited nature of current resources for young students points to the necessity of Easy Way To An A. This application provides students with the opportunity to engage in the learning process while being responsible for important aspects of their learning.
Chapter One

Introduction

Many students tend to face difficulties when learning academic material. According to Lauria, (2010) now-a-days many students do not feel comfortable learning with only one strategy. For example, some students do not feel comfortable learning only via lectures, however, teachers and parents usually force students to do so. Such methods tend to limit many students and keep them from achieving meaningful understandings of different educational subjects. Moreover, Lauria (2010) indicated that students in the classroom faced problems because they were forced to use one way to understand, learn, and answer questions. Lauria stated that even the problem of low achievement could be improved by educating students about their learning styles. Although this strategy may be useful for some students, many students would be more successful if they investigated their preferred ways of learning; academically, this is referred to as learning style, which refers to how specific strategies can help students use alternative ways to learn. Hatami (2013) indicated that students need to learn and use different ways to acquire and apply new information. Moreover, according to Levine (2002) students enter the classroom with diverse abilities, as well as different preferred ways of learning and acquiring information. Jilardi, Damavandi, Mahyuddin, Elias, Daud, and Shabani (2011) indicated that there is a link between low student achievement and the different student learning styles. They cited Sternberg’s (1997) work that showed that student awareness about their own learning styles improved their achievements, especially law students. Sternberg emphasized the importance of learning styles and how they affected academic achievement students, teachers, and educators. Gregory and Chapman (2013) discovered how the brain manipulates and understands information, which suggested a necessary increase in educating students about
learning styles and effective study strategies. According to the National Center of Educational Statistics (2013) fourth and eighth grade students in fifteen states scored at or above proficient in math, while students of the same age in nineteen states scored at or above proficient in reading. Unlike these states, Californian students scored in the lower percentile, and therefore, did not qualify in the category. With such a diverse pool of students in California, particularly Los Angeles, one factor that might improve scores is increased availability of resources on students' learning styles to accommodate those who are at risk. With the onset of new cognitive research, this notion is very realistic.

**Statement of Need/Problem**

In 2012, I observed public elementary school students in Los Angeles. From the first moment I entered the classroom, I was surprised to witness various types of students in the same classroom. Without even having to review each student’s personal profile, I could easily deduce that the students came from very different backgrounds and socioeconomic statuses. Furthermore, after a few minutes of observation, I realized that the students also differed in their abilities and in the ways that they received and retained information. While some students focused when she gave a verbal order, other students seemed to be bored. However, when the teacher used pictures, the students’ attentions were immediately grabbed. Unfortunately, because of the vast differences between students in the classroom, the teachers were unable to actively incorporate all the students. The teachers actually struggled to capture the attention of many of the students, which essentially excluded them. Such issues highlight the need to distinguish each students learning style, provide them with appropriate study strategies, and use different teaching strategies, such as differentiated instruction (DI) which does not change the
content of what is taught, but rather changes how it is taught (Aldridge, 2010). Differentiated instruction strives to gain students’ attention and fully engage them in the learning process in order to accomplish their educational goals.

In addition, children are not educated about their learning styles and how to use effective learning strategies to better understand their academic subjects. Mann (1989) indicates that the dropout problem demonstrates the importance of acknowledging different student learning styles, even though dropout rates are due to a wide range of causes (e.g. low SES). He also indicated that teachers have to understand that not all students learn similarly and that they may need to comprehend the information in different ways. Mann (1989) highlighted the need to use the concept of learning styles so that students can better grasp the material and meet classroom objectives. He also suggested that because learning styles were very different between pupils, schools needed to acknowledge, seek, and apply different activities to encourage various learning style and effective strategies. Thus, more students would be interested and highly engaged in the learning process, even the ones who previously felt alienated from education (Mann, 1989). It is important to take into consideration that the U.S Department of Education (2009) indicated that in California the percentage of public-school students who dropped out of school in grade 9 was 3.2 in 2002, a percentage that increased to 5.0 in 2009. Wolman, Bruininks, & Thurlow (1989) explained that the dropout rate is a huge problem that must be dealt with, especially because United States citizens are expected to have a high school diploma at the very minimum to enter many professions.

The need for recognizing students’ different learning styles and tailoring study strategies to these differences gives rise to helping students of different cultural and linguistic backgrounds. According to the National Center of Educational Statistics (2013), the percentage of students
enrolled in public school in the United States whose first language was not English (ELL) was 8.7, a percentage that rose to 9.1 by 2012. In California, this percentage was dramatically higher at 23.2. Edmonds (2009) stated that culture played a huge role in helping students understand the classroom lecture, and can, in the case of many ELL students, hinder this understanding. In order to further involve ELL students in the class lecture, teachers had to use different teaching strategies that incorporated visual aids and illustrations containing physical concepts in the classroom. Even with these strategies, Edmonds (2009) argued that ELL students might still have difficulty mastering academic language, as opposed to conversational English, which is necessary in the classroom. To help ensure that students bridged the gap between conversational and academic language, Edmonds (2009) suggested that both teachers and students attempt to understand different student learning styles, as well as the effect of learning strategies. This understanding could facilitate the learning process of ELL by communicating the information in the most appropriate way to them. By doing such, students would feel more comfortable and confident in applying such methods when engaged in individual learning.

Based on the previous studies, there is a great need for elementary school students to be provided with resources that address the concepts of learning styles and effective study strategies. Furthermore, it is important for students to discover and apply their unique learning styles and study strategies from a young age. By doing such, the student will be able to learn and alter their strategies to help them succeed in their academic careers.

**Purpose of Graduate Project**

The purpose of this project is to develop an accurate and helpful Phone application that demonstrates the importance of learning styles and study strategies for elementary school
students in California. This application is a computer program that is designed to run on iPhones and it will save students information’s on a server. Students can use the application at home; the application will initially help these students identify their learning styles by filling out a survey. The survey questions and vocabulary will be simple and non-complex in order to avoid confusion. Also, the application will provide students with learning strategies for different subjects (math, reading, and science) and different topics, which will suggest the learning style. Each strategy will be divided according to the different learning styles. Introducing young students to the concept of learning styles enables them to discover their primary learning styles. This leads to a more informed and positive understanding towards education because students are able to target their strengths and weaknesses in order to better accommodate their needs. Hence, their academic achievements will be positively affected. Second, various study strategies for different topics help the students choose the methods that they feel most comfortable with, which creates more welcoming learning environments. Also, students are given the opportunity to take control of their own education while having the power of choice. All these factors facilitate learning and encourage student enjoyment for all subjects.

**Description of the Proposed Project**

The product *Easy Way To An A* is an online guide for elementary school students that includes information about different learning styles and study strategies. The first section will include an explanation about how people receive information differently and how they use different ways to understand and memorize information. Also, this section will include information about visual, auditory, and kinesthetic learning modalities, or sensory preferences. The second section will include a survey that students can take in order to discover their learning
styles. At the end of the survey, students will be provided with results in a percentile format. For example, results would state the following: you are a 50% visual, 20% auditory, or 30% kinesthetic learner. Following that information, students would be provided with general strategies for their learning styles. The third section will include study strategies for specific subjects (math, reading, and science) within different grade levels. Also, the application will include links to online educational game activities that are useful for students. Following, there will be an assessment section in which students can assess their understanding regarding learning styles and study strategies, which will also provide the student with feedback. Finally, there will be a blog page where students can share their experiences and ideas about study strategies.

**Terminology**

**Students at risk:** According to the National Center for Educational Statistics (1992) student at risk, “is generally defined as a student who is likely to fail at school” (p.2).

**Differentiated instruction:** According to Tomlinson & Allan (2000), differentiation instruction is defined as “the care and attempt on the part of the teacher to meet the needs of a particular student or small group of students instead of simply teaching to the whole class as if all students were the same.” Simply put, the goal of differentiated classroom instruction is to increase an individual’s growth and success.

**English language learner (ELL):** According to the National Center for Educational Statistics (2014), English Language Learner is “a term used to describe students who are in the process of acquiring English language skills and knowledge” (p.1).

**Learning modalities:** According to Mahdjoubi & Akplotsyi (2012), “students learning modalities refer to the sensory pathways through which they send, receive and store information” (p.209).
Learning style: According to Bayrak (2012), learning style is a method used by an individual in collecting, organizing and modifying information to make it more meaningful and understandable for the person.

Proficient: Proficient is defined as, “represent[ing] solid academic performance. Students reaching this level have demonstrated competency over challenging subject matter.” (National Center of Educational Statistic, 2013, p.210).

Tradition teaching method: According to Wise (1996), traditional teaching method refers to a teacher’s ways of translating specific knowledge to a student with the use of few educational resources, such as the textbook. In such circumstances, students have little chance of connecting their experiences to their education.

Transition to Next Chapter

Chapter One introduces the need for effective resources when addressing different learning styles and applying differentiated study strategies for elementary school students in California. Chapter Two provides a literature review of theories, strategies, and issues that are relevant to the project. In addition, Chapter Two provides a closer look at learning styles by relating it to academic achievement, student self-efficacy, and technology use. Chapter Three includes a description of the development of the application, as well as the intended audience for the specific application. This chapter will also include a discussion of personal qualifications and necessary equipment to use the application. Finally, there will be an outline of the project’s content, activities, and procedures. Lastly, Chapter Four will include a summary of the purpose of the project, a description of the formative and summative evaluation process, and a discussion
of the research results. Finally, Chapter Four will include a discussion that addresses plans for future work. Screenshots of the application will be provided in Appendix B.
Chapter Two

Literature Review

Introduction

This section presents and reviews recent studies related to the concept of various learning styles that directly relate to the development of the application *Easy Way to an A*. First, this chapter explores research studies that provide various teaching strategies that aim to accommodate students’ learning styles, as well improve students’ academic achievement. This is followed by a review of various methods that improve students’ self-efficacy. Also included are reviews of studies that show the effectiveness of various educational technology programs in relation to students learning styles. In addition, this chapter will include a synthesis of the literature review and discuss the instructional strategies used in each application.

Review of the Research

**Academic achievement and learning styles.** There has been a great deal of research conducted to address the topic of academic achievement. Many studies relate the students’ academic achievements to the students’ cultures, backgrounds, and previous experiences. Recent studies emphasize the importance of students’ learning preferences and how those preferences could affect teaching processes. Such information helps educators build learning environments that maximize the students’ achievements (Ellison, Boykin, Tyler, & Dillihunt, 2005).

A study conducted by Reis, McCoach, Little, Muller, and Kaniskan (2011) discussed students’ school achievements. The researchers aimed to discover how the academic achievements of elementary school students, particularly their reading fluency and comprehension, were affected by applying the concept of differentiated instruction. They
particularly focused on providing the students with activities that accommodated their personal interests, such as selecting and reading books. The researchers stated that, “differentiation strategies are inconsistently implemented in many reading classrooms and are rarely used across the country” (p. 464). Reis, et al. (2011) defined SEM-R as:

An enrichment-based reading program designed to stimulate interest in and enjoyment of reading, leading to higher reading achievement, by enabling students to self-select and read high-interest books of personal choice that are slightly to moderately above current reading instructional levels independently with differentiated instruction provided in weekly teacher conferences. (p.646)

The implementation of this study began within two weeks of the beginning of the semester and lasted for five months. The participants included 63 teachers, who had similar experiences with regards to their own schooling and years of teaching, as well as 1,192 students ranging from grade levels three to five. The students were diverse in respect to race, ethnicity, language, and social economic status.

Teachers in the treatment group spent six hours in a professional development program. The treatment group teachers were required to designate two hours a day to reading and language art instruction. In the first hour, they taught using the regular program instruction, and in the second hour using SEM-R, which provided the use of different teaching techniques, such as allowing the students to choose their own books and activities. However, teachers in the control group taught the entire two hours using the regular reading instruction, which was dependent on the traditional method. In the study, the researchers used different means of measuring the students reading achievements; oral reading fluency (ORF) assessed the students’ reading speed, accuracy, and
efficiency when they read a specific text; Iowa test of basic skill (ITB) was used to evaluate students’ reading comprehension before and after the implementation of the program. Finally, teachers completed the Teacher and Reading Attitudes and Practices Survey’s (TRAPS) in order to gauge how teacher engagement in the classroom affected the student engagement.

Moreover, the researchers used the reading achievements test, SEM-R observation scale, as well as direct observation to collect accurate data. By using these methods, the researchers collected qualitative data and were able to analyze them. Ultimately, by using multilevel modeling to analyze the data from (ORF) and (ITB), the results of the study showed that the use of differentiated instruction, particularly the opportunity for students to choose activities that match their interests and learning styles, positively influenced the students’ reading achievements. When students were involved in the teaching methods that incorporated their personal interests, such as selecting books themselves and reading independently, they were able to demonstrate significantly higher reading fluency and comprehension. In addition, the study showed that when teachers changed their traditional teaching methods and replaced them with models that involved strategies that matched the students learning styles, there were no negative consequences in their achievements and engagements. It is important to note that, “none of the control classroom in any of the schools significantly outperformed SEM-R classrooms,” which shows that differentiated instruction methods increase students’ academic achievements (p. 493). This is further exemplified in participating students who were from families exposed to high poverty, as their reading fluency and comprehension were higher than those in the control group. Moreover, the researchers obtained information thorough observations and teacher interviews, which showed that providing students with activities that permit them to use their interests and learning styles increases their engagement and attention. This is primarily due to the fact that
when students are provided with opportunities to combine their personal and academic interests in the classroom activities, they are encouraged to participate. Essentially, the researchers highlighted the correlation between differentiated instruction, student engagement, and overall academic achievement.

Even though choice is a well-known motivational strategy, in differentiated instruction theory choice is a value strategy that allows the teacher to engage students in class activities that match their interests and learning styles. Walker (2007) indicated that choice is a valuable strategy that is primarily important when developing a differentiated instruction classroom. Scigliano and Hipsky (2010) determined that providing a choice of activities is an effective differentiation instructional strategy. To better design differentiated classrooms it is important to take into consideration the students’ interests in order to provide them with choices. Providing students with choices allows teachers to capture their students’ interests and permit them to do what is in their best interest. By providing students with choices, they become engaged in the learning process, which increases their overall academic engagement.

Reis, McCoach, Little, Muller, and Burcu Kaniskan (2011) employed a great way to examine the effect of differentiated instruction that focused on providing students with choice activities to accommodate their learning styles, reading fluency, and reading comprehension by using SEM-R. By using different measurements, the researchers were able to conclude that use of differentiated instruction, especially when incorporating students’ self-driven interest, ability to choose books themselves, and reading independently, the students’ reading achievements were improved—even in high-poverty urban schools. However, this research had some limitations. First, there was no clear measurement for student engagement; the researchers were able to collect information regarding the student engagement through teacher interviews and
questionnaires, but there was no reflective data produced by the students themselves. Second, the experiment took place over just five months, and such a short period is not enough time to find out the long term advantages and disadvantages for use of differentiated instruction. For example, it is unknown as to whether or not teachers and students would get bored of such strategies over a long period of time. Lastly, the researchers included two second grade classes that contained talented students, which points to a concern as to whether or not the results of such students accurately represents average second grade classes.

Much of the research on academic achievements focuses on the students' behavior and their learning style as factors that influence their academic achievements. One study conducted by Stipek, Newton, and Chudgar (2010) attempted to investigate the relation between elementary students’ learning styles, especially working independently and seeking challenges, and their academic achievements (specifically literacy achievements). The study involved 379 students in grades kindergarten to fifth grade, who were from low-income families and met the federal poverty guidelines. The participants had diverse backgrounds: 36.5% Caucasians, 34.7% African Americans, 23.6% Latinos, 1.5% from mixed ethnic backgrounds, 0.5% other ethnicities, and 3.2% unknown. Teachers were also involved in the study because they had observed the behaviors of the enrolled students. Teachers, who taught kindergarten, third, and fifth grade, were involved in the study; their previous teaching experiences ranged from novice to advance. Students’ academic achievement, specifically literacy achievement, was assessed individually by an examiner who attended a full day training and displayed the ability to interact and positively support children. Following, the teachers completed a questionnaire regarding the students’ study behaviors and learning styles. Additionally, interviews were conducted with the students’ parents to collect information regarding the family life and their social economic status.
In order to measure the students learning style, several items from the Teachers Rating Scale of School Adjustment (TRSSA) were measured, such as: independent learning, individual level of seeking challenge, and overall responsibility of learning. Researchers used two subtests, word reading and passage comprehension, to measure the students’ academic achievements (Stipek, Newton, & Chudgar, 2010). The two subtest scores were “converted to standardized scores and then combined within each grade to create an overall mean literacy achievement score” (p. 389). The goal of use all those measurements were to collect accurate information that demonstrated how different learning styles affected the students’ achievements. The results proved that students who were encouraged to use their own learning style performed better in literacy achievements and overall academic skills. Also, evidence supported that in order to improve the student’s achievement, the education system must encourage students from an early age to discover their learning style and develop positive study strategies.

Although Stipek et al.’s (2010) study contributes to the educational setting, and provides helpful information regarding learning styles and academic achievements, it also has some weaknesses. The entire sample of participants was from low social economic statuses, which could have greatly affected the results. However, the students’ academic achievements did not directly correlate with the social economic status. Thus, the results of this study did not reflect any consideration of high and middle social economic status students. Also, the study focused strictly on the observable learning style, and therefore ignored other those that were difficult to observe. For example, some students prefer to work alone, with more visuals to understand the information, or with more hands-on activities.

Another study by Karadag and Yasar (2010) suggests that “differentiated instruction is one of the approaches that provides a teaching opportunity appropriate for the student’s
differences and considers those differences” (p. 1394). The researchers indicated that differentiated instruction positively affects student success and allows students to develop new educational skills. They conducted a study on elementary school students in Turkey to find out whether the use of student learning style preferences, such as working in small groups, individually, or in pairs, was a way of differentiated instruction that affected their achievement. The research included 30 elementary school students (16 girls and 14 boys) and evaluated their achievements in various subjects, such as math and language. The researchers explained that the reason they chose all the participants from the fifth grade was because students in this age range are typically able to understand activity instructions and are able to work independently.

In the beginning of the implementation, the researchers had an action plan to arrange the class activities to incorporate the concept of differentiated instruction that focused in providing students with different types of activities to match their learning styles, but first they needed to collect data. In order to record the effects of working in small groups, individually, or in pairs, a behavioral scale was used in the beginning and at the end of the study. Further, semi-structured interviews were conducted to determine the students’ initial outlooks regarding the use of differentiated instruction. Such information was evaluated and analyzed by qualities and quantized analysis, which showed very important results—student behaviors scored higher in post-test results in comparison with their pre-test scores. In order to find out whether or not the difference in the scores were significant, researchers “applied t-test, t values was found 4.407 and this value was above 2.405 table value at 0.5 significant level with 229 degree of freedom” (p. 1396). The data collected from the interviews also showed that the use of differentiated instruction that focused on providing the students with new engaging activities positively affected the students’ attitudes and achievements. Moreover, the results showed that the courses
that applied the structure of differentiated instruction by encouraging students to work in small
groups, individually, or in pairs provided an overall more pleasant experience for the students.
Also, when the class activities applied the concept of differentiated instruction, the instruction
was more informative and instructive than non-differentiated classes. The differentiated classes
also engaged students more, which resulted in them attaining higher academic achievements.

The study revealed an important outcome that showed how student achievement can be
improved with the use of specific engaging activities, such as working in small groups,
individually, or in pairs; however, there are some weaknesses that must be addressed. First, the
study only involved fifth grade students, which means that participants did not include students
from different age categories. Even though the researchers justify this limitation by stating that
fifth grade students understand the instruction more than younger students, the researchers could
have involved sixth or seventh grade students in order to increase their pool of participants.
Second, the study was conducted in Turkey and the participants presumably did not differ in
their backgrounds, and it would have been better if the researchers included a diverse group of
participants to show how results could possibly fluctuate.

The previous studies provided great strategies and important evidence that show how
factors contribute to students’ academic achievement, which overall greatly influence my
project. The result of Stipek et al.’s (2010) research supports my project because it provides
evidence regarding the importance of learning styles in the educational setting, and how they
contribute to individual academic achievements. The findings highlight the use of different
teaching strategies, especially allowing students to work independently and seek challenging
activities to match their diverse learning styles. In my application, I will discuss and provide
students with possible ways to practice different scholastic activities while accommodating their
learning style. The results also show the importance of how students should be educated early on about different learning style effects, which is what I strive to achieve through my project. Also, I will help students learn more about their own personal learning styles and study habits by completing a survey. By presenting such information, students will create a simple understanding about the best learning strategies they can use. Moreover, the Reis et al.(2011) showed great points regarding the use of differentiated instruction in order to encourage students’ self-driven interest by allowing students to select books themselves and read independently, which has influenced the development of my product. In my application I will provide the students with information regarding the basis for the encouragement of new study strategies in an attempt to make the learning atmosphere more interesting and enabling. This will not only raise the student achievements, but also the student engagement; those strategies would include, but would not be limited to incorporating students’ self-driven interest by selecting books themselves and reading independently. Moreover, the Karadag and Yasar (2010) study informs my project very much. The study highlights how to use different study strategies, such as working in small groups, individually, or in pairs, which could match the students learning styles and improve their successes. In my project I plan to inform the students that the subjects (math, reading, science) could be learned using different strategies, which essentially would lead to positive student achievement outcomes. As demonstrated in the study, the use of different activities that match the student learning style positively impacts the student interest and attitude regarding courses I will incorporate this in my application by educating students about how to think about different strategies to learn subjects in various. This is done to ensure that students feel more comfortable and engaged while they study.
**Self-efficacy, learning styles, and teaching styles.** Two internal characteristics have great value in the educational setting that contribute to the students’ pleasant outlook towards education, which are referred to as self-efficacy and motivation (Niehaus, Rudasill, & Adelson 2012). Self-efficacy indicates how students think and value their abilities to succeed in specific academic tasks or activities, which relate positively or negatively to their education outcomes. Niehaus, Rudasill, and Adelson (2012) showed that students who held high self-efficacy usually achieved high academic grades and felt more comfortable in schools compared to students who have low self-efficacy. Niehaus et al. (2012) also indicated that student’s motivation is also a valuable aspect that contributes to the different educational components, such as homework and test scores. It seems that high-level motivation positively affected the students’ educational stance and engagement. They also (2012) discovered that there was little research that focused on self-efficacy and motivation in relation to teaching strategies. Many teaching styles did not provide different activities that matched the diverse students learning styles, so they conducted a study that aimed to explain whether or not students self-efficacy and motivation could change after involving the students in a one year afterschool program. This program provided different teaching strategies that aimed to match the needs of the diverse students learning styles. The students were able to choose their own activities, learn from others, and receive positive feedbacks in order to accommodate their interests and positive attitudes. The participants in the study included forty-seven Latino middle school students who attended schools in one of the two urban public school districts in the Midwestern United States. Among the forty-seven students there were thirty-four males and thirteen females. To collect the data, researchers used the following measurements. First they would use demographic questionnaires, which aimed to gather information regarding the students’ personal information, such as gender, age, date of
birth, and learning style. The second measurement was referred to as motivational orientation that included 30 reflective questions that aimed to measure the students’ motivation. The third measurement was self-efficacy beliefs, which was also answered by students. This included a thirty item self-report that measured students’ academic self-efficacy. Finally, there were academic outcome measurements, which were collected from the schools regarding students’ GPA’s and standardized test scores for the current and previous school years. After all the data was collected, the researchers would conduct analyses using Mplus. The results of the study showed that schools that applied the strategies provided students with positive feedback and allowed them to work and learn from others. The program also allowed them to choose activities by themselves, which positively increased the students’ motivation and self-efficacy. Moreover, after attending the program students exhibited a positive change in motivation, self-efficacy, attendance, math achievement scores, and their overall GPA’s. Niehaus et al.’s (2012) study provided valuable information regarding how students benefit from the use of delivery or teaching methods that include learning from others, choosing their own activities, and receiving positive feedback. However, the study is not free from limitations. First, the participants in the study were all Latino, which means there was no variance in background. It would have been better if the participants population included more diverse participants, such as Caucasian, African American, and American Asian. Second, the students were from two middle schools, which means students from different grade levels were omitted from the research. By doing such, the researchers were unable to take into consideration the differences between age or grade levels. However, this research is valuable because elementary and middle school students have similarities. Also, there is a great lack of available resources that measure the elementary school student self-efficacy. Finally, in the study there were 72% male students and only 28% female
students, and such a large difference does not provide credible information about motivation or self-efficacy in different genders. It may have been better if the participants’ genders were similar or equal in order to make the results more accurate to represent both genders.

Regarding the importance of learning styles, Ozgen (2013) indicated that students learning styles are important and should positively influence the teachers teaching practice especially when teaching math because many students believe that math is a challenging subject. Ozgen (2013) also indicated that the information about learning styles is very valuable because its assists teachers in knowing how students could learn better. On the other hand, mathematics self-efficacy refers to an individual’s confidence in his or her ability to successfully perform or accomplish a mathematical case, task, or problem. To attain more information regarding math and students self-efficacy, Ozgen (2013) aimed to explore and analyze mathematical literacy (ML) and self-efficacy beliefs in relation to their learning styles. Mathematical literacy (ML) is defined as the “understanding of basic characteristics of mathematical concepts, which are represented both orally and in writing” (p.91). The study participants consisted of 388 Turkish high school students; 53.1% of the participants were male and 46.9% were female. In order to collect data, Ozgen (2013) applied different measurements. The ML self-efficacy scale consisted of 25 items that aimed to measure students’ self-efficacy beliefs. The second measurement dealt with learning styles inventory that aimed to identify each individual’s learning style. In order to analyze the data, Ozgen (2013) used both one-way analysis of variance and multiple regression analysis. The findings of the study showed that students held different ML self-efficacy beliefs in relation to their learning styles. The students were categorized in four different learning style groups which were: diverge (which refers to the individuals who rely on active experiences and prefer to watch and think to work things out), assimilator (refers to individuals who rely on
theory and prefer to think rather than act), converger (refers to individuals who prefer to understand how things work in practice), accommodator (refers to the individuals who actively process information with a strong preference for doing rather than thinking) learning styles. The study demonstrates a valuable outcome, which positively affects the product that I aim designing. ML self-efficacy beliefs scores differed in terms of learning styles, and converger learners had higher levels of self-efficacy beliefs. Arguably most important, the study indicated important information regarding the effectiveness of using study strategies that made the students use their senses, such as watching and listening, viewing issues from different points of views, and discovering meaning in the learning materials. Moreover, it shows that some teaching methods could increase the students’ self-efficacy.

However, the study had some limitations. There were only two types of measurements that both consisted of student reports. It may have been better if the researchers used other measurement types that also provided non-self-report information, such as observations or surveys completed by the teachers. Also, the participants only included Turkish students, and the results may have been more credible if they included people of other nationalities, including immigrants in Turkey.

Tuan, Chin, Tsai, and Cheng (2005) indicated that the difference in students’ learning styles highlighted the need of the differentiated instruction method to help the students become more educated. They suggested that if the educational instruction matched the students’ learning style then they would be positively affected academically and motivationally. This highlights the need to increase the students’ motivation by using activities that match their learning styles. Therefore, another component of Tuan et al. (2005) study aimed to investigate the motivation outcome for eighth graders after implementing ten week (40 hours) inquiry-based teaching
lectures. “Science inquiry in these documents revealed that students have opportunities to participate in generating research questions, conduct investigation, generate their own conclusions and communicate their findings with their fellow pupils” (P:543). The participants in the study were 254 students who were in the experimental group; those students participated in 10 weeks of 40 hours inquiry lessons. The control group contained 232 students who are taught by regular science teaching methods. The participants had a range of different abilities, and had different genders, but they had similar science achievements. To collect data, there were different measurements that were used in the study; the students’ motivation towards science learning questionnaire (SMTSL) were filled out by both the control and experimental group students at the beginning and at the end of the study. The researchers collected information regarding different learning styles through post-test interviews. To analyze the data, they used descriptive statistic analysis, paired t-test, MANOVA, and the results of the study provided valuable information. First, students’ motivation increased after the implements of the inquiry instruction procedure. Moreover, inquiry teaching made students more engaged in the educational activities, regardless of what type of learning styles they had. Inquiry instruction enhances students’ motivation, especially motivation towards science learning. The study suggests great insights about motivation, learning styles, measurements, and procedures used to grade. However the only limitation in the study was that all the participants were from eighth grade classes; it may have been better if the researchers included more diverse participants, and included other grade levels, such as sixth and seventh graders. With a diverse pool of participants, the researchers would have been able to compare the results and provide further analyses.
The research on students’ self-efficacy and motivation supports my project in different ways. Niehaus et al. (2012) highlighted the importance of providing students with different activities that allows them to learn from others, receive feedback, and choose from different activities. Similarly in my application, students will be able to share successful learning strategies, will be provided with positive feedback, when assess their own learning and understanding; students work together to help and learn from one another. Also, Ozgen (2013) provided affective evidence that matched students’ learning styles and activities with strategies for teaching math by allowing them to watch, listen and actively involve themselves; therefore, increasing the students self-efficacy. In my application, there will be a section from math and it will provide students with different learning strategies regarding their learning styles. The Tuan et al. (2005) research influences the development of my project because it emphasized the importance of involving students in the learning process by allowing them to come to their own conclusions, and communicate their overall findings with their pupils. This is a major component of my application: to make the students feel responsible for their learning and make them active, instead of having them simply retain information. Indeed, the previous research findings highly influence the development of my application.

**Educational technology and student learning.** Nowadays technology is being increasingly implemented within the education system. Even with the vast spread of technology and its importance in education, many educators assume that their technological skills are inadequate and do not allow students to use technology in the classroom (Gatewood & Conrad, 1997). Currently, students of all ages acquire great skills that allow them to use the Internet, send electronic mails, and share different information through various programs or websites. Even with the high educational skill students acquire, schools and teachers are not prepared for
this technology revolution, and therefore do not typically incorporate it in the educational process (Gatewood & Conrad, 1997). Najla Alshammari (2014) indicated that different types of technology such as tablets, laptops, smart boards, and various applications could positively contribute to the quality of the education system by making the subject matter more understandable. This fairly recent increase of student technological skill creates a new importance in the education field to include various software and programs to better engage students and improve the overall student academic outcome (Najla Alshammari 2014).

Shin, Sutherland, Norris, and Soloway (2012) indicated that one factor that improves student learning in grades K-12 is technology. With a broad range of student experiences, backgrounds, and learning styles, different strategies are needed for them to reach the same goals. Therefore, the traditional ways such as lecture essentially restrict students and their learning needs. Shin, Sutherland, Norris, and Soloway (2012) indicated that one effective strategy to meet the individualized needs of students was to integrate educational technology games into the education process. When well designed, educational technology games can help some students build on past experiences and knowledge in order to acquire new skills and knowledge. Such games help students gain more control of their learning while simultaneously improving their achievements. Shin, et al. (2012) conducted two studies to determine the effects of educational game technology on student learning, specifically in mathematics. The first study was aimed to provide a comparison between the use and non-use of technology in the classroom, and the effects on student learning. The participants in this study included 41-second grade students (24 males and 17 females), who were either seven or eight years old. The pool of participants were diverse as the school records indicated that 28 students were white, seven were Asian, two were African–American, and four identified as ‘other.’ The participants attended two
different classes, which used either technology-based games (GB) or paper-based games (CG) for five weeks. The two different types of formats were used to demonstrate whether the groups differed in performance. Technology-based game classes included 20 students, while paper-based game classes included 21 students. After five weeks, students in both classes were assigned to use technology-based games. They would play either twice a week or more than three times per week for 13 weeks in order to exemplify the effect of frequency on student learning. Teachers were provided with information about each producer and were allowed to decide which one they preferred to apply in their classroom. In order to collect data, researchers used both direct observation and testing. The tests involved 70 questions and aimed to assess the students’ arithmetic skills to reflect the learning outcomes. In order to collect the data, researchers used ANOVA to monitor how students in the two groups performed. The data analysis relayed important results; by comparing the two group performances, students who incorporated technology-based games acquired higher arithmetic scores than students who involved paper-based game. Also, the games seem to be more effective for low performance female students, and more beneficial to supporting high-performing males, specifically learning basic arithmetic skills. The researchers explained that this finding was limited to a small number of participants, and recommended future researchers to involve a larger number of diverse participants to further identify exactly what and how game technology presented a correlation between gender and performance.

The second study aimed to investigate the correlation between students’ characteristics and success of learning using a technology-based game. The participants included 41 peers from the same two classes in the first study mentioned, as well as nine students from a new class. In total, there were 28 male and 22 female second graders; 31 students were white, six students
were African-American, eight students were Asian, one student was Hispanic, and four students identified themselves as “other”. To collect data, the researchers used different methods, including surveys and questionnaires. Surveys were used to evaluate behaviors towards mathematics, which indicated 23 positive and negative statements. Second, researchers used a questionnaire that included eight sections to investigate the students’ behaviors toward elements of the game. Moreover, in order to measure the students’ arithmetic skills and outcomes, the research used the same 70-item instrument developed, which they used in the first study. The second study lasted for four months, wherein the students were divided into three different groups where they all played technology-based games. All three groups differentiated in daily frequency of implementation, as well as the duration in using the technology-based game. At the end of the four-month period, the students in all three groups filled out a final test administered by the teachers. The researchers also used multiple regression to investigate the correlation between the students’ characteristics, such as their gender, ethnicity, and arithmetic scores. When reviewing the results, researches noted that females in all three groups had lower scores than males. Also, Asian students performed significantly higher in comparison with all other ethnic groups—researchers noted that such a finding might correlate more with the students’ prior experiences, rather than the gaming activity itself. Moreover, the results showed that students’ scores in the game predict their overall academic test scores. Students who performed better in the games were more likely to get high-test scores. In addition to academic improvement, 33% of the students indicated they enjoyed playing the games, while another 33% stated they enjoyed the game because it facilitated their learning. Also, 35% of the students indicated that the extensive features of the games were interesting, which contributed to the interest and control of their education. In sum, the results of the two-studies show that the use of
technology positively affects the learning of elementary school students, especially with regards to their arithmetic skills. The two studies emphasize that game technology could be effective in improving the students’ learning.

The two studies by Shin, Sutherland, Norris, and Soloway (2012), provide valuable information regarding the uses and effects of game technology in elementary classrooms. However, the two studies were not ideal as there were several limitations. In study one, the researchers used final tests and observations to collect information, but they did not involve any instruments for observing teaching practices in the classroom. It is important to observe the teachers practices to understand the positive or negative influences on the students behaviors and performances that may affect their final test scores. Important data could be gathered from this procedure, such as assessing whether or not the teacher treats the students with different genders, ethnicities, or backgrounds fairly or not. Moreover, in the second study the researchers use a final test which consists of 70-items, and asks all the participants, which include the 14 that were in the study to complete it. Such information poses a question as to whether or not the test scores for those students would be reliable because they completed it for the second time. Also, the participant’s population was not diverse, this could have an affect on the outcome. Even though the two studies involved White, African America, and Asian American participants, the White students made up more than half of the participants. In addition, the pool of participants makes it difficult to compare the participants regarding their ethnicities. Even though the findings in study two show that Asian students performed significantly higher, it is also important to take into consideration that there were only eight Asian students in comparison to 31 White students. Hence, the biggest difference may be that the ethnicities within the number of participants were limited, and therefore may not have accurately taken into account several factors.
Another interesting study conducted by House (2012) investigated the relationship between the use of computer educational programs (such as Microsoft Word and PowerPoint), differentiated classroom instruction (e.g. independent work and student choices), and the effect on elementary school science achievements. More specifically, “the dependent measure examined in this study was each student's score on the TIMSS 2007 fourth-grade International Science achievement test. The TIMSS 2007 International fourth-grade science assessment included three science content areas: life science, physical science, and earth science. Statistical procedures to estimate student proficiency have been developed; students are typically given relatively few test items in each specific content area and plausible values are generated for each student based on responses given” p:266. The study took place in two different countries, the United States and Japan. House (2012) selected these countries for specific reasons; first, the science achievements of elementary school students in Japan are high in comparison with other countries. Second, there is a lack in similar studies that address science classroom teaching strategies in both countries. Unlike many other studies addressed, the participant sample was huge—the number of participants were 3,378 students from Japan and 6,181 students from the United States, These students were chosen from 145 schools in Japan and 260 schools from the United States; the schools were both public and private throughout different geographic locations (northeast, southeast, mid-west, west). It is noteworthy to mention, special education schools were excluded from the sample. In order to measure the correlation between students' computer engagement and their science achievements, students answered questions that indicated how frequent, and what different programs they used for schoolwork (specifically for science), leisurely uses, and various tasks (surfing the Internet). The second measurement was to evaluate classroom instructional strategies. Students indicated how frequently their teachers used
different classroom activities that incorporated problem solving, independent work, and explanation. Finally, students’ responses to six measures that aim to examine beliefs about science. In order to analyze the data, House (2012) used multiple regression procedures to investigate the relationships between classroom instructional strategies and science belief, as well as the relationships between computer activities and science test scores. In the United States students reported using computers for educational purposes in various locations such as: their home, a public library, friend's home, Internet café, appeared to have high levels of science achievements. However, students who indicated that they spent more hours per day outside of school playing computer games for non-educational reasons had lower science test scores. In Japan the findings were slightly similar—a majority of students who indicated they used computers more frequently at both home and school for academic purposes showed higher levels of science achievement. Also, students who indicated that they used computer activities outside the school for non-academic reasons, such as playing computer games, revealed to have lower achievement test scores.

Regarding to classroom activities, there was a relationship between the use of new and different teaching strategies, such as problem solving and working independently, and science test scores. In both countries, students got higher science test scores when they were frequently engaged in problem-solving activities and encouraged to memorize science facts during lessons. On the other hand, students who were not involved in such activities and strictly relied on traditional classroom instruction exemplified lower levels of science achievement. House (2012) indicated that these strategies created positive behaviors towards science for the students. In both countries, the results demonstrated a correlation between academic attitude and test scores. The fourth grade students who reported that they usually did well in science got high
achievement test scores, however students who had negative outlooks about their science abilities demonstrated lower test scores.

House (2012) conducted a great study that showed the importance of the interrelationship between computer activities and educational learning. The study provided evidence that integrating computers in the classroom allows the students to attain more information, as well as use of different teaching strategies that have a positive effect towards science achievements. However, it is important to address the limitations of the study. First, the researchers specifically examined the relationship between different technologies and teaching instructions to science achievements. It may have been beneficial to have a larger scope of different subject matters, such as reading and writing. Japanese students are typically stereotyped as outperforming other students of different nationalities in the sciences, which may have affected the results. Secondly, the researchers concentrated solely on fourth grade students, and it may have been better if other age groups were involved in order to make the results more accurately reflect diverse elementary school students. Finally, House (2012) did not use different types of strategies to attain information (such as direct observation) of both student and teacher performances, which could have provided interesting information regarding the effective use of computers in classrooms.

Sun, Lin, and Yu (2008) indicated that with the emergence of technology in the classroom, the Internet seems to be influential pertaining to teaching and learning styles. They indicated that distant learning could offer new ways of teaching that would help provide new solutions to the many problems in the traditional teaching method. Furthermore, Sun et al. explored how a web-based virtual science laboratory affected elementary students’ achievements. They describe the study as an, “online virtual lab [that] allows teachers to integrate information and communication technology (ICT) into science lessons” p: 1411. Before
starting their research, they (2008) established a web-based virtual lab for elementary school science courses. Moreover, the purpose of the study was to find out how this online virtual lab would influence students with different learning styles. The web-based-lab contained different tools. The left half of the lab contained the desktop and the right half consisted of folders storing different tools, such as thermometers, alcohol burners, etc. The users were able to move the tools to the desktop for experimental use. Before the study was conducted, there were individual tables that provided information regarding the properties (such as name, color, mobility) for each tool. To use these features, students had to double-click on an object to open a related pop-up window. Students in the web-based lab could use each tool and see how it would affect the experimental process. Because each step is recorded during the operating process, the teacher is able to observe and correct the students’ mistakes if necessary. The teacher is also able to access the records in order to observe the students’ weakness and strengths to plan future lessons. The purpose of creating this web-based-lab is to investigate whether or not it would better facilitate students’ sciences learning. The participants of the study included 132 students from four and fifth-grade classes in Tainan City and Kaohsiung City. Using random sampling, sixty-five students were selected to be in the experimental group where they were able to use the web-based lab teaching. The remaining 67 students were in the control group, which implemented traditional classroom teachings. In order to collect data, the researchers used the following methods: questionnaires surveying learning styles and web-based lab teaching, as well as pre and post-tests pertaining to science achievements. Researchers explained the study as, “[it] adopted a quasi-experimental design method to examine how the web-based lab influenced the effectiveness of teaching the natural sciences in elementary schools. This experiment applied the nonequivalent-control group design to evaluate teaching effectiveness. Following a two-month
experimental curriculum, the students in the experimental group filled out the ‘questionnaire of Web-Based Lab Teaching’ to analyze their opinions about studying the natural sciences this way.” In order to analyze the data, researchers used one-way and two-way ANOVA designs to investigate how this web-based lab affected the students learning effectiveness. Finally, single-factor ANOVA and two-factor ANOVA were applied to investigate the differences between web-based lab teaching and traditional classroom teaching for science in elementary schools. The overall results showed that students who used the online virtual lab acquired high test scores compared with the control group students who were taught using traditional teaching methods. However, the results also showed that with regard to the different students’ learning styles, students in the experimental group showed no difference in the achievements score. This finding indicated that the web-based virtual learning environment was appropriate for students with different learning styles. Moreover, the data collected from the survey showed that 75% of students preferred integrating the web-based virtual lab in their learning processes along with the traditional resources, such as textbooks.

Sun, Lin, and Yu (2008) study brought in relative information about how new teaching methods could be very effective and improve students’ achievements when incorporating web-based learning. This study is a great resource for future researchers that aim to investigate the possibility and effectiveness of new teaching methods that depend on technology. However, it is important to note the limitations of the study. All of the participants were fourth grade students from two cities in Taiwan. Hence, the study was very specific to just Taiwan and therefore disregards the different attitudes of students in different countries. It would have been better if the researchers included other countries and used different grade levels in order to broaden the sample pool and essentially produce more efficient results. Also, the study was over a timespan.
of merely two months, which limits the study results. Although the results were remarkable, it may have been beneficial to see how online teaching methods influenced student educational outcomes and behavior over a long period of time.

The research on educational technology highly influences my project because I plan to incorporate phone applications in teaching methods. Shin, Sutherland, Norris, and Soloway (2012) research showed how integrating technology games could positively facilitate the students learning, provide more control to the student, and improve their academic achievements. These results prove the importance of providing students with resources of educational technology games for different subjects, which will be provided in my application to better master the subjects. There are many different types of technologies that students should be educated about in order to incorporate while learning, such as games and PowerPoint presentations. Such technologies can provide students the opportunity to increase their academic enjoyment, as well as their performances. Therefore, it would be necessary to provide students with these resources through the application. House (2012) informs my study in the way it addresses the relationship between the use of computer educational activities, such as Microsoft Word and overall student engagement. This highlighted the importance of providing students with information about how they can improve their learning engagement while using technology. This is emphasized, because when students approach their studies with a positive attitude, they essentially learn more and therefore achieve more. On the other hand, Sun et al. bring forth an important point about the effectiveness of web-based learning environments. Unfortunately, due to various reasons, teachers doubt the effectiveness of using online web-based learning; however, students need to know about these ways to implement it in their learning processes. By doing such, students would be able to use their study time more effectively. In my application, I will
create a source page that provides students with resources that explain the positive influences of web-based learning environments and methods.

**Synthesis of Literature Review**

Previous findings support the development and ideologies embedded in the phone application: *Easy Way To An A*. The synthesis of research findings identifies the components that need to be addressed in the application. The majority of research findings in the literature show how different learning styles and specific teaching strategies are important. Such studies have shown that students’ academic achievements could be improved by applying different teaching strategies, such as setting up independent learning situations and offering challenging activities. Such different ways of teaching encourage identifying and matching the students’ learning styles in order to better accommodate their students with different scholastic activities. In addition, the synthesis of research findings show the importance of how students should be educated early on about different learning styles. The application should be a source that improves student’s self-efficacy by providing information about different study strategies choices. With the application, students will feel comfortable while they study and try to achieve better understandings of the topics. Students will also feel more confident about their abilities, which will increase their level of self-efficacy. The literature also demonstrates the importance of technology in the education field. Different types of technology have been effective in the educational setting, such as games, web-based instruction, and computer activities. This is why I have come up with the idea of creating a phone application that can provide students from an early age with a way to identify their primary learning styles and affective study strategies. The application also includes sections for teachers and parents, which will be implemented in the
future. The teachers section will help teachers learn new ways to deliver the information to their students using different activities and techniques. The parents’ sections will provide parents with information about learning styles, study strategies and tips that they can use while helping their children completing their school assignment.
Chapter Three

Project Design and Development

Introduction

The application *Easy Way To An A* is a phone application that aims to help students from a young age understand the concept of learning styles and how to apply appropriate learning strategies to help them feel more comfortable in the academic environment. As reported in Chapter One, the percentage of dropouts and students at-risk is high in Los Angeles, California, and has increased over time. Research show that the integration of the understanding of learning styles and study strategies are an effective means of solving such problems, and improving student achievement. Therefore, the phone application *Easy Way To An A* could be implemented in the school system as a new way to communicate this information to students. This chapter will take into consideration and include the following components: a discussion of the design and development of the application, the target audiences (their personal qualities and qualifications), the environment and the equipment needed to use the application, and finally, a general outline of the application.

Development of the Project

**Instructional design model.** The Instructional-Development model of Dick, Carey, and Carey was used to design and develop the application *Easy Way To An A*. This model focuses on students in K-12, which is the pool of students this application focuses on helping; it also offers a prescriptive model that is useful for the development of this application. Additionally, this
model is ideal because it is detailed in each step of the process and does not require the designer to have advanced levels of expertise.

This model includes ten components, nine of which are part of the iterative cycle, with the last consisting of a culminating evaluation of the effectiveness of the instruction. Below is a step-by-step overview of how this specific model informed the design and development of this application:

**Needs assessment and goals.** In order to understand and carefully analyze the need for this application, I took several educational statistics into consideration. As mentioned in Chapter One, when students are unaware of their learning styles their academic progresses can be stalled, stunted, or delayed. In 2013, the National Center of Educational Statistics released information pertaining to fourth and eighth graders in fifteen states who scored at or above proficient in math, as well as information pertaining to those of the same age in nineteen states who scored at or above proficient in reading. Unlike these states, Californian students scored in the lower percentile, and therefore, did not qualify in either category. Another important current problem in education is the student dropout rate. As mentioned in previous chapters, the U.S Department of Education (2009) indicated that in 2002, ninth grade public-school students in California who dropped out of school was at 3.2%, which later increased to 5.0% in 2009. Such educational problems do not strictly affect individuals negatively, but also the community as a whole—uneducated individuals mean an uneducated community. These concepts and statistics demonstrated the need to find new ways to deliver educational information in order to improve the students’ academic achievements. Student must be informed about their own learning styles to help them better grasp material and meet classroom objectives. After researching the lack of this type of product, the necessity of such an application became even clearer. When students
(grades four to eight) download the app, they will use it to identify their learning styles and learn about the associated learning strategies and use them to complete their schoolwork and assessment tasks for the rest of their schooling careers. In learning situations when students (grades four to eight) encounter new challenging educational topics (on math, reading or sciences) or problems they will use the application to learn a specific learning strategies that match their learning style for the rest of their schooling careers. Moreover, when students (grades four to eight) select the gadget box option they will explore and get more information about study strategies and continent information by using the available resources in the app for the rest of their schooling careers

**Conduct instructional analysis.** The second step was to conduct instructional analysis. Instructional analysis aims to determine and analyze the instructional components of the application *Easy Way To An A*, which involved analyzing the following components: content, task, student, and context.

**Content analysis.** The content analysis includes the following theories, models, strategies, and subject matter standards for math:

I. Learning Styles

A. David Kolb's Model

B. Learning Modalities

C. Peter Honey And Alan Mumford's Model

D. Anthony Gregorc's Model

E. Sudbury Model Of Democratic Education

F. Neil Fleming's Vak/Vark Model

G. Other Models
1. Cognitive Approach To Learning Styles

2. A More Recent Evidence-Based Model Of Learning

3. Nassp Learning Style Model

H. Assessment Methods

1. Learning Style Inventory

2. Nassp Learning Style Profile

3. Other Methods

I. Criticism

1. Critique Made By Coffield, Et Al.

2. The Critique Regarding Kolb's Model

3. Other Critiques

4. 2009 Aps Critique

J. Learning Styles In The Classroom

K. Learning Styles At Home

II. Differentiated Instruction and Assessment

A. Brain-Based Learning

B. Pre-Assessment

C. Ongoing Assessment

D. Content

E. Process

F. Product

G. Learning Environment
H. Helping Parents Learn About Differentiated Instruction. (More information about Fourth Grade Common Core Math Standards are located in Appendix C)

**Context Analysis.** After individuals download the application, they can view it anywhere, as long as they have a mobile device. Students and teachers can use this app at home in order to get information about learning styles and differentiated instruction. Teachers in the school can ask their students to fill out the survey in order to educate them about how to properly organize their class structure in order to best accommodate their diverse students’ needs.

**Task analysis.** To determine a step-by-step breakdown of what pupils are doing when they are achieving goals. For the application *Easy Way To An A*, students must do the following: read the introduction for the application to understand the meaning of learning styles; investigate their primary learning styles by completing the learning styles survey; learn specific study strategies that are appropriate for their primary learning styles; and later answer the assessment questions. Also, teachers and parents will be able to access the application and will be involved within the educational environment to facilitate the use of the application and ensure that the students understand and process the information provided. How teachers and parents will help the students with the application will be further explained in the following sections.

**Analyze learners.** This step was to analyze students to identify their present skills, characteristics, preferences, and attitudes towards the instructional setting. The useful information about the target population includes prior knowledge about learning styles, academic motivation, initial behaviors; attitudes toward content and potential delivery systems, as well as toward the organization. In order to create effective study strategies, the California state standards (math, reading, and science) for students in grades four to eight were reviewed and evaluated. Additionally, interviews with elementary school teachers will be conducted to share
information regarding the certain situations and challenges they face when completing their academic work. Moreover, there will be interviews with students’ parents in order to attain information regarding their children’s overall motivation, attitude, and academic achievements in the subjects of math, reading, and science.

**Performance objectives.** This step focuses on writing performance objectives that specify what the pupils will be able to do with the overall skills they learn under the certain conditions and criteria. The following are the performance objectives for the application *Easy Way To An A*:

1. While doing their homework, elementary school students will identify and use at least two appropriate study strategies that match their learning styles 95% of the time.
2. When offered an option of class activities, elementary school students will choose the activities that best match their learning styles 100% of the time.
3. When encountering new information, elementary school students will apply the knowledge of learning styles to make accurate understandings (90% of the time).

**Develop assessment instruments.** This step include develop assessment instruments to develop a criteria-referenced assessment consistent with the performance objectives. Tests and evaluations were created to ensure the students meet the necessary prerequisites for performing the new skills; identify the learner progresses in meeting the performance objectives during the learning process; and evaluate the learning process itself to ensure it is structurally sound. In the application, this is where the test will be implemented as an assessment to measure the students' understanding about the learning strategies. The assessments will be shown after discussing each study strategy to ensure the students' understanding.
Develop instructional strategies. This step included develop instructional strategies to set pre-instructional activities that targeted motivation, objectives and entry behavior; presentation of information (instructional sequence, information, examples); learner's participation (practice and feedback); testing (pretest and posttest); follow-through activities (remediation, enrichment, memorization and transfer). Also, the development of the application will permit the students to learn and acquire information in a new interesting way that frees them from excess pressure and anxiety. Even though the activities require the students to engage and read the information to gain knowledge about their learning styles and to select effective study strategies, they are not mandatory assignments. Mandatory assignments are typically constraining in nature, and the application is meant to be user-friendly. In the beginning, teachers will introduce the application to the students during class and advise them on how to download it. Teachers will also help the students create an account in order to allow them to save their information. Teachers will be able to add short quizzes and view the students’ answers, which will allow them to track the students’ academic improvements without the students necessarily being in the classroom. Also teachers will be able to provide the students with feedback regarding their academic progress. Teachers then will communicate with the parents to discuss the app’s benefits, and encourage them to use and read the parent user guide in order to familiarize themselves with the information needed to help their children. Parents will be able to see the children’s progress by receiving the student progress information from the teachers and by helping their children complete their school assignments.

Develop and select instruction materials. This step includes developing and selecting instructional materials for the application. The application includes the students guide, which will include the following four components: first, a learning style survey; second, an overview of
general learning strategies; third, specific learning strategies regarding learning in math, reading, and science; fourth, different assessment questions after each strategy is thoroughly explained. The application will also include the teacher user guide, which explains the following: how students learn differently (introduction to learning styles); teaching strategies (teaching strategies for different grade levels and subjects); teacher-student and teacher-parent communication. Finally, the application will include the parent guide, which will include the following topics: how my child learns (introduction to learning styles); how I can facilitate my child’s learning (steps on how to effectively apply study tips for different learning styles); how I can use this app with my child (how to assist in completing surveys and assessment questions on application).

**Formative evaluation.** This step is to design and conduct a formative evaluation to collect data and determine how to improve instruction. For the application I used different ways to conduct a formative evaluation. First, in the instruction design course (EPC 615) I presented a mock-up of the application that I shared with my college colleagues to gain feedback and insights regarding the application design and content (see more information about the mockup and the resulting modification in Chapter Four). In addition, I created a questionnaire that is completed by three school teachers who have taught students in elementary schools. This questionnaire included nine yes or no questions and one written question that asked them for their suggestions pertaining to the elements and design of my product (see more information about the questionnaire and the resulting modification in Chapter Four).

**Summative evaluation.** This step is to design and conduct a summative evaluation to judge the final overall effectiveness of the entire application. When the application is completed, and the students are able to access it, there is an experimental study to find out whether or not the instructional goals have been met. In the study, students will be divided into four groups, two
control group and two-experiment groups (see more information about the summative evaluation in Chapter Four).

**Revise instruction.** The final step is to revise instruction: to use the data from the evaluations to examine the validity of the instructional analysis, learner and context analysis, performance objectives, assessment instruments, and instructional strategies. By using the data from the formative evaluation, I modified my product to make it more effective and efficient to the students’ needs in order to facilitate the learning process for the students (see Chapter Four for detail information about the revising process).

**Intended Audiences**

The application is specifically designed for elementary school students between grades four and seven. The users will include both genders; students of different ethnic and cultural backgrounds, such as Asian, Asian American, Black, and White; and students from low and high social economic status (SES). Users have the ability to read simple English.

Fourth and fifth grade students are able to think independently and critically, though they lack self-confidence. Students in this age group typically want to put some distance between themselves and adults by seeking independence. On the other hand, students in sixth and seventh grade generally have similar developmental attributes, such as: showing more self-assertion and curiosity; being moody and easily frustrated; being spirited and enthusiastic, which develops a growing sense of intuition and insight into self; being increasingly self-reliant. Students’ knowledge could vary between no knowledge about learning styles to a basic understanding about the topic with a lack of effective study strategies. In addition, the students could have different learning modalities, such as visual, auditory, or kinesthetic sensory
preferences. Students’ attitudes toward the content could alter if they use the application to explore the information in new ways. Students of this age group generally hold positive attitudes towards using electronic devices, such as cellphones; generally, students have one similar interest, which is the use of technology regardless of their motivation level.

Most students have relatively fair eyesight or corrected eyesight in order to read the information and questions provided through the application at the font size of 12. Students in this age range typically have basic motor and hand-eye coordination skills. Besides those factors, students of the current generation typically have such basic technology skills as turning the cellphone on and off, as well as downloading and opening various applications.

These students' reading levels vary between second and eighth grade. The prior knowledge and skills of students in fourth and fifth grade could vary based on their individual differences; however, generally, fourth grade students are able to read, write, add, subtract, multiply, and divide with very large numbers. In regards to mathematical topics, they are able to solve factoring problems; problems involving multiples; and geometry formulas for determining perimeter, area, and angle measurements. Students in fifth grade are generally able to solve moderately difficult problems with complex numbers. They are also able to divide whole numbers (with and without remainders); make connections between decimals, fractions, and percentages; and multiply and divide fractions. To the contrary, sixth and seventh graders could vary greatly in their math skills, but they are generally proficient in the four basic math skills: graphing, algebraic operations, geometry concepts for problem solving, and the use of functions and probability to make predictions.

The application is introduced by another target audience, credentialed/experienced elementary schoolteachers who will explain the app to students and parents. Teachers must have
a good understanding of learning styles so that they are able to answer the students’ and parents’ questions. Also, teachers in general have moderate technology skills, including the use of the Internet, applications, downloading, and basic Microsoft programs (e.g. PowerPoint) and the ones who will incorporate this app into their curricula and classrooms will have an open attitude toward the use of technology in instructional situations. Parents who use the app are expected to have a bachelor’s degree at minimum; they should also have a general sense of how technology works, how to operate a cell phone, how to download applications, and how to send emails. Also, they will hold positive attitudes regarding the use of the technology in the educational setting.

**Environment and Equipment**

To use the application *Easy Way To An A*, the user must have an iPhone and Internet access (electronic delivery system). This delivery system provides the target audience with the opportunity to access resources online and at anytime. Students need to connect to the Internet to download the free application through the apple IPhone app store. However, Internet connection is not necessary thereafter; they can use the app with or without Internet connection. After teachers introduce the application in the classroom, the application is mainly intended for students to use it at home when studying or completing class assignments. It is important to mention that teachers and parents are not required to check in on students all the time. Students are able to use the app whenever and wherever they like so parent or teacher supervision is not always necessary. However, parents and teachers should provide the student with help when needed.
Product Outline

The application *Easy Way To An A* contains different aspects that all aim to deliver impactful information about learning styles to elementary school students. The application contains the sequence outlined below (samples of the application are located in Appendix B):

I. Introduction
   A. App Orientation
   B. Users’ Guides
      1. Students
      2. Teachers
      3. Parents

II. Student Portal
   A. Introduction to Learning Style
   B. Strengths Survey
   C. Study Strategies
      1. Math
      2. Reading
      3. Science
   D. Links To Other Educational Resources

III. Teacher Portal
   A. Information about Learning Styles
   B. Teaching Strategies
      1. Math
      2. Reading
3. Science

C. Communication with Students and Parents

D. Resources.

IV. Parent Portal

A. Information on Learning Styles

B. Information on Mentoring

C. Communication with Teachers and Children

D. Resources
Chapter Four

Conclusion

Summary

The purpose of this project was to provide easy, interesting ways to enable young students to understand their own personal learning styles, as well as the corresponding study strategies that are most applicable to them. Chapter One stated the need/problem and discussed the purpose of the project; followed by Chapter Two, which presented research that supported the design and development of Easy Way To An A. A discussion regarding the project design and development was shared in Chapter Three. Finally, Chapter Four will describe the formative and summative evaluation processes, and present plans for future work.

Evaluation

Evaluating my product during the design and development process was critical to gauge the effectiveness and efficiency of the Easy Way To An A. The formative evaluation helped identify and correct weaknesses in the product throughout its design and development processes. The details of the formative evaluation are found below. When the product is fully completed and actually practiced in classrooms, a summative evaluation will be done to measure the effectiveness of the project’s instructional goals and performance objectives.

Formative evaluation. During the design and development of Easy Way To An A, I gave a mockup presentation in an instructional design course. The audience included an education expert, teachers, graduate students, parents, and instructional design experts. All the evaluators indicated that the application idea was unique, well organized, and likely to be successful in the
classroom environment. Through this evaluation, I received positive feedback and suggestions regarding the design and the development of the product. The evaluators suggested that I make the application very colorful, and include icons to make it catchier. Also, one evaluator suggested to include different types of surveys to make it more valid and accommodate all students’ needs. They also suggested to allow students to send their survey results to their teachers or to themselves. The evaluator also suggested changing the app sections names to make them more catchy and interesting. The evaluators’ feedback through the mock up presentation helped me improve the design and development of *Easy Way To An A*. After considering the feedback, I made several changes to improve the effectiveness of the application. I changed the application’s name from *Learn With Me* to *Easy Way to an n A*. Also, I used a colorful theme that included colors and pictures. The other point the evaluator mentioned, such as including more surveys, will be worked out in the future.

In addition, in order to gather more feedback about the application, I created a questionnaire that was completed by three experts in the educational field whose qualifications are as follows: reviewer A works as an educator at Kuwait University, reviewer B is a teacher who has worked in both private and public elementary schools, and reviewer C works as an educator at King Saud University; see Appendix A for the formative evaluation questionnaire. Reviewer A found the application to be appealing because it tackles different subjects and topics, and provides different strategies to deliver the information to the students. Also, reviewers A and B found that the application vocabulary and sentences are understandable and appropriate for elementary school students. Reviewer A indicated that the section “How I Can Use My Strength” should be personalized so that when the app is used, the student’s preferred way of learning is applied. However, because of time constraints and limited funds, this suggestion will be implemented in
the future. Reviewers A and B pointed out that the font size was too small and recommended bolding important words. Hence, I changed the font size to 20 and bolded the important words and phrases. Reviewer B thought that the survey instructions were not enough and recommended adding a line that asks the parents to be near their children when taking the survey. I then added additional instructions that suggest to students that they be with an adult or parent when taking a survey. Reviewer A also stated that there have to be introductions that summarize the goal of this application; therefore, I decided to add a description on the app goals that appear once the user downloads the app.

Reviewer B stated that the application is useful in the way it introduces students from a young age about the concept of learning styles and enables them to find their best ways of learning. Reviewer B shared that as a teacher it is useful for her to know how her students differ in their learning styles because she would be able to improve her teaching strategies. She also liked the idea that she would be able her to communicate with her students and send them comments regarding their progress in non-traditional ways. She indicated that she would be able to work more easily with any shy students who prefer not to communicate in front of a class. Also reviewer B mentioned that it is nice for parents to know their children’s best ways of learning so that they can encourage study strategies accordingly. Reviewer B indicated that she would not use the app frequently in her classroom, but she would introduce and encourage the app for home use. In the classroom she would work hard to ensure the students’ understanding of the material since she is there to help, but if the student is having difficulties at home then they will be able to use the app because they may not have someone to help them. Not all parents have experience or knowledge in certain subjects, so this is when it would be most beneficial.
Reviewer C found the app to be appealing in the way it presented an easy way for students to better understand their learning styles. Such information for a student can lead to an easier learning process for each student. Reviewer C also indicated that some language used in the app was not understandable, so I changed some of the vocabulary and some text to make the language easier to understand. Moreover, reviewer C liked how the final version of the app is a helpful tool for parents and teachers to better assist students in the teaching process by understanding different types of strategies to employ in their learning. Reviewer C also recommended emphasizing the role of the parents and teachers. Taking this suggestion into consideration, I will have sections that emphasize parent and teacher roles in the education process; this will help students individually, which will lead to an overall academic improvement.

**Summative evaluation plan.** Once the application is being used in the school system, the summative evaluation will take place. The goal of this step is to evaluate the effectiveness of instructional goals and performance objectives for the instructional product. The main question this evaluation addresses is, “did the instructional product meet its goals and objectives?” To conduct a summative evaluation for the application there will be an experimental study. The participants will be 100 elementary school students of different genders, social economic status’ (SES), ethnicities, and backgrounds along with their elementary school teachers. The study will include four groups, two control group and two-experiment groups. Each group will have 25 students. The participants in all groups will complete a pretest that will help collect data on the participants’ level of performance, motivation, and self-efficacy before the intervention took place. Experiment group number 1 will be introduced to the application and asked to use it for one year whenever needed. Experiment group number 2 will get information on general study
strategies three times a week during lunchtime; they will be able to use the app once a day every day for one year. One of the control groups will get new books that help with homework in general, and they will use these books once every day for one year. However, the second control group will just participate in the regular classroom activities. In addition, there will be observations of the classrooms and teacher and parent surveys administered.

After that period, all groups will complete a posttest and the results will be compared. The result from the summative evaluation will provide information regarding whether or not the application met its goals and objectives. The groups’ results will then be compared. Moreover, the summative evaluation will help provide information regarding the change in all groups, both pre and posttest.

Discussion

During the evaluation process, I made changes in the application to more positively affect the students and the educational process. However, during the process of researching and designing the application, I have faced a great challenge: even though technology use in the classroom environment is becoming more common, many teachers, principles, and parents are not supportive of it. Many believe that technology will prevent students from reading their text books, which will affect their academic achievements. However, I believe that by showing the educators and parents statistics and studies that demonstrate how such products are actually academically beneficial, this obstacle will hopefully be removed. This information’s will be shown in an orientation section of the parent and teacher portals.

Future Work
To make the product achieve its optimal goal, the designer must be creative to come up with ideas to improve the product in the future. This section will discuss the further needed improvements to the application *Easy Way To An A*.

**Languages.** One way to improve the effectiveness of the application is to include other languages. My second step is to translate the application into Arabic, which will result in making the app available to more users. I chose the Arabic language because it is my native language and I would be able to be more creative by adding information and discussing topics.

**Sections.** Even though the main users of the application will be students, the educational success relies on the cooperation among the students, teachers, and parents. The second section I will add in the future is a teachers’ section. In this section, teachers will be provided with information regarding learning and teaching styles, as well as teaching strategies for different subjects and grade levels. By viewing their students’ results and knowing their learning styles, teachers will be able to further accommodate their students with appropriate teaching strategies.

The third section will be for parents; parents’ knowledge must be improved. When parents know their children’s learning styles, and they understand how learning styles work, they will stop forcing their children to learn in specific ways that are not suited to them. The parent section will provide the parents with appropriate teaching strategies and activities that they can use at home to facilitate topics for their children, which will help to create a positive educational experience. This common understanding of education will create strong bonds between children and their parents. Also, parents will be able to better communicate with teachers to track their students’ progress.

**Grade levels.** Even though the primary audience for the application is elementary school students, I plan to include middle school students. The middle school students will be provided
with information regarding multiple intelligences learning strategies and a survey that measures their learning styles, especially their learning modalities. By doing this, students can discover more about themselves. In other words, when students are introduced to the application in elementary school, they will be able to identify their learning styles and effective ways of addressing their styles.

**App team.** To make the application more successful, I will create a team that consist of three elementary school teachers. Each teacher will be responsible for a different subject. The team will work with me to create the study strategies, and to make them appropriate to elementary school students. Also, there will be an application designer who will be responsible for the following: fixing app problems, adding sections, or making changes to the design. Moreover, there will be a programmer who can develop a security system for the app to ensure the app safety.

**Conclusion**

Students all over the world have their own preferences as to how they learn and study. Teachers and educators have the responsibility to facilitate the students learning and understanding as much as possible. They must create an educational environment that is positive and encouraging. *Easy Way To An A* will help facilitate student learning while providing teachers with knowledge about their students’ learning styles; parent knowledge will also be enriched in order to help children’s learning. Hence, all three components work together to make the students’ learning environments more comfortable, and to enable them to learn in the most suitable manner.
References


Washington, D.C. Retrieved on 5 February 2015 from


Appendix A:

**Evaluation Form for Easy Way To An A App**

Please take your time to review the app and then complete the evaluation form below to help improve the effectiveness of my project. For questions 1 to 7, please circle one answer and then add any comments you may have about the App. Your answers will be appreciated and taken into consideration. Your name and answers will be kept confidential. Thank you!

1. *The application was*
   - A. Appealing
   - B. Somewhat appealing
   - C. Not appealing

   What did you find useful or not useful?

2. *The information was*
   - A. Understandable
   - B. Somewhat understandable
   - C. Not understandable

   If you chose answer C, what did you find that was not understandable?

3. *The application was*
   - A. Useful
   - B. Somewhat useful
   - C. Not useful

   If you chose A or B, in what ways would it be useful to you, your students, or the parents?

4. *Would you recommend the application to your students or their parents?*
   - A. Yes
   - B. Maybe
   - C. No

   If no, why not?
5. Do you think you would use this application in your own classroom?
   A. Yes        B. Maybe        C. No

   If yes, how would you integrate this app into your curriculum/instruction?

6. Which section(s) needs to be improved? Circle all that apply.
   A. How I Learn       B. What Is My Strength       C. Who I Can Use My Strength
   D. Gadget Box

   Please share any ideas you have for improvement:

7. Do you think the information presented is appropriate for elementary school students?
   A. Yes       B. Somewhat       C. No

   If you chose answer C, what do you believe is inappropriate?

8. Additional Comments. Suggestions, or Recommendations:
Appendix B:

Sample Screenshots of the Application *Easy Way To An A*

This section enables the users to select the category that represents them.
Figure B2

*Easy Way To An A: student portal*

Which include four options: How I learn: introduction to the nature of learning and the concept of learning styles

What is my strength: students can complete a survey to discover their learning style

How I can use my strength: In this part, students will be provided with different study strategies (for visual, kinesthetic and auditory learner) regarding different topics.

Gadget box: link to online educational resources.
Did you know that each person has their own way and preference of learning and understanding new material?

When learning in school, you and your classmates will always be introduced to new information; however, the way in which you understand the information may not be the same as your peers. This refers to a term called learning styles, which mean how different students learn the same or similar content with different methods. For example, when learning how to build a clock, some students understand the process by following verbal or visual instructions, while others have to physically manipulate the clock themselves. There are three main categories of learning styles: visual, auditory, and kinesthetic.

Are you interested in discovering your learning style(s)?
Click here and answer the questions.

Figure B3

Easy Way To An A (How I learn)

Introduction to the nature of learning and the concept of learning styles
Figure B4

*Easy Way To An A (Assessment)*

After each study strategies, there is button that enables the students to assess their knowledge and ensure their understanding.
After students complete the survey, they will be able to know their results and send it to their email.

Figure B5

*Easy Way To An A: Survey Result*
Figure B6

*Easy Way To An A: How I can use my strength*

In this section students will be provided with different study strategies (for visual, kinesthetic and auditory learner) regarding different topics and grade levels.
In this section, students can select the topic that they want to get knowledge on.
Figure B9

*Easy Way To An A (Gadget Box)*

This section includes links to educational resources for different topics and grade levels.
Appendix C:

Fourth Grade Common Core Math Standards

According to Arizona's Department of Education (2010), fourth grade common core math standards should include instructional time focused on three critical areas:

1. Developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends
2. Developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers
3. Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry.

1. Students generalize their understanding of place value to 1,000,000, understanding the relative sizes of numbers in each place. They apply their understanding of models for multiplication (equal-sized groups, arrays, area models), place value, and properties of operations, in particular the distributive property, as they develop, discuss, and use efficient, accurate, and generalizable methods to compute products of multi-digit whole numbers. Depending on the numbers and the context, they select and accurately apply appropriate methods to estimate or mentally calculate products. They develop fluency with efficient procedures for multiplying whole numbers; understand and explain why the procedures work based on place value and properties of operations; and use them to solve problems. Students apply their understanding of models for division, place value, properties of operations, and the relationship of division to multiplication as they develop, discuss, and use efficient, accurate, and generalizable procedures to find...
quotients involving multi-digit dividends. They select and accurately apply appropriate methods to estimate and mentally calculate quotients, and interpret remainders based upon the context.

2. Students develop understanding of fraction equivalence and operations with fractions. They recognize that two different fractions can be equal (e.g., \( \frac{15}{9} = \frac{5}{3} \)), and they develop methods for generating and recognizing equivalent fractions. Students extend previous understandings about how fractions are built from unit fractions, composing fractions from unit fractions, decomposing fractions into unit fractions, and using the meaning of fractions and the meaning of multiplication to multiply a fraction by a whole number.

3. Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

**Grade 4 Overview Topic:**

I. **Operations and Algebraic Thinking**
   A. Use the four operations with whole numbers to solve problems.
   B. Gain familiarity with factors and multiples.
   C. Generate and analyze patterns.

II. **Number and Operations in Base Ten**
   A. Generalize place value understanding for multi-digit whole numbers.
   B. Use place value understanding and properties of operations to perform multi-digit arithmetic.
III. **Number and Operations—Fractions**

A. Extend understanding of fraction equivalence and ordering.

B. Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

C. Understand decimal notation for fractions, and compare decimal fractions.

IV. **Measurement and Data**

A. Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

B. Represent and interpret data.

C. Geometric measurement: understand concepts of angle and measure angles.

V. **Geometry**

A. Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

VI. **Mathematical Practices**

A. Make sense of problems and persevere in solving them.

B. Reason abstractly and quantitatively.

C. Construct viable arguments and critique the reasoning of others.

D. Model with mathematics.

E. Use appropriate tools strategically.

F. Attend to precision.

G. Look for and make use of structure.

H. Look for and express regularity in repeated reasoning.