

**EFFECTIVE DIFFERENTIATED INSTRUCTIONAL ELEMENTS FOR IMPROVING  
STUDENT PERFORMANCE AS PERCEIVED BY SECONDARY PRINCIPALS  
IN EXEMPLARY PUBLIC HIGH SCHOOLS IN TEXAS: A DELPHI STUDY**

A Dissertation

by

TERESA ANN DURRETT

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2010

Major Subject: Educational Administration

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August 2010

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**ABSTRACT**

Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by Secondary Principals in Exemplary Public High Schools in Texas:

A Delphi Study. (August 2010)

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The primary purpose of this Delphi study was to determine which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals in 2A to 5A 2009 “Exemplary” public high schools in Texas. A secondary purpose for this study was to determine what additional differentiated instructional elements are perceived by this study’s targeted principals as being critical for student success.

The researcher obtained feedback during three Delphi survey rounds from the twenty-four member expert panel regarding which of the research-identified differentiated instructional elements they perceived to be the most effective for improving student performance. The differentiated instructional elements presented in the survey were based upon a sound theoretical framework resulting from a review of existing research on differentiated instruction. After Round Three, consensus was reached, and the data collection period ended. Each of the surveys for the study, as well as the statistical analysis, can be found in the appendices of this dissertation.

The findings of this study determined that using a variety of resources, as well as a variety of strategies, were the top-ranked research-identified differentiated instructional elements that the expert panel perceived to be the most effective for improving student performance. In addition, panelists agreed that the differentiated instructional elements already identified in existing research, as presented in this study, are comprehensive and sufficient for improving student performance.

Without a doubt, the conclusions and recommendations of this study could extend the current knowledge base by promoting the use of the most effective research-identified differentiated instructional elements to improve student performance. Furthermore, the implications of the study will be invaluable for ongoing professional development, principal and teacher preparation programs, and for those in the field seeking to improve their daily educational practices for student impact.

## DEDICATION

I dedicate this dissertation to the Glory of God. After all, it was His calling that inspired me to make the journey. “I know the plans I have for you,” declares the Lord, “plans to prosper you and not to harm you, plans to give you hope and a future” (Jeremiah 29:11). Then, when life’s tumultuous trials came, it was God who wouldn’t let me quit, even when I wanted to be a Jonah and run the other way. He has always been there for me, and I owe Him everything! Indeed, His is the victory!

I also dedicate this dissertation to the loving members of my family who supported me unconditionally throughout my journey to completion.

Dwight, my precious husband, your unconditional love, prayers, and encouragement helped me finish the daunting task. Dwight, you believed in who God made me to be and cheered me on when I was ready to drop the baton. *Thank you for loving me!*

Mother and Daddy, my dear parents, your unwavering faith in me never faltered, even as the years went by and life challenges came and went. Mother and Daddy, you taught me to “have faith and to press on.” *Thank you for uplifting me!*

Carolyn and Larry, my caring sister and brother-in-law, your loving reminders to take “one step at a time” and to “persevere” made a difference! Carolyn and Larry, your praises for my progress kept me moving forward. *Thank you for encouraging me!*

Jason, Kristy, Misty, and Megan, and your spouses, Kim, Manny, John, and Blake, plus all our grandchildren—Jaden, Zeus, Canon, Kalen, Priest, and Trinity—your lives have inspired me to “finish the race.” Family, your love and acceptance gives me the freedom to be me. *Thank you for supporting me!*

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## CHAPTER I

### OVERVIEW OF STUDY

#### Introduction

Effective teachers differentiate instruction and monitor progress of their students in a variety of ways, while results-oriented principals look for indicators of student progress via teachers' differentiated instructional outcomes. Principals who understand and model differentiation can help teachers meet today's performance standards, while respecting the uniqueness with which each teacher implements differentiation in the classroom (Pajak, 2003). Understanding the impact of differentiation, an effective principal understands that he or she takes on the same role with teachers that teachers have with their students (Tomlinson & Allan, 2000). Interestingly, Glickman, Gordon, and Ross-Gordon (2006) developed a variety of supervisory approaches to facilitate the process for principals to give teachers the support best suited for their differing needs. Indeed, a campus principal needs to acknowledge and understand the impact of differentiated leadership upon differentiated classrooms (Tomlinson & Allan, 2000).

Having a knowledgeable and supportive principal for teachers who are using differentiated instructional elements in their classrooms is instrumental to facilitating student performance (Crowther, Hann, & McMaster, 2001). In fact, principals' perspectives are critical to the process of improving student achievement and school performance (Willis & Mann, 2000). Principals, having referent power—relative to their

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This dissertation follows the style of *The Journal of Educational Research*.

teachers' successful utilization of differentiated instructional strategies for increased student performance—can link differentiation and best practice (Smith & Andrews, 1989). To determine the effectiveness of research-identified differentiated instructional elements for improving student performance, the researcher-moderator will obtain feedback from principals of “Exemplary” 2A to 5A public high schools in Texas, as designated by the Texas Education Agency’s 2009 *Academic Excellence Indicator System (AEIS)* report.

No doubt, standards-based instruction—and the high-stakes testing that drives it—dominates the nation’s educational terrain in a time of increased academic diversity. Educational approaches that ignore academic diversity are likely to be counterproductive in reaching the full range of learners (Marzano, 1992; Marzano, Pickering, & Pollock, 2001; Schlechty, 1997; Tomlinson, 2000a; Tomlinson, 2000b). With alignment of sound teaching and learning practices, notes Danielson (1996) and Marzano (2003), identification and utilization of effective differentiated instructional elements can serve to facilitate student performance.

Not a new concept, differentiated instruction was used in the days of the one-room schoolhouse, when students aged 6-16 learned together, cites Carol Ann Tomlinson (1999). Simply defined, differentiated instruction is responsive teaching that acknowledges student differences. The theoretical framework for differentiated instruction comes from a compilation of theory and research. Constructivists such as Dewey (1938), Piaget (1969), and Bruner (1966), according to Tomlinson and Allan (2000), were forerunners of the differentiated instructional model, which promotes an active, student-centered, meaning-making approach to teaching and learning. Brooks and Brooks (2001) attest to the necessity of today’s teacher becoming a constructivist,

as well. According to Tracy Hall (2002), differentiated instruction, with its concept of “readiness,” is grounded in the 1962 learning theory work of Vygotsky—his zone of proximal development—that is, the concept that the difficulty of skills to be taught should be somewhat beyond the range of a student’s current level of mastery in order to challenge students to continue learning. Furthermore, research regarding multiple intelligences and learning styles acknowledges differentiation as a conduit for expanded learning (Gardner, 1983; Sullivan, 1993). Much of the literature on differentiating instruction describes research that was conducted in elementary and middle schools with gifted and talented students (Weinbrenner, 1992). Empirical studies, however, offer scant information about how secondary school teachers use differentiated instruction to address students’ academic differences (Tomlinson, 1999). What evidence that is available suggests that subject-specific differences are important in analyzing how teachers address academic differences in their secondary classrooms (Grossman & Stodolsky, 1994). Researchers’ descriptions of the relationships between secondary teachers’ practices and the particular subjects they teach illustrate how secondary instruction is typically delivered (Stodolsky, 1993; Lou et al., 1996). Essentially, differentiated instruction must be a refinement of, not a substitute for, high-quality curriculum and instruction (Brandt, 1998). Expert teaching—utilizing differentiated instructional elements—focuses on the competencies and skills of a discipline, prompts students to wrestle with profound ideas, calls on students to participate in establishing learning goals and making choices, assists students in organizing and making sense of ideas and information, and aids them in connecting the classroom with a wider world (Danielson, 1996; Schlechty, 1997; Brandt, 1998; Wiggins & McTighe, 1998). Differentiated instruction, as it has evolved, promotes an educational



philosophy of improving student performance based on the premise that teachers should adapt instruction to student differences, rather than marching students, lockstep, through curricular mandates (Willis & Mann, 2000). With differentiation, teachers' assessments and subsequent instructional responses to students' varying interests, readiness levels, and learning profiles optimizes student learning (Tomlinson, 2001).

The work of numerous researchers reveals the importance of fostering student motivation to learn via interest differentiation to enhance achievement and productivity (Torrance, 1995). Such motivation evolves when teachers systematically engage students in the freedom of choice in their own learning by means of using differentiated instructional elements; thus, affording students the opportunity to develop a high level of intrinsic interest (Collins & Amabile, 1999). Researchers explain that teachers should tap into key student interests in order to lead students in addressing tasks of ever-increasing complexity or even uninteresting tasks (Tomlinson & Allan, 2000). Researchers also concur that when students sense an invitational environment and discover interesting content for study, an important positive influence on both short- and long-term learning emerges (Renninger, 1990; Hebert, 1993; Barrell, 2001).

A continuous line of research conducted by David Hunt since the 1960s has established that more effective learning takes place when the amount of task structure provided by an instructor matches a student's level of readiness (1971). Related studies show a relationship between student achievement and a teacher's ability to diagnose the student's skill level in order to prescribe appropriate tasks via readiness differentiation (Fisher et al., 1980; Weinbrenner, 2002). While researchers focus on the principle of differentiation for student readiness, they caution teachers that student achievement is not likely to improve when teachers ask students to practice that which

they already know or to complete tasks that cause students ongoing frustration due to their lack of readiness to tackle the tasks (Fisher et al., 1980). In a five-year longitudinal study of why some of the 200 teenagers studied were committed to the development of their abilities while others were disengaged, researchers concluded that there existed a necessity for a match between the complexity of tasks developed by a teacher for a student and the student's skill level readiness for the tasks. Students whose skills were not challenged sufficiently demonstrated low involvement in learning activities and lessened concentration, while students whose skills were inadequate for the level of challenge level afforded demonstrated both low achievement and diminished self-worth (Csikszentmihalyi, Rathunde, & Whalen, 1993). These types of studies support the differentiation principle of adjusting learning tasks to learner readiness to enhance student achievement (Tomlinson & Allan, 2000).

In addition, addressing students' learning profiles—which are the indicators of students' learning styles, gender and/or cultural factors, as well as intelligence preferences that influence students' learning—provides invaluable information for teachers seeking to facilitate students' learning via differentiated lessons to improve achievement (Sullivan, 1993). A learning style is the way a person processes and internalizes new and challenging material. Coffield (2004) postulates that students learn in different ways; therefore, a student's learning profile should include his or her learning style, whether visual, auditory, tactile, or kinesthetic; grouping preferences, whether individual, small group, or large group; and environmental preferences, whether a preference for lots of space or a quiet area to work. The cornerstone of learning styles theory, according to Dunn (2000), is that each individual has his or her own unique way of mastering new and difficult subject matter. Hawk and Shah (2007)

posit that “faculty who are consciously aware of their students’ learning styles as well as their own are in a position to make more informed choices in course material, design, and learning processes to broaden the opportunities for effective learning in their courses” (p. 2). In fact, students’ learning preferences can be categorized into learning processes based on (1) experiential learning; (2) orientation to study; (3) instructional preferences; and (4) development of cognitive skills and learning strategies (Rayner, 1998). Additional learning-styles research purports the positive effects of instruction that is correlated to the preferred learning styles of a number of gender-specific and/or culturally-based students, including Native American, Hispanic, African American, and Asian American students (Dunn & Griggs, 1995). Yet, Gutierrez & Rogoff (2003) caution against cultural categorization of individuals in groups, which may lead to prescribing certain learning environments in order to complement assumed learning-style differences of students from various ethnic groups (i.e., such as the time of day individuals of particular groups are receptive to instruction or which instructional seating arrangement is the most conducive to students of particular ethnic groups). Educators should avoid stereotyping and/or generalizing about the learning styles of individuals in groups. The focus in a differentiated classroom is to accelerate the learning for all students, as it works best for them as individuals (Finnan & Swanson, 2000). Classroom teachers can work to benefit many more students by implementing patterns of differentiated instruction to address a wide range of cultural and language groups, if needed (Tomlinson, Callahan, & Lelli, 1997). Certainly, the objective of acknowledging students’ learning profiles in differentiated classrooms is not necessarily to assign group work and/or tasks to students based upon assumed learning styles, gender and/or cultural factors, but to establish learning environments in which individual students—

whatever their learning style, gender and/or cultural backgrounds—can find a match with their individually preferred modes of learning (Delpit, 1995).

Furthermore, studies by Sternberg (1997), as well as Sternberg, Torff, and Grigorenko (1998), establish that when students are matched to instruction that suits their intelligence preferences (i.e., analytic, creative, practical), they achieve academically at significantly higher rates than comparable students whose instruction is not matched to their learning patterns. Positive effects of teaching with a multiple-intelligence focus, as proposed by Howard Gardner (1993), are also documented in further research. For example, Campbell and Campbell (1999) write about the increased test scores of a research control group of students from varied multicultural groups who flourished academically as an outcome of receiving differentiated instruction that addressed their multiple intelligences. Noble (2004) relates that teachers in an 18-month study in which they integrated Gardner's (1983) theory of multiple intelligences with Bloom's (1956) taxonomy to create a planning tool for curriculum differentiation allowed them to cater to different students' strengths across multiple intelligences and to intellectually challenge their students. Dunn, Denig, and Lovelace (2001), as well, report that the merger of multiple intelligences with learning styles has had a positive effect on students' academic achievement.

Ultimately, teachers who assess and address their students' interests, readiness levels, and learning profiles with differentiated instructional strategies are more likely to meet their students' diverse academic needs and improve their achievement (Tomlinson & Allan, 2000). In differentiated classrooms, teachers build upon the premise that students—of varying interests, readiness levels, and learning profiles—differ in their approaches to learning (Coffield, Moseley, Hall, & Ecclestone 2004).

Consequently, teachers act upon the premise that, in order to enhance student performance, they must engage students in instruction by appealing to students' differing interests, by using varied rates of instruction and varying degrees of content complexity, and by addressing students' differing learning modalities (Smith, Lee, & Newmann, 2001).

Beyond student interest, readiness, and learning profiles, however, a teacher's differentiation of content, process, and product are the definitive hallmarks of differentiated classrooms. Content-process curricular models can provide structure for student-centered teaching strategies (Erikson 2002). Indeed, content can certainly be differentiated through compacting, acceleration, flexible pacing, and/or the use of more advanced or complex concepts, abstractions, and materials (Tomlinson, Brighton, Hertberg, Callahan, Moon, Brimijoin, Conover, & Reynolds, 2004). When students master a particular unit, they need to be provided with more advanced learning activities, not more of the same activity (Tomlinson, 2003). With differentiation, such content-knowledge and/or concept-based instruction affords students multiple opportunities to integrate and apply ideas, as well as to generalize—all standards-based skills that are necessary for student understanding and achievement (Kendall & Marzano, 2000). To differentiate process, activities must be restructured to be more intellectually challenging. Over the years, there have been different models for structuring higher-order learning opportunities (Bloom, 1956; Taba, 1962; Parnes, 1966; Berman, 2001). To differentiate process, a teacher can give students choices, for example, about how they will demonstrate mastery of concept acquisition. Active exploration, open-ended questions, and discovery opportunities encourage students to think about subjects in more abstract and complex ways (Tomlinson, 2001). A teacher

can also differentiate students' product assignments, giving them opportunities to demonstrate concept or process mastery in a variety of ways. A product, for example, can be a portfolio of student work, an array of solutions to a real-world problem, and/or a demonstration to showcase concept and skill mastery. Through the teacher's evaluation and feedback of students' products, students' learning opportunities are further extended (Herman, Klein, & Abedi, 2000). As more school districts embrace differentiated instruction, teachers who have expertise in differentiating instruction—via content, process, and product—can be invaluable resources for other teachers, particularly novice teachers, on campus, as well as for students (Carolan & Guinn, 2007).

Numerous differentiated instructional elements support student interest, readiness, and learning profiles, as well as reflect modifications of content, process, and product. Among these differentiated elements are those researched in this study: curriculum compacting, flexible grouping, varied instructional strategies, tiered assignments, higher-order questioning, problem-based learning, student choice of learning contracts, and assessment options (Tomlinson, 2001). Using differentiated instructional elements addresses varying individual students' learning needs to facilitate student achievement and performance (Kameenui, Carnine, Dixon, Simmons, & Coyne, 2002). A differentiated classroom offers a variety of learning and assessment options designed to tap into each students' differing interests, readiness levels, and learning profiles—via differentiation of content, process, and product—to afford students every opportunity to succeed in learning. Indeed, differentiated instruction is a means by which to address the learning needs of the academically diverse learners in today's classrooms. Without large numbers of classrooms in which teachers are skilled in

meeting the varied learners where they are and moving them ahead along the educational spectrum, however, the number of frustrated and, perhaps, disenfranchised learners in schools may only multiply (Reynolds & Teddlie, 2000).

The challenge, then, for principals is to provide their teachers, especially their new ones, with guidance, training, feedback, and support for developing classrooms capable of addressing the academic diversity that typifies today's schools. "The mission of effective leadership is to maximize the number of expert teachers in a school's or district's classrooms," according to Tomlinson and Allan (2000) in *Leadership for Differentiating Schools and Classrooms* (p. 13). More than a strategy, however, differentiation involves a holistic way of thinking about teaching and learning (Shellard & Protheroe, 2000). To increase the effectiveness of differentiated practices in instructional settings to impact student performance—that is, to move from differentiation in individual classrooms to differentiation that is pervasive throughout campuses and school districts—requires knowledgeable, involved, and skilled leadership (Cotton, K, 2003). No doubt, a principal should be able to recognize differentiated instructional activities in the classroom, judge their appropriateness for a particular unit and particular learners, evaluate their instructional effectiveness, and be able to suggest alternative strategies, as necessary, to enhance student performance (Tomlinson & Allan, 2000). Administrative awareness, instructional leadership, and ongoing support at all levels for differentiation facilitate student achievement (Witziers, Bosker, & Kruger, 2003). The principal should make differentiation a consistent expectation and monitor teachers' progress toward that end. Principals' perspectives can impact their teachers' implementations of differentiated instructional elements in the classroom.

### **Problem Statement**

Standards-based instruction—and the high-stakes testing that drives it—dominates the educational scene in a time of increased academic diversity. Particularly in this age of high-stakes testing, teachers frequently experience genuine frustrations in trying to develop competencies among diverse learners. Research indicates that today's diverse learners have a wide range of interests, abilities, and learning profiles (Tomlinson, 1999). No doubt, educational approaches that ignore academic diversity are likely to be counterproductive in reaching the full range of learners (Marzano, 1992).

Without knowing which of the research-identified differentiated instructional elements are the most effective in improving student performance, educators may not make the greatest impact on student learning. However, principals on high-performing campuses are in a position to perceive which are the most effective research-identified differentiated instructional elements that their teachers can employ to meet their students' diverse academic needs in order to improve student performance. No doubt, principals' perceptions of the impact of differentiated instructional elements used in their teachers' classrooms are critical to the process of improving performance (Willis & Mann, 2000). To this end, this research study seeks to determine which research-identified differentiated instructional elements Texas principals of 2A to 5A 2009 "Exemplary" public high schools perceive to be the most effective in improving student performance.

### **Purpose Statement**

The primary purpose of this research study is to determine which of the research-identified differentiated instructional elements are the most effective for



improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas. The secondary purpose of this research study is to determine what differentiated instructional elements that have not already been identified in existing research are perceived by this study’s targeted principals as being critical for student success.

### **Research Questions**

The study will address the following research questions:

1. Which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas?
2. What differentiated instructional elements that have not already been identified in existing research are perceived by this study’s targeted principals as being critical for student success?

### **Operational Definitions**

Academic Diversity (diverse academic needs): Diversity, in this sense, refers to varying levels of student understanding and mastery of instruction that exists among students.

Academic Excellence Indicator System (AEIS): The AEIS of the Texas Education Agency annually reports information regarding Texas school district student testing performance. Reported indicators tracked include student testing performance, school completion and drop-out rates, school size,

staff experience and certification, and campus budget distributions. This research study references the 2009 *AEIS* student standardized testing performances in high schools in Texas who were ranked as “Exemplary.”

Achievement: Accomplishment of goals as prescribed by federal regulations, the Texas Education Agency, and a local school board. Typified by teacher-assessed products and/or a graded or scaled outcome whereby a student passed the established criterion of reference for passing. Achievement is frequently denoted by standardized test scores, as well.

Consensus: General agreement (as in opinion); the trend of opinion

Content: That which is to be studied and learned

Curriculum Compacting: A differentiated instructional strategy which uses the process of adjusting instruction—frequently based upon the outcomes of utilizing pretests and posttests—to determine student learning or mastery needs. Compacting involves a three-step process: (1) assessing the student to determine his or her level of knowledge to determine that which he or she still needs to master; (2) implementing learning plans for what the student needs to know, yet excusing the student from studying that which he or she already knows; and (3) creating plans for available time to be spent in enriched, extended, and/or accelerated study.

Delphi Study: A research methodology involving repeated rounds of isolated individual consultation with persons designated as experts in a particular field. The purpose of a Delphi Study is to eliminate expert confrontation that sometimes occurs in group settings and to develop consensus based on increasingly relevant information (Cunningham, 1982).

Differentiation: Responsive teaching that acknowledges student differences. It is an approach to teaching that is based on a philosophy that expects student differences in learning and proposes that teaching should be responsive to these differences. Differentiation refers to the utilization of different ways and means of imparting information for enhancing understanding.

Differentiated Instruction: Instruction, as delivered by a teacher, when he or she reacts responsively to a learner's interests, readiness, and learning profile to alter instruction in in content, process, or product for increased student understanding and mastery.

Differentiated Instructional Elements: Differing instructional components such as content, process, and/or product used by teachers to address student learning variances and to facilitate student mastery with the use of such as instructional elements as curriculum compacting, flexible grouping, varied instructional strategies, tiered assignments, learning contracts, higher-order questioning, problem-based learning, and assessment options.

Effective: Producing desired results, and/or more specifically for this study, producing "Exemplary" high school campus ratings, on the *Academic Excellence Indicator System (AEIS)*.

"Exemplary" Rating: According to the *Academic Excellence Indicator System (AEIS)* in Texas, the basic performance standards needed to achieve an "Exemplary" rating were a 90 percent or better passing rate in all *Texas Assessment of Knowledge and Skills (TAKS)* subjects for all students and all student groups that meet minimum size criteria, plus a completion rate of at least 95 percent, and an annual dropout rate for students of 2 percent or lower.

Expert: One who has acquired special skill in or knowledge and/or experience in a field

Flexible Grouping: A differentiated instructional element often utilized in which students are part of many different groups—and/or work alone, when needed—depending upon the task and/or content and based on the match of the learning task to student interest, readiness, or learning style. The goal of flexible grouping is to balance the need to teach students where they are and to provide them with opportunities to interact in meaningful and productive ways with a wide range of peers (Tomlinson, 2001).

High-Stakes Testing: Reference to state and national expectations regarding standardized test performance of students, who, in some grade levels, are not allowed to pass to the next grade (i.e., third grade) or exit (i.e., graduate) from high school if certain standardized tests are not passed by the student.

Interquartile Range (IQR): A statistical measure for the spread (dispersion) of a variable. The IQR is calculated by subtracting the First Quartile (Q1) from the Third Quartile (Q3). This value is used to measure the spread of the middle 50 percent of a variable's values.

Interest: Refers to topics that the learner may want to explore or that will motivate him or her to learn. Individuals learn in accordance with what they are interested in learning.

Learning Environment: The classroom conditions that set the tone and expectations for learning.

Learning Profile: Includes learning style (i.e., visual, auditory, tactile, or kinesthetic), grouping preferences (i.e., individual, small group, or large group), and environmental preferences (i.e., lots of space or a quiet area to work).

Learning Style: Preferred way of accessing learning.

Principal: The certified leader of a school campus who has had adequate campus and personnel training to assume the instructional leader role in a public school

Process: How students make sense of new information.

Product: How students show what they know and can do as a result of learning.

Readiness: Refers to the skill level and background knowledge of the learner. Generally, individuals learn in accordance with their inclination to do so.

School District: In Texas in 2009, there were 1,235 school districts and charter operators, the majority, of which, are independent school districts governed by a local school board.

Stability: The concept is that iterative polling of panelists continues until variability has stabilized so that there are little or no opinion changes.

Standards-Based Instruction: Instruction that is aligned with state or national standards as a reference so that the written, taught, and tested curriculum is measurable.

Student Performance: Measurable outcomes in areas such as percentage of students meeting expectations on the *Texas Assessment of Knowledge and Skills (TAKS)* test, drop-out and completion rates, attendance rates, graduation rates, and college entrance examination scores.

*Texas Assessment of Knowledge and Skills (TAKS)*: A statewide annual standardized assessment administered in Texas public schools in grades 3-11. The 11<sup>th</sup> grade assessment is also called the "Exit Level" test. A student must pass all four sections of the exit level test (English / Language Arts, Mathematics, Science, and Social Studies) and meet academic credit requirements to graduate from high school.

Tiered Assignments: A differentiated instructional element in which assignments are designed to instruct students on essential skills that are provided at different levels of complexity, abstractedness, and/or open-endedness.

### **Assumptions**

The following assumptions will be made:

1. The researcher-moderator will be impartial in collecting and analyzing the data gathered.
2. The persons to receive the survey will be the individuals who will complete the instrument.
3. The respondents surveyed will understand the scope of the study and the language of the instrument, will respond objectively and honestly, and will be competent in self-reporting.
4. Interpretation of the data collected will accurately reflect the intent of the respondents.
5. The Delphi methodology proposed and described herein offers a logical and appropriate design for this particular research project.

### **Limitations / Delimitations**

The following limitations / delimitations will be recognized:

1. The Delphi method should not be viewed as a scientific method for creating new knowledge; rather, it is a process for making optimum use of available information (Murphy et al., 1998, p. 5).

2. The scope of this study is delimited to the information acquired from the literature review, survey information, and participant interviews.
3. This study is delimited to a selected number of high school principals (34), with at least three years' experience, from "Exemplary" public high schools in Texas in 2009, categorized as 2A to 5A in enrollment by the University Interscholastic League.
4. This study is delimited to the "Exemplary" 2A to 5A public high schools in Texas in 2009 which were traditional / comprehensive in nature.
5. These selected Texas public high schools were rated as "Exemplary" by the 2009 *Academic Excellence Indicator System (AEIS)*.
6. The panel members' professional responsibilities may limit the amount of effort that each individual can invest in the decision-making process.
7. The process by which the panel arrives at consensus and stability remains largely unknown. It is uncertain whether the panel members alter their decision-making process as a result of careful reconsideration or due to conformity.
8. The strength of the findings depends largely on the backgrounds and perceptions of the panel members.
9. The findings of this study may only be generalized to the selected public high schools in this research study.
10. The results of a Delphi study are not easily generalizable to the overall body of high school principals, given the small number of respondents in this study.

## Methodology

Determining which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas, is the primary research focus of this study. The research methodology to be utilized to achieve this aim will be the Delphi technique (Murry & Hammons, 1995). The process of using the Delphi technique employs the use of iterative rounds of questionnaires which are sent to the research study participants to “systematically solicit, collect, evaluate, and tabulate independent expert opinion without group discussion” (Tersine & Riggs, 1976, p. 51) to reach consensus. Given that questions #5 through #8 of this study’s Round One questionnaire are structured statements to reflect the literature, rather than being open-ended, the Delphi process utilized in this study is considered to be modified, rather than conventional. Ultimately, the Delphi method should not be viewed as a scientific method for creating new knowledge; rather, it is a process for making optimum use of available information—whether that includes scientific data or the collective wisdom of experts (Murphy et al., 1998, p. 5).

Initially, a survey invitational letter and email—along with the *Differentiated Instruction’s Impact: Texas Principals’ Perceptions Survey*, a research packet of materials, and a stamped, addressed envelope—will be sent to qualifying panelists to request their participation in the research study. See Appendix A for the *Informed Consent* form, including the survey participation preference options. Contact information for principals of “Exemplary” public high schools in Texas for 2009 will be obtained via the online *Texas School Directory*. The *Informed Consent* form, as approved by Texas A&M University’s Institutional Review Board (IRB), is to be sent in order to inform



eligible principals of the study's guidelines and to obtain written consent and participation (Appendix A).

In addition, participants will be informed via the *Informed Consent* form's survey participation preference options that they may choose to participate, or not, (1) by receiving an emailed copy of the questionnaire and emailing their survey responses back to the researcher-moderator or (2) by completing the print copy of the questionnaire mailed to them and mailing their survey responses back to the researcher-moderator (Appendix A). The survey participation preference options will be included in the Round One research packet for each participant to communicate their preference as to how they wish to respond, or not, to the surveys: (1) emailed survey / emailed response return or (2) print copy survey / postal service return. At least two rounds of follow-up emails inviting research study participation will be sent, if needed, to those qualifying participants who do not promptly respond to the initial Round One questionnaire. In addition, a telephone call inviting research study participation will be made, if necessary, to those qualifying participants who do not promptly respond to the initial Round One questionnaire.

As panel experts, the eligible participants will be Texas high school campus principals who are employed on 2A to 5A 2009 "Exemplary" campuses. The high school campus principals participating in the research study will be selected in partnership with the Texas Education Agency (TEA) and the University Interscholastic League (UIL), using the criteria that (1) the campus will be an "Exemplary" rated public high school via the 2009 *Academic Excellence Indicator System (AEIS)*; (2) the high school will be a Texas public high school that is traditional and comprehensive in nature with a University Interscholastic League (UIL) conference designation for a school size

of 2A, 3A, 4A, or 5A; and (3) the campus principal will have at least three years' experience.

Specifically, then, the research study will consist of eligible principals who are qualified to serve as experts in the study, given they have been in a principal leadership role for at least three years on a 2A, 3A, 4A, or 5A Texas public high school campus that received an accountability rating of "Exemplary" in 2009.

Round One of the Delphi process will present respondents with a ten-question survey, with thirteen research-identified differentiated instructional elements presented in questions #5 through #8. Targeted high school principal survey participants will use the questionnaire's four-point Likert scale to rate—according to their perception as a principal—each differentiated instructional element's (found in questions #5 through #8) degree of effectiveness for improving student performance, using rank-order choices of a "4" (*significant*), "3" (*moderate*), "2" (*minimal*), or "1" (*none*). Question #1 on the ten-question survey consists of a principal profile question, which asks how many years each participant has been a principal on his or her high school campus. Question #2 requests that the participants identify the source(s) from which they have learned the most about differentiated instruction. Survey questions #3 and #4 ask participants about their teachers' frequency of usage of differentiated instructional elements during the 2008-2009 school year. The next set of survey questions (#5 through #8)—which represent the study's research-identified differentiated instructional elements—request that the participants rank—via a four-point Likert scale—the effectiveness of their teachers' usage of these research-identified differentiated instructional elements in improving their students' Spring 2009 TAKS performances. Extracted from the research on differentiated instruction, the survey questions, #5 through #8, address such

differentiated instructional elements as curriculum compacting, flexible grouping, varied instructional strategies, tiered assignments, learning contracts, higher-order questioning, problem-based learning, and assessment options within the contexts of content, process, and product. Then, question #9—an open-ended question—requests participants to identify what differentiated instructional elements that have not already been identified in existing research they perceive to be critical for student success. Finally, in question #10, panelists are asked to rate (on the four-point Likert scale) the impact of their teachers using differentiated instruction on their campus to improve their students' Spring 2009 *TAKS* performances, according to the principals' perceptions.

In Round One, the ten-question survey emphasizes questions #5 through #8 for which participants must rank each research-identified differentiated instructional element's degree of effectiveness for improving their students' Spring 2009 *TAKS* performances on a four-point Likert scale. The principals' responses to questions #5 through #8 will answer Research Question #1 in the study. The other question that is emphasized in Round One is open-ended question (#9), for which participants are asked to identify what differentiated instructional elements that have not already been identified in existing research they perceive to be critical for student success. The principals' responses to question #9, or lack thereof, will answer Research Question #2 in the study.

Round Two will inform each participant of the entire group's collectively ranked responses to the structured Round One questionnaire. Participant responses to individual survey questions in Round One which fell outside the interquartile range (IQR) of responses, as well as the mode, for the entire group will also be presented confidentially to individuals, along with the opportunity in Round Two for these panelists

to either maintain or change (with justification) any of their initial responses. In Round Two, panelists will be asked to choose to approve or change the prioritized list (according to degree of effectiveness) of research-identified differentiated instructional elements. Specifically, this prioritized list of the most effective differentiated instructional elements will be derived from the principals' Round One rankings of questions #5 through #8, using "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*), or "1's" (*none*) on the survey's four-point Likert scale. In Round Two, panelists will confidentially receive from the researcher-moderator the mode and interquartile range (IQR) of any of the research-identified differentiated instructional elements on the prioritized list from Round One for which panelists' responses may have fallen outside the interquartile range (IQR) and mode. Furthermore, responses to Round One's question #9 will be presented in Round Two. In Round Two, panelists may choose to maintain or modify (with justification) the ranked list of any additional differentiated instructional elements that have not already been identified in existing research that principals perceive to be critical for student success which were derived from Round One principals' responses.

Next, respondents will receive the groups' survey results, as well as their individual input, from Round Two in Round Three. Participant responses to individual survey questions in Round Two which fell outside the interquartile range (IQR) and mode for the entire group will be presented confidentially to individuals in Round Three, along with the opportunity for these panelists to choose to either maintain or modify (with justification) any of their Round Two responses. Confidentially, individual respondents will be asked to approve the Round Two prioritization of the list of most effective research-identified differentiated instructional elements or modify (with justification) their prior responses.

In each round, the prioritized list, ranked by degree of effectiveness, of the research-identified differentiated instructional elements will be presented for panelists' consideration, showcasing the mode, interquartile range (IQR), variance, and standard deviation of each of the elements. In each round, the prioritized list of most effective research-identified differentiated instructional elements will reflect the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*), or "1's" (*none*)—in descending order—as indicative of the principals' utilization of the four-point Likert scale. Round Three will also present from Round Two any added or edited differentiated instructional elements that have not already been identified in existing research that are perceived by principals to be critical for student success. In Round Three, participants will be presented with another opportunity to choose to approve the ranked list of additional differentiated instructional elements or modify it.

The iterative process will continue in the aforementioned format until convergence occurs to the point of consensus. The final Delphi round will occur after a consensus has been reached by the surveyed principals, in terms of which research-identified differentiated instructional elements they perceive to be the most effective in improving student performance. Similarly, the final Delphi round will occur after a consensus has been reached by the surveyed principals, in terms of whether there are differentiated instructional elements that have not already been identified in existing research that principals perceive to be critical for student success. Final prioritized lists of the most effective differentiated instructional elements will be distributed to the expert panel for review, followed by telephone interviews for verification and validation of input.

### **Significance Statement**

Since scant research exists on the effectiveness of differentiating instruction to improve secondary students' performance, the findings of this research study may contribute to evidence-based education and the current knowledge base by ascertaining which research-identified differentiated instructional elements are the most effective for improving student performance, according to principals of "Exemplary" 2A to 5A public high schools in Texas in 2009. Targeted principals' perceptions can be shared, relating their consensus of which research-identified differentiated instructional elements they perceive to be the most effective in improving student success. The implications of this research are that public high school principals in Texas on campuses—which are rated as "Exemplary" by the 2009 *Academic Excellence Indicator System (AEIS)*—will have a "practitioner proven model" for student success to share with others. The significance of a research study of this nature can also be found in that its conclusions will be invaluable for guiding professional development, as well as for principals and teachers seeking to improve their daily educational practices for student impact (Hallinger & Heck, 1996; Riehl, 2000).

Not only can the information from this study be shared with other campus principals and experienced teachers to impact practice, but it can also inform principal training and teacher preparation programs. Principal training programs must make a commitment to develop leaders who understand and value differentiated instruction because of its impact on student success. Moreover, with the findings from this research study, teacher preparation programs should be able to provide novice teachers with additional insights regarding what differentiated instructional elements are the most effective for addressing students' diverse academic needs. It can be argued

that introducing novices to student-centered views of instruction, providing them with practitioner models for implementing the most effective strategies, and giving them the tools and confidence to impact student success, early on, may be necessary to break the one-size-fits-all conception of teaching that many a novice teacher adopts just to survive (Tomlinson, Callahan, Moon, Tomchin, Landrum, Imbeau, Hunsaker, & Eiss, 1995). Research suggests that teacher preparation programs too often fall short in their efforts to prepare novice teachers for the inevitability of academically diverse classrooms (Tomlinson, Callahan, & Kelli, 1997). Tomlinson's (1999) research further reveals that, generally speaking, novice teachers seldom, if ever, experience differentiated instruction in their teacher education classes. Indeed, the quality of tomorrow's classrooms relies upon today's preparation of the next generation of teachers, so pushing the envelope to investigate which research-identified differentiated instructional elements are the most effective and, subsequently, implementing them in classrooms of academic diversity brings research into practice for student benefit. No doubt, ongoing studies to determine how best to meet student needs warrants more attention; there is no shortage of students with diverse academic needs (Leithwood & Riehl, 2003).

## **CHAPTER II**

### **REVIEW OF LITERATURE**

#### **Introduction**

The purpose of this chapter is to provide an overview of relevant literature related to differentiated instruction. There are eight major parts incorporated into this literature review. The first component considers the rationale for the practice of using differentiated instruction. Closely related, the second component examines the conceptual framework of differentiated instruction, while the third component highlights the theory and research that supports it. The fourth component of the literature review addresses learner variances in student readiness, interest, and learning profile. Furthermore, the fifth and sixth components discuss the research-identified elements of differentiated instruction. As extensions, the seventh component provides examples of research studies on differentiated instruction, while the eighth component reviews the Delphi Method as a research study design.

#### **Rationale for the Practice of Differentiation**

##### *Demographic Diversities*

The demographic reality of increasing classroom diversity remains a challenge for many educators at all levels. More likely than not, today's classrooms host students of both genders, students from broadly diverse cultures and economic backgrounds, students whose first language is not English, students with identified learning problems, students who are either advanced, struggling, or otherwise, and/or, at the very least, students with widely varying interests, preferred modes of learning, and different life



experiences who are seated side by side in classrooms that still harbor the myth of “homogeneity by virtue of chronological age” (Darling-Hammond, Wise, & Klein, 1999). Indeed, the homogeneity of yesteryear has been replaced by today’s demographics. Yet, while today’s classrooms are already typified by diversity, by 2035, increased numbers of students of color, as well as children of immigrant and migrant families, will expand the presence of cultural diversity on campuses, and half of all children will reside in single-parent homes at some point during their school life (Sapon-Shevin, 2000 / 2001).

#### *Current Educational Trends*

Moreover, these demographic diversities in the general classroom are further extended by current educational trends that mainstream students with special education needs and reduce special programs for gifted learners. No doubt, students with different ability levels have different needs. In many schools, students are heterogeneously grouped, but they sit in classrooms in which the content is too complex and/or abstract for struggling learners or the content is too superficial for the gifted students (Reis et al., 1992). Teaching the same way to students with different gifts and learning styles proves to be ineffective for both high and low achieving students (Rogers, 2002). Although it may be true that some gifted students may succeed in the classroom without any additional opportunities or enrichment, it does not necessarily imply that they will benefit from such environments. Frequently, these students receive assignments that they have already mastered in a prior school year and are forced to be “mere consumers of existing information rather than producers of knowledge” (Renzulli, 1988).

Much of the focus in schools these days is for teachers to “teach to the middle” to reach most of the students, but without appropriate challenges to their differing abilities, students on either end of the spectrum of achievement—or those in between—may never reach their full potential (Cloud & Thornburg, 2004, p. 56). All students deserve an education that corresponds to their capabilities and potential. Certainly, students with learning difficulties should be accommodated and not left behind, while students who are gifted and talented should also be accommodated and pushed forward. Each student—at whatever level of ability—needs to be given the knowledge and tools to reach his or her potential. “Differentiation is no longer an option but an obvious response” (Earl, 2003). Equality of opportunity and equity of education become a reality only when students receive instruction suited to their varied needs, thus enabling them to maximize their opportunities for growth (McLaughlin & Talbert, 1993).

#### *Charge to Practitioners*

Conclusively, the charge to practitioners is to address student needs in the interest of maximizing learning. Such student diversities in the classrooms of the land require teachers to address learner variance and to make adjustments in curriculum, resources, and support to promote educational equity and high-quality learning for all students. As the transformation of diversity in schools continues to evolve, principals will need to lead teachers in contemporary classrooms in modifying their teaching and learning routines to address a broad range of learners’ readiness levels, interests, and learning modalities (Tomlinson, 1999). Such routines may be referred to as “differentiating” curriculum and instruction (Tomlinson, 2001). According to Stradling and Saunders, 1993, “Differentiation involves a pedagogical, rather than an

organizational, approach” (p.135). Indeed, in recent years, differentiation has become a popular educational trend in classrooms across the nation. The implementation of differentiated instruction, moreover, has been driven, in part, by increasingly diverse student populations, the inclusion of special needs students into the general classroom, and limited attention to the needs of gifted students.

## **Conceptual Framework**

### *Social Constructivist Learning Theory*

Differentiation, typically defined as responsive teaching that acknowledges student differences, embraces the social constructivist learning theory of Russian psychologist, Lev Semenovich Vygotsky (1896-1934) as central to instructional enhancement, classroom change, and redevelopment (Goldfarb, 2000; Shambaugh & Magliaro, 2001; Kearsley, 2005). This working definition of differentiated instruction reflects Vygotsky’s sociocultural theory (1962), the main tenet of which emphasizes the social, interactional relationship between teacher and student (Tomlinson, 2004). The sociocultural theory of learning—with its premise that the learner must be studied within a particular social and cultural context—evolved primarily from the works of Vygotsky (1962) and has impacted teaching, schooling, and education for years (Tharp & Gallimore, 1988).

### *Zone of Proximal Development*

#### **Social Interaction and Cognition Development**

Generally speaking, this theory promotes social interaction as being fundamental to the development of cognition (Scherer, 2001). Vygotsky’s zone of

proximal development (ZPD), a central proposition of the sociocultural theory of learning, refers to a level of development attained when learners engage in social behavior (1978). Differentiated instruction views the learning experience as social and collaborative, involving teachers and learners, collectively (Tomlinson, 2004). Furthermore, differentiated instruction supports the classroom as a community focused upon accommodating differences (Lawrence-Brown, 2004).

### **Point of Optimal Learning**

More specifically, learners further develop their zone of proximal development—that is, the distance between a learner’s actual development level and their level of potential development—when they interact with knowledgeable mentors and/or with capable peers (Riddle & Dabbagh, 1999). Vygotsky (1978), who researched this phenomenon, stated it this way, “The zone of proximal development is the distance between what learners can do by themselves and the next learning that they can be helped to achieve with competent assistance” (p.15). Indeed, learning begins from a student’s point of readiness. Tomlinson (2004) cites the teacher as the professional in the classroom, who should be trained with appropriate techniques to assist each learner to reach his or her potential. The relationship between teacher and student should be reciprocal, according to Tomlinson (2004), with students responding to the teacher’s prompting. Within the learning environment created by the differentiated instruction model, teachers, support staff, principals, and other professionals collaborate to facilitate an optimal learning experience for students (Mulroy & Eddinger 2003).

### **Moderate Challenge**

According to Vygotsky (1962), in considering a student's zone of proximal development, teachers should design the difficulty of skills to be taught to be just beyond the range of a student's current level of mastery for learning to continue. According to Howard (1994), a learning experience stretches the learner beyond his or her independence. Tomlinson (2003) asserts that brain research purports that the brain downshifts into a protective response when the learner's brain ascertains that tasks are too difficult for the learner and, in addition, that the brain displays patterns mimicking sleep when the brain determines that tasks are too easy for learners. "When a student continues to work on understanding and skills already mastered, little if any new learning takes place; on the other hand, if tasks are far ahead of a student's current point of mastery, frustration results and learning does not" (Vygotsky, 1962, p. 23). Only when tasks are moderately challenging for an individual does the brain "think" in terms of learning (Tomlinson, 2003). "High expectations of success by all are matched by tasks that provide a high degree of challenge for the individual" (Csikszentmihalyi, 1997, p. 34).

### **State of Flow**

The zone of proximal development in an enhanced learning environment mirrors a situation in which an individual's skills and competencies intersect with moderate challenge so that a state of "flow" exists because the learning activity is just enough challenging to stretch the individual's limits (Csikszentmihalyi, 1990; Csikszentmihalyi et al., 1993; Whalen, 1998). Csikszentmihalyi (1990) refers to the state of "flow" as the

condition that exists when the learning task appropriately challenges learners so that they remain engaged in and excited about learning.

### **Linking Known to Unknown**

Furthermore, a learner's zone of proximal development links the "known" to the "unknown" as learning takes place (Riddle & Dabbagh, 1999). Accordingly, responsive instruction assesses what the learner already knows to determine what the learner needs to know next. Differentiation's design responds to students' progress on the learning continuum in order to bridge what students already know with what they need to learn (Heacox, 2002). Differentiated instruction adapts instruction to meet the specific needs of individual learners, providing them with the appropriate level of challenge and customized supports to help them continue reaching learning goals. Within this framework, this study considers the use of the differentiated instruction model to be a pedagogical instrument for facilitating the ongoing learning process. Building upon the theoretical foundations of constructivism and social learning within students' zones of proximal development, differentiated instruction—as an instructional model supported by theory and research—affords teachers and students, alike, opportunities to work and learn together (Joyce, Weil, & Calhoun, 2004).

### **Theory and Research Supporting Differentiated Instruction**

#### *Compilation of Educational Theories and Research*

A compilation of educational theories and research supports differentiated instruction. In some ways, differentiated instruction emanates from the work of constructivist John Dewey (1938) who advocated for teacher instruction to be aligned

with student needs. An important aspect of constructivism comes from the work of Piaget (1954, 1969) whose theory of cognitive development and his genetic epistemology studies purported that “knowledge comes neither from the subject or the object, but from the unity of the two” (Brooks & Brooks, 1993, p. 5). The basic idea of constructivism is that knowledge must be constructed within the learner (Piaget 1954). The construction of knowledge is a dynamic process that requires the active engagement of the learner (Piaget 1954). Piaget (1978) proposed that understanding developed in learners through the processes of assimilation (taking in new information) and accommodation (changing behavior to account for new knowledge), as associated with the construction of internal schemas for understanding their world. Vygotsky (1978) placed greater emphasis, however, on the role of social interaction, language, and discourse in the development of understanding to allow learners to scaffold each other’s learning and co-construct. Despite the differences between Piaget’s (1978) cognitive constructivism and Vygotsky’s (1978) social constructivism theories, both require peer interaction, which is typically a motivating context for pupils (Blatchford et al., 2003).

Furthermore, Betts’ work (1946) on differentiation focused upon what he referred to as “differentiated guidance,” which was grounded in the belief that continuous evaluation of individual strengths and weaknesses navigated the progression through developmental stages. Bruner (1961, 1966) another proponent of constructivism, also forged the way for the differentiated instructional model, which promotes an active, student-centered, meaning-making approach to teaching and learning. Beyond experiential evidence that uniformity in teaching fails many learners, evidence from both theory and research support movement toward teaching that is attentive to student

variance (Tomlinson, 2001). To this end, research suggests that students are more successful when taught in ways that are responsive to their readiness levels (Vygotsky, 1962, 1978, 1986), interests (Maslow, 1962, 1970; Csikszentmihalyi, 1990, 1997), learning profiles (Sternberg et al., 1998), and motivational catalysts (Deci & Ryan, 1985).

### *Brain Research*

Additional bodies of research worth mentioning that support differentiated instruction include brain-based research, learning styles, and multiple intelligences. “Brain-based instruction is cognizant of the brain’s natural learning system” (Greenleaf, 2003, p.15). Brain research suggests that students should be appropriately challenged, working with content that is neither too difficult nor too easy (Tomlinson & Kalbfleisch, 1998, p.54). Current brain research (Howard, 1994; Jensen, 1998; Sousa, 2001, Wolfe, 2001) claims that students should work at a level of moderate challenge for learning to occur. Indeed, “learning is enhanced by challenge and inhibited by threat” (Caine & Caine, 1991, p. 18). Furthermore, making meaning of the ideas and skills presented in the classroom through relevant association has significant implications for learners in a differentiated classroom, according to brain-based research (King-Friedrichs, 2001, p. 77). The brain seeks meaningful patterns and resists meaninglessness; it seeks to connect parts to wholes, with “individuals learning by connecting something new to something they already understand” (Caine & Caine, 1991, p.41). “Learning is the construction of understanding and application which requires that individuals make their own meaning” (Corley, 2005, p.22). Brain research purports that each learner’s brain is unique, and educators must provide diverse opportunities for varied learners to make



sense of ideas and information to extract meaning (Caine & Caine, 1991). Thus, teachers should use this brain research relative to student learning needs and provide different challenging experiences for students for them to construct understanding by making connections and meanings from experiences.

### *Learning Styles Research*

Learning styles research also supports differentiated instruction and presents the varied learning preferences that students use to receive and/or process information in the learning process. Learning styles theory suggests that individual preferences related to environment, physical needs, emotions, interactions, and/or such factors as light, temperature, seating arrangements, degree of learner mobility, time of day, and perceptual mode impact learning (Dunn, 1996). New evidence continues to emerge to support the premise that an awareness of different learning styles is a significant tool for understanding student variance (Strong, Silver, & Perini, 2001, p. 58). Teachers, equipped with models of education based on learning styles, are better able to accommodate learner preferences and facilitate student achievement (Strong, Silver, & Perini, 2001, p.59). In fact, research shows that being able to identify and accommodate a student's learning style can facilitate student achievement (Green, 1999, p. 684). Sullivan's (1993) meta-analysis of research on learning styles reported that addressing a student's learning style through flexible teaching results in improved student achievement across a wide range of cultural groups. Fine (2003), as well, reported a significant gain in special education students' test scores when their preferred learning style was utilized during instruction. Indeed, learning styles research supports

differentiation with its emphasis upon facilitating student learning via varied learning style approaches to instruction rather than with traditional teaching methods.

### *Multiple Intelligences Research*

Differentiating opportunities for all learners by enriching the classroom through addressing students' multiple intelligences capitalizes upon students' strengths in the learning process. Supportive of differentiation, Gardner's (1983, 1993) multiple intelligences (MI) theory focuses primarily upon eight intelligences (verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, musical, interpersonal, intrapersonal, and naturalist). Moreover, students' multiple intelligences serve as tools for learning and problem solving (Campbell & Campbell, 1999; Gardner, 1993). In addition, research by Sternberg (1996, 1997) proposes that individuals have proclivities for one of three modes of thinking: analytical, practical, or creative, and, in fact, when matched with their intelligence preferences, they achieve academically at significantly higher rates than comparable students whose instruction is not matched to their intelligence preferences. Research indicates that learners achieve better when instruction addresses their preferences (Sternberg, 1997). Ultimately, teachers who implement differentiation as their classroom model of instruction in order to address student needs can find support for their instructional choices via brain-based, learning styles, and multiple intelligences research. Moreover, differentiated instruction presents an effective means to address learner variance (Tomlinson, 2001), avoids the pitfalls of the one-size-fits-all curriculum, (McBride, 2004), incorporates current research (Tomlinson, 2003), while supporting students' multiple intelligences and varying learning styles (Lawrence-Brown, 2004). Overall, a wide variety of research studies point to

differentiated instruction as a manageable, creative, practical, and proactive response to the quest for enhanced student engagement and achievement in the face of student diversity.

### **Learner Variance in Readiness, Interest, and Learning Profile**

One of the greatest challenges for a teacher is to address the learning needs of all students in a classroom while moving them toward high levels of achievement. Differentiated instruction can be employed to serve students at all levels of readiness, interest, and learning profile. Evidence indicates that students are more successful in school if they are taught in ways that are responsive to their readiness levels (Vygotsky, 1986), their interests, (Csikszentmihalyi, 1990), and their learning profiles (Sternberg et al., 1998). Tomlinson (2005), a leading expert in differentiation, defines differentiated instruction as a philosophy of teaching based on the premise that students learn best when their teachers accommodate their differences in readiness levels, interests, and learning profiles (p. 25). Building on this definition, Mulroy and Eddinger (2003) purport that differentiated instruction emerged within the context of increasingly diverse student populations. To this end, Tomlinson (2000a) maintains that differentiation is not just an instructional strategy; rather, it has evolved into an innovative way of thinking about teaching and learning to meet student needs. Differentiation encourages teachers to shift their thinking from completing the curriculum to catering to individual student needs (Tomlinson, 1999). “When teachers recognize diversity in their students, in terms of how and what they identify with and how they learn, and when this recognition is reflected in how teachers teach, students are free to discover new and creative ways to solve problems, achieve success, and become lifelong learners” (Ferguson et al., 2005, p.

12). To differentiate instruction, then, is to acknowledge variance in students' life experiences, languages, readiness levels, interests, and learning profiles and to shape instruction to accordingly (Hall, 2002). Therefore, in a differentiated classroom, teachers should attend to students' differences in readiness, interest, and learning profile to maximize their learning potential.

### *Student Readiness*

Differentiation in response to student readiness is grounded in Vygotsky's central proposition of the sociocultural theory of learning; namely, the zone of proximal development (1962). This term refers to the point of required mastery in which a task is slightly more complex than a student can manage alone without support from a mentor or teacher. Indeed, humans learn best with moderate challenge (Csikszentmihalyi et al., 1993; Jensen, 1998; Tomlinson, 2004). "Challenges ... must be at the proper level of difficulty in order to be and remain motivating: tasks that are too easy become boring; tasks that are too difficult cause frustration" (National Research Council, 1999, p. 49).

Readiness refers not only to the degree of background knowledge and skill level of the learner, but also to the point of entry to learning of each student (Tomlinson, 2000a). In other words, it is influenced by a student's cognitive proficiency as well as prior learning, life experiences, and attitudes. "Differentiation is making sure that the right students get the right learning tasks at the right time" (Earl, 2003, p. 86). Some students are typically at their grade level, while others are either below or above it (Tomlinson, 2001). The primary aspect of differentiation in terms of readiness is to begin instruction where students are. Teachers should begin where students are, not

the front of the curriculum guide. Teachers should assess the evolving readiness levels of their students and provide tasks that are appropriate for their students' readiness levels. The approach of using single tasks for all learners of varying readiness levels with only occasional modifications, however, fails for many students, generally speaking, because the task itself is outside their zones of proximal development, and minor modifications do not correct the mismatch; research related to readiness supports this conclusion (Byrnes 1996). On the other hand, research indicates there is a positive relationship between student achievement and a teacher's ability to diagnose each student's skill level in order to prescribe appropriately challenging tasks via readiness differentiation (Fisher et al., 1980; Weinbrenner, 2002). No doubt, student readiness levels vary widely and are keys to student learning.

### *Student Interest*

Theory and research also supports modifying instruction to elicit student interest as a means of enhancing motivation, productivity, and achievement (Amabile, 1996; Torrance, 1995). Topics that evoke curiosity and passion spark interest in students so that they desire to invest their time, energy, and effort to learn. Teachers can gain insight into student interests by taking interest inventories, through informal conversations, and from classroom dialogue (Learning Point Associates, 2005). Students are more likely to be engaged and persist in learning when their interests are tapped (Maslow, 1962; Csikszentmihalyi, 1990; Sousa, 2001; Wolfe, 2001).

Linked to motivation, interest-based study appears to promote positive impacts on learning (Hebert, 1993; Renninger, 1990; Tobias, 1994). Research shows students display a higher level of intrinsic motivation, as well as a higher degree of autonomy,

when interacting with tasks that interest them, which leads to more engagement, greater creativity, and increased productivity (Bruner, 1961; Sharan & Sharan, 1992; Amabile, 1996; Collins & Amabile, 1999). While learners differ in general motivation to learning and in response to specific tasks, experts suggest that they be encouraged to select their own topics, when warranted, for projects (Collins & Amabile, 1999). In essence, when students enjoy tasks, they typically continue seeking cognitive stimulation (Gottfried & Gottfried, 1996). Interest proves to be a catalyst for sustaining academic focus (Csikszentmihaly et al., 1993).

Providing opportunities for all students, even struggling learners—who also have passions and aptitudes—to explore and express their interests, mitigates against the sense of failure previously experienced, perhaps, by many of these students (Lawrence-Brown, 2004). Tobias (1994), in his research studies, concludes that adapting instruction to the interests of students positively impacts academic development. Differentiated instruction reflects the belief that students learn best when they make connections between the curriculum and their diverse interests and experiences. Teachers can instill the value of academics by relating lesson topics to past experiences, life outside of school, and/or involving learners in tasks that reflect civic or work-related responsibilities (Caskey & Anfara, 2007). No doubt, teachers should find ways to engage students by tapping into their interests and life concerns (MacGillivray and Rueda, 2001). Researchers agree that in order to facilitate students in addressing learning tasks, particularly those of increased complexity, teachers should springboard from their interests (Tomlinson & Allan, 2000). Indeed, tapping into student motivation—frequently driven by student interest—shapes interest-based differentiation.

### *Student Learning Profile*

In addition, differentiation of instruction as a response to variance in student learning profile benefits all students. A student's learning profile refers to his or her preferred mode of learning, which can be impacted by gender, learning style, intelligence preferences, and culture (Tomlinson, 2003). It profiles how a student learns best. Some students, for example, prefer logical or analytical approaches to learning, while others prefer creative, application-oriented lessons (1999). A meta-analysis of research on learning styles (Sullivan, 1993) reported that addressing a student's learning style through flexible teaching results in student achievement gains.

Learning styles theory purports that each individual has his or her own way of mastering new and difficult subject matter, whether the person's learning style is visual, auditory, or tactile-kinesthetic; personal learning style also includes grouping preferences, as well as environmental preferences (Dunn, 2000; Dunn, Denig, & Lovelace, 2001; Barrell, 2001). Generally, auditory learners typically prefer assignments that allow them to listen to instructions and then to work logically and sequentially on tasks, while visual learners usually like learning from sight, followed by opportunities to develop products. Tactile-kinesthetic learners generally learn best from a hands-on approach (Dunn, Denig, & Livelace, 2001). If attentive to student learning style preferences, teachers can develop learning opportunities to foster either independent learning or various types of group learning within varying classroom environments (Tomlinson, 2001; Lawrence-Brown, 2004).

Research points to orientation of the learning environment as a critical factor for motivating and engaging students. Specifically, the classroom that is task-oriented and focuses upon effort and improvement—rather than the one that is performance-oriented

and emphasizes ability relative to others—is the classroom in which there are greater levels of student engagement and achievement (Brewster & Fager, 2000). Furthermore, “a student’s ‘functioning’ in school is inextricably linked with his or her sense of belonging and connection to the school environment and his or her relationships with peers and teachers within it” (Schonert-Reich, 2000, p. 62). Students must feel safe in their learning environment, according to Tomlinson and Kalbfleisch (1998), rather than experiencing discomfort from pressure, intimidation, rejection, humiliation, and/or failure in the classroom. No doubt, a safe non-threatening, respectful student-centered environment is vital to student achievement.

Because differentiated instruction enables teachers to individualize the learning environment to better respond to students’ needs within their learning profile, it can provide a nurturing environment for student voice to develop and grow (Tomlinson et al., 2008). Making time to glean student input and solicit feedback affords teachers an opportunity with differentiated instruction to cultivate student voice. Hosting student discussions, assigning dialogue journals, providing guided student choices for tasks, offering problem solving, arranging for student meetings, and soliciting student consensus are some of the ways teachers can foster student voice (Tomlinson et al., 2008). Thus, teachers who differentiate are those who consider student learning preferences, abilities, styles, and interests—even student voice—and then create safe classroom climates that build student connections and comfort levels into the learning environment to encourage both academic and personal growth (Barrell, 2001).

The body of research from Saxe (1990), as well as Grigorenko and Sternberg (1998), claims there are achievement benefits to addressing differing learning styles and intelligence preferences during the learning process. Specifically, Sternberg and



Grigorenko (1998) assert that traditional instruction limits the likelihood of academic success for many students, while usage of instructional approaches that help students capitalize upon strengths and compensate for weaknesses increase student achievement on a variety of measures. Teachers in differentiated classrooms work with pupils continuously so that they are in a position to know pupils' interests and abilities; the needs of the pupil are important to consider in teaching and learning (Ediger, 1996). To this end, teachers utilizing differentiated instruction should take notice of student variance in gender, learning styles, intelligences, as well as cultural background in order to plan their content and process of instruction, accordingly, to facilitate student achievement.

An objective of effective instruction—indeed, of differentiated instruction—would be to have flexibility in a teacher's mode of presentation and in a student's learning options—including availability of choices for learning—so that a student could generally find a match for his or her learning profile preferences in order to be more successful in learning. "A readiness match maximizes the student's chance of appropriate challenge and growth; an interest match heightens a student's motivation and engagement; a learning profile match increases efficiency of learning" (Tomlinson, 2004, p. 34). When teachers offer different modes of learning, more students successfully complete learning tasks (Sternberg et al., 1998; Campbell & Campbell, 1999). Differentiated instruction is an approach to teaching that acknowledges that learners have multiple paths for learning and making sense of ideas (Tomlinson & Allan, 2000; Willis & Mann, 2000; Sizer, 2001; Tomlinson, 2001; Hall, 2002; Tomlinson & McTighe, 2006). Ultimately, teachers using differentiated instruction in order to meet student needs

implement different approaches to content, process, and product applications in response to student differences in readiness, interest, and learning profile.

### **Research-Identified Elements of Differentiated Instruction**

Three cornerstone elements guide differentiated instruction: content, process, and product. In response to differing learner characteristics of readiness, interest, and learning profile, teachers can differentiate content, process, and product (Tomlinson, 1999, 2001, 2003). Moreover, differentiated instruction allows for student variance as teachers plan their content, implement process, and provide for differing products to be proof of student mastery. Furthermore, differentiation spurs teachers to shift thinking from completing the curriculum to addressing student needs in the learning process (Tomlinson, 1999). Engaging students actively in the learning process and in the content allows them “to see learning as a cumulative whole” (Coleman, 2001, p. 26). Indeed, a relevant curriculum relates content to students’ daily lives, concerns, experiences, and social issues.

#### *Differentiation of Content*

##### **Content Guides Differentiation**

Content—the first of the three cornerstone elements that guide differentiation—involves what students need to learn: the major concepts, principles, and skills that are taught (Corley, 2005). It refers to the concepts, principles, and skills that teachers want students to learn (Willis & Mann, 2000). According to Hall, Strangman, and Meyer (2003), the content “may include acts, concepts, generalizations or principles, attitudes, and skills” (p. 89). Content—whether that is curriculum, topics,

concepts, or themes—is often dictated by a course of study based on average performance at grade level. Furthermore, teachers must navigate students through a learning path that takes into account district and/or state content knowledge standards, the corresponding assessments of that knowledge, and full inclusion policies that expand the range of students' academic needs (Roberts & Inman, 2007).

### **Major Concepts and Generalizations**

Students benefit when teachers differentiate major concepts and generalizations for differing student abilities and needs (Tomlinson, 2004). Depending upon where students are in their learning process, it might be necessary for the teacher to break assignments into smaller, more manageable parts that include structured instructions for some students to improve their access to the content. Teachers should adjust the degree of complexity using diverse instructional resources and processes to teach the content so that students can learn where they are and be able to proceed to different places, according to their learning needs (Tomlinson & McTighe, 2006).

### **Equitable Access**

All students should be given access to the same core content; it is the complexity of the content that should be adjusted (Tomlinson, 2000b; 2001). All students need equitable access to the same content (the non-negotiable), but should be allowed to learn and master concepts within the content in the way that works best for them (the negotiable). When a teacher differentiates content, he or she might adapt what he or she desires his or her students to learn and/or how students will gain access to the knowledge or skills to be learned, while still guiding all students toward the same

objectives and standards (Anderson, 2007). For example, teachers might choose broad instructional concepts and skills to be taught that lend themselves to student understanding at various levels of complexity (Heacox, 2002). Namely, specific lessons in all subjects can be differentiated by varying the levels of complexity to meet students' needs.

### **Variety of Instructional Resources and Materials**

Content can be differentiated by providing a variety of resources and materials, in addition to the standard text, at varied student ability or grade levels within one classroom (Tomlinson, 2001). Using reading materials that address course content below and/or above grade levels, for example, is a common way to differentiate content. Furthermore, designers of differentiated instruction view the alignment of tasks with instructional objectives and learning goals to be a key for student academic growth (Tomlinson, 2001).

### **Pretest and Posttest for Curriculum Compacting**

Differentiating content by diagnosing student skills and understandings, then matching learners with appropriate learning activities, helps teachers determine students' entry points of learning—as well as their next steps. For some teachers, a most important step in differentiated instruction is to determine what students already know so as not to teach material students have already mastered. Once a teacher knows what each student “knows” and what he or she “needs” in order to learn, differentiation is no longer an option; it is an obvious response (Earl, 2003). Indeed, teachers should pretest students to determine their prior mastery levels in order to

determine the approach to further learning for them. With curriculum compacting, in fact, instruction is adjusted to account for prior student mastery of learning objectives (Reis & Renzulli, 1992). Curriculum compacting is a differentiated instructional strategy which uses the process of adjusting instruction—frequently based upon the outcomes of utilizing pretests and posttests—to determine student learning or mastery needs. Compacting involves a three-step process: (1) assessing the student to determine his or her level of knowledge to determine that which he or she still needs to master; (2) implementing learning plans for what the student needs to know, yet excusing the student from studying that which he or she already knows; and (3) creating plans for available time to be spent in enriched, extended, and/or accelerated study.

### **Assessment Informs Instruction**

In addition to the pretests and posttests that teachers administer, some models of differentiation have students self-assess daily via journal entries, rubrics, and/or oral defense, for instance, to ascertain the entry points of learning for themselves (Nunley, 2004). Differentiation of content offers students the opportunity to start at different places in the curriculum and to proceed to different places, if needed. Testing, after lesson applications, allows teachers to make determinations regarding students' mastery levels in order to move forward with the learning process to the next levels. According to Tomlinson and McTighe (2006), "the teacher who emphasizes assessment to inform instruction understands that only by staying close to student progress can he or she guide student success" (p. 32). Ultimately, meaningful pretests and posttests can lead to successful differentiation by producing findings that communicate student learning needs.

### *Differentiation of Process*

#### **Process Guides Differentiation**

Process—the second of the three cornerstone elements that guide differentiation—refers to the instructional strategies and learning activities that help students make sense of—and come to own—the ideas, concepts, and skills being taught (Willis & Mann, 2000). When teachers differentiate instruction, they can vary not only the resources and materials students use, but also the way students interact with them. “Varying instructional activities allows all students to learn the same concepts and skills with varied levels of ‘support, challenge, or complexity’ ” (Tomlinson, 2000a, p. 6).

#### **Learner Variance**

Differentiating process also implies allowing students to access instruction in different ways by means of a variety of materials and resources that target different learning preferences, as well as having access to activities that vary in level of complexity and degree of abstract thinking. Differentiating process translates to varying learning activities or strategies to provide appropriate avenues for students to explore the lesson concepts. It is important to give students alternative paths to manipulate and experience the ideas and concepts embedded within the lesson. For example, students might use graphic organizers, maps, diagrams, or charts to display their understanding of concepts introduced by the teacher (Tomlinson, 2003). Varying the complexity of the graphic organizer could facilitate differing levels of cognitive processing for students of differing ability (Sternberg, 1996). Therefore, acknowledging students’ different modalities of learning profiles and learning inventories (Dunn et al.,

2001), cognitive dimensions (Sternberg, 1996), and multiple intelligences (Gardner, 1983, 1993) by differentiating process can facilitate student achievement.

### **Variety of Instructional Strategies**

Teachers can use a variety of instructional strategies to address learner variances (Tomlinson, 1999). Some differentiated instructional strategies recommended by Tomlinson (1999) are:

- Chunking, or breaking assignments and activities into smaller, more manageable parts, and providing more structured instructions for each part;
- Using entry points (Gardner, 1994) so that learners can explore a topic through as many as five avenues: (1) Narrative (presenting a story); (2) Logical-Quantitative (using numbers or deduction); (3) Foundational (examining philosophy and vocabulary); (4) Aesthetic (focusing on sensory features); and/or (5) Experiential (hands-on).
- Using flexible pacing to allow for variance in students' ability to master key concepts within a certain timeframe;
- Setting up learning (interest) centers (or stations) in the classroom where different learners can work;
- Encouraging independent study for students who want to work on their own on topics of interest to them

Good (2006) recommends that a teacher plan several activity options so that he or she can work with the whole class, small groups, individual students, or a combination of all three. When a teacher introduces content, for example, he or she might address all students as a whole group, using artifacts in addition to lecturing. At a different time, a

teacher might ask most of the students to work in pairs or independently while he or she assists a small group of students who needs to work on critical thinking and understanding. Small groups can be arranged by achievement levels, for instance, but they can also be grouped by a common interest or student need (Willis & Mann, 2000).

### **Flexible Grouping**

A specific grouping strategy utilized to differentiate process is flexible grouping. Teachers incorporate flexible grouping opportunities based upon students' readiness, interests, and learning profiles (Lou et al., 1996; Tomlinson, 2003). Flexible grouping is a differentiated instructional element often utilized in which students are part of many different groups—and/or work alone, when needed—depending upon the task and/or content and based on the match of the learning task to student interest, readiness, or learning style. The goal of flexible grouping—whether collaborative or independent, as well as heterogeneous or homogeneous—is to balance the need to teach students where they are and to provide them with opportunities to interact in meaningful and productive ways with a wide range of peers (Tomlinson, 2001, 2003). This strategy affords students the opportunity to work with a variety of peers and keeps them from being labeled as advanced or struggling. It is essential for teachers to provide clear communication regarding group guidelines to facilitate student success. The expectations are for learners to interact and work together as they develop knowledge and skills relative to new content (Hall et al., 2003).

Student groups may be coached from within groups or by the teacher to complete assigned tasks. Grouping and regrouping serves as a dynamic process, changing with the content and student need (Hall et al., 2003). For example, after



teaching a lesson, a teacher might assign some students to small ability groups—based upon their readiness level—and give each group a series of questions, while creating other student groups—grouped according to their learning styles—to address their assignments (Anderson, 2007). The primary reason for establishing the different groups is that the students are at different levels of readiness and learn in different ways, so the teacher needs to teach them differently for them to be successful.

### **Scaffolding and Tiered Assignments**

Differentiating the process dimension of learning experiences allows students to study the same concept but at levels that match their readiness and abilities (Roberts & Inman, 2007). Teachers can provide activities at different levels of difficulty, such as tiered assignments, to build upon students' varying degrees of prior knowledge and skill mastery, in order to scaffold their learning (Tomlinson, 2003). Student placement within a tier is based upon a preassessment score that measures background knowledge and skill level (Richards & Omdal, 2007). A tiered assignment is a differentiated assignment that is designed to instruct students on essential skills that are provided at different levels of complexity, abstractedness, and/or open-endedness. Teachers can modify these activities, of course, to provide some students with more complexity and others with more scaffolding, depending upon their readiness levels (Tomlinson, 2001). Tiered instruction assists learners with minimal prior knowledge and low level skills to experience meaningful academic growth, while it provides learners with above average background knowledge and high level skills the opportunity to go beyond the basics to add depth, complexity, and new applications to the content (Richards & Omdal, 2007).

With scaffolding, the teacher models the desired learning task, provides support to the student, and then gradually shifts the responsibility for learning the task to the student. Effective scaffolding occurs in a student's zone of proximal development (Vygotsky 1962, 1978). Examples of scaffolding include step-by-step instructions, reteaching, and additional models, if needed (Willis & Mann, 2000). Scaffolding in class discussions occur when the teacher adjusts questions, using the levels of Bloom's (1956) taxonomy that are more abstract and complex (Learning Point Associates, 2005). Assignments, activities, homework, writing prompts, experiments, and/or assessments are other examples of potentially tiered and/or scaffolded instruction. Based on the existing knowledge and skill level of the learner, tiered and/or scaffolded instruction provides students the opportunity to gain additional knowledge and skills at a pace better suited to their instructional level (Richards & Omdal, 2007). By keeping the focus of the activity the same, but providing different access routes at varying degrees of difficulty, the teacher maximizes the likelihood that each student is successful with the challenge of new learning (Vygotsky, 1986; Tomlinson, 2003).

### **Student Choice**

Yet, another instructional strategy to differentiate process is to grant students choices in completing their tasks. Using choice boards from which learners can select one of several assignments that are printed on cards and affixed to the choice boards is a way to differentiate process for students (Corley, 2005). Choice boards are organizers that contain a variety of activities from which students can choose an assignment to complete—or a product to develop—as they learn about particular

content and/or acquire or refine a skill. These boards can be set up so as to address students' readiness, interests, and learning styles (The Access Center, 2005).

“Adolescent learners sometimes perceive that they experience a world of rules imposed on them by adults who seem not to understand their world” (Learning Point Associates, 2005, p. 5). Therefore, providing opportunities for students to make choices regarding their learning acknowledges their need to exercise more decision-making power. In fact, they need practice and experience working with a prescribed range of choices before they will be able to make informed choices independently. Indeed, having a choice in their learning builds confidence and fosters independence among students.

### **Learning Contracts**

Another vehicle for student choice in the learning process is a learning contract, which is an agreement between the teacher and the student (Tomlinson, 2001). “The teacher specifies the necessary skills expected to be learned by the student and the required components of the assignment, while the student identifies methods for completing the task” (The Access Center, 2005, p. 43). This instructional strategy, which affords students choice, allows them to work within their own learning styles at an independent pace. According to Deci and Ryan (1985), students are intrinsically motivated if they are given opportunities to choose tasks to complete. By allowing students to choose among the assignments provided, rather than telling students which assignments to complete, teachers find students to be more successful in learning (Deci & Ryan, 1985).

### **Higher-Order Questioning Techniques**

Teachers can also engage students in varying degrees of higher-order questioning techniques as a means of differentiating process (Rosenshine et al., 1996). Indeed, learning the art of questioning facilitates the overall learning process. In class discussions, teachers can vary the kinds of questions posed to learners based upon their readiness, interests, and learning styles. In particular, questions that are adjusted to match a learner's readiness, interest, and/or learning profile will target each student as they seek to master the learning goals. Closed-ended questions check student knowledge, while open-ended questions check student understanding (Anthony & Raphael, 1987). Generally, teachers should adjust questions to students' thinking levels. Usually questions at the lower levels, based on Bloom's (1956) Taxonomy, are appropriate for:

- Evaluating students' preparation and comprehension;
- Diagnosing students' strengths and weaknesses;
- Reviewing and/or summarizing content

On the other hand, questions at the higher levels, based on Bloom's (1956) Taxonomy, are appropriate for:

- Encouraging students to think more deeply and critically;
- Problem solving;
- Encouraging discussions;
- Stimulating students to seek information on their own

Indeed, high-level questions, such as those that begin with "why," can prompt students to probe and explain their thinking. A typical high-level question asks students to justify how they solved a problem. "Justifying a solution requires the student to look beyond

the right answer and defend how he or she knows that the answer is correct“ (Pashler et al., 2007, p. 2).

One technique used to develop questions at all thinking levels is question frames. These question frames provide teachers with question springboards—based upon Bloom’s (1956) Taxonomy—and assist teachers in knowing the level of questions they are asking and determining what question is most appropriate to ask to elicit a particular type of student response (Anthony & Raphael, 1987). Socratic questioning is another technique for developing questions. Socratic questions can be used to develop students’ critical thinking skills because they are used to clarify, evaluate, process, and store relevant information, as well as to discover reasons and viewpoints (Rosenshine et al., 1996). The ultimate goal is for students to learn to ask themselves and their peers high-level questions in order to assess and build their own understanding.

### **Problem-Based Learning**

Teachers can present students with opportunities to solve relevant problems at different levels of complexity as a means of differentiating process, as well (McDaniel & Schlager, 1990). Based on the premise that people are naturally curious, problem-based learning gives students the opportunity to use higher-order thinking skills (Ediger, 1998). According to Wiggins (1993), thinking or problem solving should be a major focus for instruction. An instructional technique that can improve motivation to learn, inquiry-based learning allows the student to use information constructively; that is, to analyze and generalize, as well as make decisions—not merely to take in information and pass it back, verbatim (Fogarty, 1997). Inquiry-based learning is based upon the

scientific method and helps students develop critical thinking and problem solving skills (Fogarty, 1997).

Problem-solving, at its best, is student-centered, requiring students to conduct investigations independent of the teacher, unless otherwise directed or guided through the process of discovery. Students create knowledge and understanding through learning activities built around intellectual inquiry and a high degree of engagement with meaningful problems (McGrath, 2003). Indeed, problem-solving is itself a type of learning. Differentiated instruction makes it possible for the teacher to include authentic instruction by using problem-based learning and by bringing relevant and meaningful application into the classroom (Lawrence-Brown, 2004). If teachers give students interesting and challenging problems to work on—problems that pique their interest and are relevant to their lives—they are more likely to acquire higher-level reasoning and problem-solving skills that are the prerequisites for success in real life (Treisman, 1992).

While there are other examples of instructional strategies to use to differentiate process, the key for teachers to choose the “right” strategy is understanding students’ academic needs and capitalizing upon their strengths (Willis & Mann, 2000). Problem-based projects can be designed to allow students with a variety of different learning styles to demonstrate their acquired knowledge (McGrath, 2003). Process, specifically, refers to the different ways in which content can be taught in differentiated instruction.

### *Differentiation of Product*

#### **Product Guides Differentiation**

Product—the third of the three cornerstone elements that guide differentiation—refers to the culminating projects that students complete, by which they demonstrate,

extend, and show mastery. Products entail students' demonstrations of their understanding of content and show whether they can apply the knowledge gained. Worthwhile projects assist pupils in clarifying the abstract in project form (Ediger, 1995). Teachers of differentiated instruction offer students a choice of projects that reflect a variety of learning styles and interests. Different students can then create different products, according to Tomlinson (2001), based upon their readiness levels, interests, and learning preferences.

### **Product Choices**

Product differentiation means that students have some variety and choice in how they will demonstrate what they have learned, whether they prove mastery to peers, the teacher, and/or other audience (Tomlinson, 2003). Students should be given a choice of four or five different products from which they may select to demonstrate mastery; in addition, they should be allowed to choose to work alone or in a group (Tomlinson, 1999). According to Deci and Ryan (1985), providing students different assessments from which to choose increases their motivation to complete a product. In differentiated instruction, students could typically be given a choice of products from which to choose to demonstrate mastery, including reports, oral presentations, group discussions, models, games and/or events (Tomlinson & Eidson, 2003).

### **Assessment Options**

Differentiating the product also means varying the complexity of the product. Students working below grade level might have reduced performance expectations, while students above grade level might be asked to produce products that require more

complex, advanced thinking (Tomlinson, 2000a). Products allow students to demonstrate whether they have learned the key concepts and skills of an educational unit, as well as apply their learning to solve problems (Tomlinson, 2001). In a differentiated instruction classroom, teachers give students assessment options from a variety of product choices for demonstration of mastery (Tomlinson & McTighe, 2006). A classroom in which differentiated instructional products are utilized is a learner-responsive, teacher-facilitated classroom where all students have the opportunity to meet curriculum objectives (Tomlinson, 2001).

When an educator differentiates assessment by product or performance, he or she is affording students various ways to demonstrate what they have learned (Nunley, 2006; Anderson, 2007). Since students must be accountable for their learning, regular assessment of students is essential when differentiating instruction. In addition, teachers must measure academic growth to determine if differentiated instructional strategies are working or need to be amended. Teachers who effectively teach all their students not only stay focused on teaching challenging academic content that is differentiated for their learners, but they also vary the instructional materials and strategies for students. They also give students options for demonstrating mastery, with these options allowing for another form of differentiation (Tomlinson, 1999).

### **Self-Assessment**

Allowing students to self-assess their work, says Costa and Kallick (2004), affords them the chance to self-monitor, self-manage, and self-modify. Over time, students advance in learning as they develop self-monitoring skills when they realize they do not understand something and must decide what to do next. “Students, as



active, engaged, and critical assessors, can make sense of information, relate it to prior knowledge, and master the skills involved” (Earl, 2003, p. 25). Involving students in the evaluation process shifts the focus of assessment from measuring learning to promoting learning (Stiggins, 2004).

### **Rubrics**

Using rubrics—guides that identify the criteria for mastery of assignments—for example, can empower students to choose how they will show what they know, plus provide them the means to self-assess the quality of their own work (Willis & Mann, 2000). Rubrics are a way to evaluate a student’s work based on established criteria. Specifically, the rubric lists the established criteria and correlating levels of competency. Generally, the levels of competency in the rubric range from an indicator that implies the product is less than acceptable to one that indicates outstanding achievement. By sharing the criteria listed in the rubric with students before they begin their assignment, the teacher can apprise them of the expectations of the assignment. With rubrics, students know expectations up front, giving them the opportunity to achieve the optimal grade without their asking what they need to do to earn the grade (Willis & Mann, 2000).

### **Formative and Summative Assessment, Including Benchmarking**

Informative assessment can be the beginning of better instruction (Tomlinson, 2007 / 2008). Just as meaningful pretests and/or posttests of student readiness and academic growth by teachers of differentiated instruction lead to functional and successful differentiation for students, so, too, does a teacher’s formative and summative evaluation assess ongoing student progress (Black & William, 1998a).

Assessment in a differentiated classroom is not only summative in nature—that is, used to measure student academic growth at the end of a unit of study—but it is formative in nature—that is, reflective, diagnostic and ongoing throughout the learning process (Black & Wiliam, 1998a). Moreover, summative assessment shows the extent to which students understand the objectives, content, and skills of a program of study, with the assessment being administered after the opportunity to learn subject matter has ended (Herman & Baker, 2005; Olson, 2005).

While summative assessment—which is formal, final, and comprehensive—is used typically at the end of a chapter/unit/semester, on district benchmarks, and/or with state/federal standardized assessments, to evaluate the effectiveness of instruction (Black et al., 2003), formative assessment—which is formal or informal—is used to obtain evidence of student learning that will inform the instructional process in ways to maximize learning along the way (Stiggins et al., 2004). Benchmark assessment can serve as an interim assessment that can be used formatively to provide local accountability data on students' performance on identified learning standards, providing teachers with student outcome data to inform instructional practice (Herman & Baker, 2005). On the other hand, according to Bennett (2002), school practitioners view the use of standardized benchmarks—as summative assessments—that is, as a way to use student performance data on classroom measures to predict likely performance on external measures, such as statewide or national tests. Benchmark assessment, as summative assessment, is typically used much less frequently (three to four times annually) than formative assessment, *per se*, and is designed, primarily, for predicting a student's academic success, monitoring progress, and providing information about a student's performance on a specific set of standards or skills that teachers can use to

differentiate instruction (Hunt & Pellegrino, 2002). Benchmark assessments are generally regarded as a promising practice (Herman & Baker, 2005; Olson, 2005).

Studies investigating the effects of benchmark assessment programs on student outcomes are scarce; in contrast, ample research on the effects of formative assessment suggests that it is associated with improvements in student learning (Black & Wiliam, 1998b; Kingston & Nash, 2009), particularly among low achievers (Black & Wiliam, 1998b). Consequently, formative assessment literature is frequently cited to support the effectiveness of benchmark assessments (Perie et al., 2007). More recent research literature on formative assessment, however, distinguishes it from benchmark assessment (Torgesen & Miller, 2009). Substantial literature on the effects of formative assessments more generally points to the positive effects of formative assessment on student learning (Black & Wiliam, 1998a, 1998b; Bloom, 1984). Additional studies support students and teachers in identifying learning goals and the instructional strategies to achieve them with regard to formative assessment (Boston, 2002).

Black's and Wiliam's (1998b) extensive literature review yields studies that show that classroom "formative" assessment, properly implemented, is a powerful vehicle for improving student learning, while summative assessments such as standardized tests can potentially have a harmful effect on student learning. Summative assessments, say Black and Wiliam (1998a), are not designed to provide students with the immediate, contextualized feedback useful for assisting teacher and student during the learning process, as does formative assessment. Formative assessment generally comes in various forms—from individual or small-group student discussions with the teacher, whole-class instruction and feedback, observations, pop quizzes, worksheets, journal entries, interest surveys, skill inventories, pretests, homework assignments, portfolio

input, to exit cards—and can yield precise indicators to guide teacher follow-up instruction (Popham, 2006, p. 86). A teacher may ask his or her students to complete an exit card at the end of class, for example, to summarize what they have learned from a lesson. Their exit-card summarizations, or lack thereof, help the teacher sift through their feedback and then adjust instruction if any of the students miss any key concepts.

### **Feedback**

Black and Wiliam (1998b) discuss in their studies that feedback should include opportunities for students to improve, as well as teacher guidance on how to improve. “Instruction and formative assessment are indivisible,” say authors Paul Black and Dylan Wiliam (1998a, p. 143). Useful feedback, adds author Thomas Guskey (2005), is “both diagnostic and prescriptive; it reinforces precisely what students were expected to learn, identifies what was learned well, and describes what needs to be learned better” (p. 6). According to Guskey (2005), “to be optimally effective, correctives must be qualitatively different from the initial teaching” (p. 58). Moreover, using formative assessment to evaluate students’ understanding of lesson concepts to guide instruction enables teachers to make instructional adjustments to ensure students achieve targeted standards-based goals within a set time frame (Butler & Winnie, 1995). Using effective formative assessments can empower both teachers and learners so that corrective instruction, if needed, and additional opportunities for the student to demonstrate learning can occur.

### **Authentic Assessment**

Teachers who use authentic forms of formative and summative evaluation to assess student progress do so for multiple purposes, but especially for making accountability, eligibility, and/or instructional decisions (Wiggins, 1993a). With authentic assessment, however, the focus is less on judging students and more about guiding students (Wiggins, 1993b). Three variations of authentic assessments that are formative in nature most frequently noted by researchers are dynamic (Lydz, 1991), performance (Mehrens, 1992; Meyer, 1992), and portfolio assessment (Gatlin & Jacob, 2002). According to Wiggins (1993a), these types of authentic assessments share the following characteristics:

- Skills to be measured that relate to long-term educational outcomes such as success in the workplace;
- Tasks to be completed that require extensive engagement and complex performance;
- An analysis to be constructed of the processes used to produce the end result(s)

With dynamic and performance assessments, students receive immediate feedback regarding their outcomes, while portfolio assessment is more likely to provide students with an opportunity to monitor and self-regulate their learning process (Dembo, 2004).

Proponents of authentic assessments say learners should solve complex problems and/or produce higher-order projects that are linked to the development of real-life skills (Meyer, 1992). During this process, students would engage their higher-order learning skills such as synthesis, analysis, collaboration, and problem solving. As Eder (2004) sees it, authentic assessments attempt to seamlessly combine teaching,

learning, and assessment to promote student motivation, engagement, and the advancement of their higher-ordered learning skills. Grant Wiggins (1993a) describes authentic assessments as “faithful representations of the contexts encountered in a field of study or in the real-life ‘tests’ of adult life” (p. 206). Ultimately, teachers in differentiated classrooms need to create learning environments based upon student needs to mirror authentic contexts, whenever possible, in order to ensure that assessment truly measures whether students can use their knowledge and skills effectively in real-life scenarios (Cumming & Maxwell, 1999). Indeed, teachers who use authentic formative assessments to determine their students’ strengths and weaknesses during the learning process are better able to differentiate instruction accordingly to optimize student success.

### **Differentiated Instruction and Other Components**

#### *Cooperative Learning Groups*

In addition to the research-identified elements of differentiated instruction presented heretofore, researchers purport that other components which can also be used to differentiate instruction contribute to student achievement, as well. Research on classroom cooperative learning techniques, for example, in which students work in small groups and receive recognition and/or rewards based upon group performance, has been increasing over the years (Slavin, 1980). Cooperative learning, by definition, is a type of instructional technique that affords students the opportunity to work with classmates in a social situation by interacting with them during a learning process (Alford, 1997). The use of cooperative learning structures and group reward contingencies can increase social motivation (Johnson et al., 1981). Indeed,

cooperative learning exists when students work together to accomplish a shared learning goal (Johnson & Johnson, 1999b). Moreover, the goal is accomplished through interdependence among all group members, with each member being responsible for the outcome of the shared goal (Johnson & Johnson, 1999b). In fact, cooperative learning—more than working together—has been described as “structuring positive interdependence” in pursuit of a specific shared goal or output (Slavin, 1990, p. 16).

Cooperative learning has social, as well as academic, benefits. Students in cooperative learning groups have the opportunity to see points of view other than their own, and they learn to take risks to make contributions to the group (Johnson & Johnson, 1999a). Students learn to work with other classmates who have different learning skills, cultural backgrounds, attitudes, and personalities. These differences force them to interact, communicate, resolve conflicts, and learn from each other in order to function as a team (Johnson & Johnson, 1979; Slavin, 1986). According to Cohen, 1994, heterogeneous groups promote student learning. If employed correctly, cooperative learning groups are small teams of students heterogeneously assembled according to ability, interest, and background. In addition, Slavin (1996) states that cooperative learning produces greater student achievement than traditional learning methodologies. Indeed, research findings support the utility of cooperative learning methods, in general, for increasing student achievement (Sharan, 1980).

### *Peer Learning Groups*

Whether peer editing, peer tutoring, “bubble” kids,” or tutorial groups, the concept of peer learning groups has a long history. Peer learning can be defined as

“the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions” (Topping, 2005, p. 62). Of the main kinds of peer learning groups—whether it is peer editing, peer tutoring, or cooperative learning groups—the longest established and most intensively researched forms of peer learning in schools are cooperative learning and peer tutoring (Topping & Ehly, 1998). Research evidence clearly reports that both peer tutoring and cooperative learning yield gains in academic achievement (Topping & Ehly, 1998; Topping, 2001). Cooperative learning, as presented previously, involves the specification of goals, tasks, resources, roles, and rewards by the teacher, who facilitates and guides the students’ interactive process of learning (Slavin, 1999). While peer editing developed in the late sixties when Moffet (1968) proposed writing workshops for small groups of students who were to exchange papers and critique each other’s for improvement purposes, peer tutoring was initially deployed specifically for practice and consolidation purposes and targeted core skill areas, such as reading (Topping, 1987) and mathematics (Topping & Bamford, 1998).

Academically-oriented peer tutoring programs are characterized as including “a system of instruction in which learners help each other and learn by teaching” (Goodlad & Hirst, 1989, p. 13) or “a more able student helping a less able student in a cooperative working pair carefully organized by the teacher” (Topping, 1989, p. 489). In fact, peer tutoring is an intervention in which one student provides academic assistance to another (Fantuzzo et al., 1992). Specifically, peer tutoring is an instructional strategy that consists of student partnerships, typically linking high achieving students with lower achieving students, or those with comparable achievement, for structured reading and/or math study sessions (Rohrbeck et al., 2003). Moreover, Moffet (1968) emphasized the importance of peers as feedback providers in peer editing, while peer



tutoring is more likely to be characterized by the specific roles of tutor or tutee (Topping & Ehly, 2001). Most importantly, peer tutoring gives teachers the vehicle by which to accommodate a classroom of diverse learners to improve academic achievement across ability levels and content areas (Cohen et al., 1982). Teachers can simultaneously implement different lessons to address a greater range of learner needs (Fuchs et al., 2000).

With the recent increase in standardized testing, “bubble kids” and/or tutorial groups—other kinds of peer learning groups—generally consist of those “students who score just above or below the edge of proficiency and need extra assistance, often in the form of drill and test preparation” (Brunner et al., 2005, p. 255). “Bubble kids” refers to those students scoring within a range of five to ten points above or below the standardized test proficiency mark (Nichols & Berliner, 2007, p. 4). Because of their statistical location, the probability of advancing these students on the “bubble” prompts some administrators to target them for extra resources, placing them in tutorial groups, such as in pull-outs, special programs, and after-school tutorials (Brunner et al., 2005). Many times, these students get special attention and tutoring while students doing less well get little extra help and more able students are on their own (Nichols & Berliner, 2007). Engineering student tutoring groups—whether “bubble kids,” or otherwise—can provide opportunities for different learners in groups to work at different paces and/or on different material, while offering students another perspective from which to learn.

A series of empirical studies has evolved to determine the merit of peer editing, one of which was a study by Ford (1973) who compared two groups of composition students. In Ford’s (1973) study, one group received peer feedback, while the other received teacher feedback. Results indicated that the peer feedback group did

significantly better. Perhaps, the most influential peer editing study was conducted by Karegianes, Pascarella, and Pflaum (1980) who reported that peer editing groups developed significantly higher writing proficiency than did students whose essays were edited by teachers. Other experimental studies documented the effectiveness of peer editing (Copland, 1980; Elias & Clabby, 1992). These empirical studies added strength to the recommendations of peer editing advocates and led to a widespread adoption of the technique. Empirical studies on peer tutoring, as well, indicated that students' academic skills improved, but they were also able to practice their social skills with peers in a natural setting (Fuchs & Fuchs, 2001). Students engaged in these structured tutorial activities reported higher levels of competence and positive conduct than students in unstructured activities (Fantuzzo et al., 1992). Studies have shown that peer tutoring can improve students' performance in a variety of subjects, including spelling, mathematics, science, and functional community skills (Kohler & Greenwood, 1990). Taken together, this body of research has demonstrated the robust effect of peer learning across diverse educational settings and groups of students.

#### *Hands-On Science Labs*

Generally, peer learning in science can take place through two main processes. It can take place between peers in the form of peer tutoring, or peer learning can also take place as collaborative and hands-on learning. In this context, although peers will be at different stages of cognitive development and understanding relative to science concepts, for example, their relative levels of development, as well as achievement, will show gains due to their opportunities to co-construct new meaning and cognitive structures from these collaborative, hands-on learning experiences (Webb et al., 1995).

“Learning is defined as the construction of knowledge as sensory data are given meaning in terms of prior knowledge; constructivism implies that students require opportunities to experience what they are to learn in a direct way, time to think, and to make sense of what they are learning” (Tobin, 1990, p. 404-405). The benefits of such peer interaction have been reported in science (Thurston et al., 2008).

Hands-on learning, an important aspect of constructivist epistemologies that suggest that learners construct their own understandings of the world, has long been important in science education, in particular, and will likely be held in esteem by constructivist science educators to come (Loucks-Horsley et al., 1990). An emphasis on actively involving students in learning has influenced American schools since the 1860s; yet, the term “hands-on learning” seems to have emerged during the 1960s (Hodson, 1990). “After a quarter of a century, the familiar phrase, ‘hands-on science,’ is now a part of the educational world, with descriptions of science education shifting from vocabulary and text material to activities, projects, and inventions” (Flick, 1993, p. 1).

Bruder (1993) clarifies hands-on learning as “students manipulating physical objects to physically engage in experiencing science phenomena” (p.38) In the classroom, hands-on teaching can be differentiated from lectures and demonstrations by the criterion that students interact with materials to make observations; the assumption is that direct experiences with natural phenomena will provoke curiosity and thinking (Lumpe & Oliver, 1991). “Hands-on activities mean students have objects (both living and inanimate) directly available for investigation” (Meinhard, 1992, p. 2). According to Lumpe and Oliver (1991), hands-on learning has three different dimensions: (1) the inquiry dimension; (2) the structure dimension; and (3) the experimental dimension. Namely, in inquiry learning, the student uses activities to

make discoveries, while in the structure dimension, the student has a certain amount of guidance throughout the activity. Neither of these dimensions necessarily increases a student's problem-solving abilities. The third dimension—the experimental dimension—however, involves the aspect of proving a discovery (usually through the use of a controlled experiment), which does increase a student's problem-solving abilities.

Hands-on learning has been shown to increase learning and achievement in science content (Bredderman, 1982; Brooks, 1988; Mattheis & Nakayama, 1988). Hands-on learning affords students the chance to manipulate objects to make the abstract become more concrete since, generally speaking, scientific content knowledge, is often abstract and complex (Friedlander & Tamir, 1990). Specifically, hands-on activities create additional associations between pieces of knowledge so that information can be referenced both by its abstract meaning and by a physical representation of it (Gage & Berliner, 1984). Piaget's (1973) research clearly mandates that the learning environment should be rich in physical experiences for cognitive construction. Bruner (1983) points out the quick rate of change in the world and says, "the principal emphasis in education should be on skills—skills in handling, in seeing, in imagining, and in symbolic operations" (p. 138). Evidence clearly indicates that hands-on activities increase skill proficiency, especially in laboratory skills and specific science process skills, such as graphing and interpreting data (Mattheis & Nakayama, 1988). While a body of research provides evidence that hands-on science enhances the learning of various process skills (Bredderman, 1982), other research has not conclusively led to a firm consensus regarding the link between hands-on science and student achievement, critical thinking, and understanding (Hofstein & Lunnetta, 1982). Hands-on science's strengths appear to be in making the abstract concrete through

physical representations, as well as in facilitating students to become more responsible to do science on their own (Koran & Koran, 1984). Teachers who embrace hands-on learning in science endorse these student-centered instructional approaches.

### *Teaching Beyond TAKS*

Testing is an essential tool of teaching. Teachers use tests to determine how much students know and can do. Ironically, according to Darling-Hammond, Wise, and Klein (1999), in many cases, teachers spend too much time focusing on basic skills development, basic skills testing, and test preparation, instead of focusing on higher-level knowledge and thinking. In many cases, students in this country are asked to recognize facts that they have memorized from a list of answers during test preparation sessions in order to perform on their standardized tests, while students among the highest achieving countries have a curriculum focused on critical thinking, problem solving, and examinations that require them to solve complex real-world problems and to defend their ideas orally and in writing (Darling-Hammond et al., 1999). Instruction that requires students to tackle challenging tasks and to justify their assertions with evidence and reasoned arguments is associated with higher achievement (Darling-Hammond et al., 1999). A growing body of research shows that as more stakes become attached to standardized tests, teachers feel pressured to teach a multiple-choice curriculum that does not produce real-world skills (Volante, 2004). Moreover, teaching to the test tends to inflate scores at the cost of in-depth classroom instruction, according to Volante (2004). In theory, the alignment of state curriculum with the tests would ensure that teaching to the test is teaching the curriculum (Ash, 2008).

Teaching the curriculum, however, according to Kritsonis (2007), includes more than student success on standardized tests. Kritsonis (2007) proposes six philosophical strategies for teaching beyond standardized tests in order to develop the complete person. A complete person, according to Kritsonis (2007), should be skilled in:

- Symbolics (fluent in speech, symbol, and gesture);
- Empirics (factually well informed);
- Esthetics (capable of creating and appreciating objects of esthetic significance);
- Synnoetics (endowed with a rich and disciplined life in relation to self and others);
- Ethics (able to make wise decisions and to judge between right and wrong);
- Synoptics (in possession of an integral outlook)

The first realm, symbolics, “comprises ordinary language, mathematics, and various types of nondiscursive symbolic forms, such as gestures, rituals, rhythmic patterns, and the like” (Kritsonis, 2007, p. 11). Symbols are visual representations or visual representations that are common and known by almost everyone around, which can be as simple as your everyday traffic signs to the basic symbols used to govern the daily operations of schools that students are familiar with. These basic symbols, everyday language, and so forth, can be taught in all disciplines. Speaking this universal language to students within a school will ensure that the students are well prepared (Kritsonis, 2007).

The second realm empirics, includes the science of the physical world, of living things, and of man (Kritsonis, 2007). These sciences provide factual descriptions,

generalizations, and theoretical formulations and explanations that are based upon observation and experimentation in the world of matter, life, mind, and society. They express meanings as “probable empirical truths framed in accordance with certain rules of evidence and verification and making use of specified systems of analytic abstraction” (Kritsonis, 2007, p. 12). Empirics deal with the sciences in everyday life. The second realm, then, focuses on the subject areas of physical science, biology, physics, psychology, and the social sciences.

According to Kritsonis (2007), the third realm is that of esthetics. “Esthetics contains the various arts, such as music, the visual arts, the arts of movement, and literature. Meanings in this realm are concerned with the contemplative perception of particular significant things as unique objectifications of ideated subjectives” (Kritsonis, 2007, p. 12). “Humans teach their children the arts to help them achieve what we consider a well-rounded education, exposing them to new and interesting forms of sensory satisfaction” (Kritsonis, 2007, p. 284). Schools, therefore, should look at innovative and creative ways to motivate and stimulate student success in more creative and artistic ways.

The fourth realm, synnoetics, “embraces what Michael Polanyi calls ‘personal knowledge’ and Martin Buber the ‘I-Thou’ relation; it may apply to persons, to oneself, or even to things” (Kritsonis, 2007, p. 12). It is important with this realm that educators reinforce to their students the importance of being responsible for their own actions and taking some responsibility for the choices they make with their education.

The fifth realm, “ethics, includes moral meanings that express obligation rather than fact” (Kritsonis, 2007, p. 13). “In contrast with sciences—which are concerned with abstract cognitive understanding, and to the arts—which express idealized esthetic

perceptions, and to personal knowledge—which reflects inter-subjective understanding, morality has to do with personal conduct that is based on free, responsible, deliberate decision” (Kritsonis, 2007, p. 13).

Synoptics is the sixth realm of meaning (Kritsonis, 2007). Synoptics “refers to meanings that are comprehensively integrative” (Kritsonis, 2007, p. 13). This realm includes history, religion, and philosophy. “These disciplines combine empirical, esthetic, and synnoetic meaning into coherent wholes” (Kritsonis, 2007, p. 13). This realm is used in a variety of subjects in the field of education. Indeed, educators must teach learners about the past, so that they will not repeat past mistakes, but make greater strides in life. Teaching these realms should be the aims of general education in the development of the complete person, according to Kritsonis (2007). “An educational institution or school system claiming to be purposive must make some attempt to classify, codify, and integrate the knowledge base it has selected to become part of its curriculum so that the basic competencies of general education develop every person” (Kritsonis, 2007, p. v).

### **Hallmarks of Effective Differentiation**

Acknowledging theory, research, and best practice, teachers, administrators, and the community should develop schools that respect and respond to individuals as complete persons, eschewing a factory approach to student education. “To customize schooling for individual learners, rather than mass produce students who have essentially been taught the same thing in the same way in the same amount of time...is not a superficial change; it is a deep cultural change” (Mehlinger, 1995, p. 154). In agreement with Mehlinger (1995), Tomlinson et al. also acknowledges that



implementing effective differentiation of curriculum and instruction is not a minor adjustment in instruction, but a significant transformation (2004). Unless the curriculum and instruction are modified for academically diverse learners, student outcomes are likely to be disappointing (Gamoran & Weinstein, 1995; Hootstein, 1998). Furthermore, adaptations to curriculum and instruction need to be distinct enough to address a wide range of student readiness levels, interests, and learning modes (Tomlinson, 1999). To this end, researchers agree on certain characteristics of differentiated instruction as the hallmarks of effective differentiation:

- Effective differentiation of curriculum and instruction is proactive, rather than reactive (Schumm & Vaughn, 1991; Tomlinson, 1995);
- Effective differentiation employs flexible use of small teaching-learning groups in the classroom (Lou et al., 1996; Tomlinson, 2003);
- Effective differentiation varies the materials used by individuals and small groups of students in the classroom (Kulik & Kulik, 1991; Lou et al., 1996; Tomlinson, 2001).
- Effective differentiation uses variable pacing as a means of addressing learning needs (Dahloff, 1971; Oakes, 1985; Tomlinson, 1999);
- Effective differentiation is knowledge-centered (National Research Council, 1999; Tomlinson, 2003, 2004);
- Effective differentiation is learner-centered (McLaughlin & Talbert, 1993; Anderson et al., 1996; Elmore et al., 1996; Pintrich & Schunk, 1996; Callison, 1998; Marlowe & Page, 1998; Tomlinson, 2003);

Indeed, differentiation must be conceived and practiced as a reflection and extension of educational best practice (Tomlinson, 1999). Differentiated instruction should target the

needs of students with the aim of moving all students toward high levels of achievement.

### **Research Studies Supporting Differentiated Instruction**

Despite empirical research being scarce on the impact of using differentiated instruction, several recent studies on differentiated instruction have shown positive outcomes. Johnsen (2003) conducted a study in which undergraduate teachers differentiated instruction to suit different student ability levels. Interning teachers, in this context, were encouraged to differentiate content and process, using learning centers, different reading materials, and different instructional strategies (Johnsen, 2003). The study revealed that their use of differentiated techniques proved to stimulate student interest and engagement (Johnsen, 2003). In another study that investigated the impact of differentiated instruction on students' standardized test scores, as well as teachers' perceptions of their ability to meet the needs of diverse students, Hodge (1997) found that students who were prepared for tests using differentiated techniques showed a gain in their mathematics scores, while teachers' perceptions of being able to meet the needs of diverse learners did not appear to be influenced by the use of differentiated instructional techniques. Furthermore, McAdamis (2001) reported significant improvement in the test scores of a Missouri district of low-scoring students, following the use of differentiated instruction. In addition, teachers in this study reported that their students were more motivated and enthusiastic about learning (McAdamis, 2001). Because teachers were initially resistant to change to differentiated instruction, their administrators used strategies such as action research, peer coaching, study groups, and professional development workshops, plus offered them ongoing support

and feedback (McAdamis, 2001). Consequently, teachers became convinced of the benefits of differentiated instruction and implemented it (McAdamis, 2001). In this study, the training sessions, mentoring, and professional development were implemented over a five-year period and required a concerted effort from all stakeholders, including school principals, teachers, district trainers, and school authorities (McAdamis, 2001).

Another study, led by Tomlinson (1995), revealed initial teacher and administrator resistance toward modifying instruction to suit learner variance, as well. Observations of those teachers who adopted the use of differentiated techniques demonstrated that age was not a factor in accepting the philosophy of differentiation, but attitude proved to be a decisive factor (Tomlinson, 1995). Teachers who experienced early successes with differentiation, however, were more likely to continue (Tomlinson, 1995). Tomlinson (1995) concluded that there was a need to further examine teacher resistance to differentiated instructional models catering to academic diversity, as well as to afford teachers ongoing support and assistance in implementation. Furthermore, an examination of differentiated instruction strategies utilized by teachers in a study conducted by Affholder (2003) found that teachers using these strategies developed improved individual perception and adopted greater responsibility for student growth. In addition, this study revealed that teachers employing higher levels of differentiated instruction techniques experienced increased self-efficacy (Affholder, 2003). It appeared, from the study, that during implementation, differentiated instruction was favored by more experienced teachers due to their familiarity with the curriculum and prior trainings (Affholder, 2003). With contemporary

classrooms becoming increasingly diverse, researchers, principals, and teachers, alike, acknowledge that the practice of differentiating instruction is a tool to facilitate learning.

### **Delphi Research Method**

Since this research study utilizes the Delphi research method, this portion of the literature review defines the Delphi, giving its historical background, goals and objectives, types of Delphi, as well as characteristics and attributes. In addition, this part of the literature review examines the instrument design, application, process, strengths and weaknesses of this research model, as well as specific components such as panels, rounds, along with data collection, analysis, and reporting features. It also addresses the issues of validity, reliability, research studies, and significance. Concisely, the Delphi technique is a survey method of futures research which aims to structure group opinion and discussion in order to reach consensus on a body of knowledge among a panel of experts (Linstone & Turoff, 1975). The emphasis of the Delphi method is to overcome the disadvantages inherent in conventional committee action in coming to group consensus.

#### *Delphi Definition*

A number of definitions exist for the Delphi research method. Most commonly, the Delphi research method is defined as a procedure for structuring a group communication process among a group of experts to deal with a complex issue and to reach consensus on a body of knowledge (Linstone & Turoff, 1975). According to Baldwin (1981), when lacking full scientific knowledge, decision-makers must rely on their own intuition or on expert opinion. Moreover, Helmer (1983) specifies that the

Delphi method represents a useful communication device among a group of experts, facilitating the formation of a group judgment. Delbecq, Van de Ven, and Gustafson describe it as “a method for the systematic solicitation and collection of judgments on a particular topic through a set of carefully designed sequential questionnaires interspersed with summarized information and feedback of opinions derived from earlier responses” (1975, p.10). According to Adler & Ziglio (1996), the Delphi method is based upon a structured process for collecting and distilling knowledge from a selected group of experts by means of a series of questionnaires—using multiple iterations—that are interspersed with controlled opinion feedback as a method for consensus-building (p. 12).

Another definition for the Delphi process is given by Piercy and Sprenkle (2005) as the attempt to negotiate a reality that can be useful in moving a particular field forward, planning for the future, or even changing the future by forecasting its events (p. 28). The purpose of the Delphi is usually goal setting, policy investigation, or predicting the occurrence of future events (Ludwig, 1997). Dalkey (1969) clarifies that the purpose of the Delphi is “to provide a practical means for obtaining the opinion of a group while avoiding the biasing effects of dominant individuals, of irrelevant communications, and of group pressure toward conformity” (p. 408). The Delphi’s objective is to creatively explore ideas and/or to produce suitable information for decision making; that is, to generate forecasts in education and other fields (Cornish, 1977). Overall, the Delphi technique is an accepted method of futures research for gathering data from respondents within their domain of expertise. Ultimately, the Delphi research method provides a venue for an expert panel to reach consensus without having the logistical

inconveniences of meeting and/or the group dynamic issues associated with more traditional face-to-face collaborative processes.

### *Historical Background*

Named for the Greek town of Delphi, this research method's name is derived from the Oracle of Delphi, associated with Apollo, who supposedly spoke to the ancient Greeks to predict the future (Piercy & Sprenkle, 2005). Apollo, the god of light, purity, wisdom, and the arts, was known for his ability to foresee the future (Strauss & Ziegler, 1975). Although the Delphi technique has historical roots in Greek mythology, most scholars agree that its first scientific use was in military technology forecasting, information gathering, and group decision-making after World War II through a study in the 1950s by the RAND Corporation (Dalkey & Helmer, 1968). Referred to as "Project Delphi," the Delphi method was primarily developed by RAND as a tool for forecasting aspects of future warfare (Cornish, 1977, p. 36). Its mission was to develop consensus among United States experts regarding Soviet opinions on optimal American industrial targets (Linstone & Turoff, 1975). Gordon and Helmer's (1964) study at RAND Corporation—forecasting long-range trends in science and technology and their impact on society—was one of the early applications of the Delphi method. After RAND Corporation, the Delphi methodology increased in usage in the 1960s and 1970s, with implementers recognizing human judgment as legitimate and useful in generating forecasts (Gordon & Hayward, 1968). Over the years, the Delphi method has matured and proven to be a highly adaptable research methodology that has been used in numerous industries (Linstone & Turoff, 1975).

### *Goals and Objectives*

Turoff (1970), McKenna (1994), and Hasson et al. (2000) suggest that the goal of most Delphi exercises fits one of four major categories:

- To gain insight into respondent assumptions or factors involved in making judgments;
- To seek consensus based on information presented by members of an expert panel;
- To correlate expert judgments on a diverse set of issues or disciplines;
- To educate an entire panel on the diversity of thinking with respect to any issue(s)

These goals, while relatively broad in nature, fairly represent the intent of application of most any variation of the Delphi methodology in either natural or social science today.

The research objectives commonly associated with Delphi methodology reflect a rationale that promotes a group decision-making process. Three fundamental objectives of the Delphi method, according to Murray and Hammons (1995) are summarized as follows:

- Develop a range of responses to a problematic issue;
- Rank a range of responses in order to provide an indication of significance;
- Establish consensus regarding a range of responses

Similarly, Stahl and Stahl (1991) identified the following objectives for Delphi investigations:

- Identify and investigate underlying assumptions that contribute to divergent judgments or opinions;

- Ascertain information that may help to generate a consensus of opinion from a selected panel of experts;
- Establish relationships between expert judgments in the form of rankings on a topic that pertains to a number of disciplines;
- Educate the respondent group to the diverse and multidisciplinary nature of the topic in question

Furthermore, the Delphi method has been recommended for use when the complexity or ambiguity associated with the problem exceeds the intellectual capabilities of the individual decision-maker (Sahakian, 1997).

#### *Types of Delphi*

The conventional (classic) Delphi has evolved over the years, spawning several different variations. According to Linstone and Turoff (1975), the conventional Delphi pertains to a paper-and-pencil application aimed at forecasting and estimating unknown parameters. Over time and application, the conventional Delphi has spawned several different Delphi variations. These variations typically exhibit differences in the objectives of the research project and the method of communication (Wilhelm, 2001). With the conventional Delphi, which is less structured, the researcher-moderator designs and analyzes a series of questionnaires (typically the initial questionnaire is open-ended) that are sent to members of an expert panel, generating qualitative data. The researcher, as moderator, is also responsible for evaluating the group's responses and continuing the process for multiple rounds. Through the use of this process, the variance of the median rating attached to a topic tends to decrease as the number of rounds in the Delphi exercise increases (Dalkey & Helmer, 1968). The conventional



Delphi—also known as the Policy Delphi—follows a process that exists solely to highlight all opinions on a particular subject for purposes of sparking discussion and/or debate with respect to an issue. Utilizing this Delphi method creates a forum for members of the respondent group to express all the pros and cons of their individual positions across the range of opinions represented by the entire panel (Bjil, 1992). A Policy Delphi produces verbal rather than numeric data, for the most part. This type of Delphi is generally used to enhance the communication that is already taking place within a well-defined committee approach or through some other type of nominal communication process. At the completion of this type of study, a small group often takes the information gained through the Delphi process and generates policy in the area under consideration (Turoff, 1970).

Strauss's and Ziegler's (1975) variant of the conventional Delphi in the 1970s, called the historic Delphi, is based on the work of great political philosophers and the application of their work to contemporary societal issues. In this type of Delphi, usually well-published university professors become the expert panel members. Each professor represents a group of members with expertise in the teaching or work of a particular philosopher, such as Aristotle, Plato, Aristotle, Machiavelli, Hobbes, Swift, Burke, Locke, Rousseau, Freud, or Marx (Strauss & Ziegler, 1975). The objective of the historic Delphi is to connect a large body of historical knowledge to the present, developing a format in which students of political science can place this historical knowledge in a new context and format that is relevant to both their current and future society (Strauss & Ziegler, 1975).

Another variation of the conventional Delphi, the real-time Delphi, has communication characteristics that differ from the conventional model. In fact, the

method of communication differs dramatically. Rather than paper-and-pencil usage, the real-time Delphi incorporates computer conferencing. That way, there is enhanced expediency in completing each round of the Delphi process. In implementing this type of forecasting, all of the communication characteristics for the entire study must be defined in advance of the first round (Wilhelm, 2001).

A basic Delphi exercise is the numeric Delphi. Unlike the policy Delphi, the numeric Delphi produces numeric data. Specifically, it solicits quantitative estimates of dates, amounts, or values (Strauss & Ziegler, 1975). Another Delphi, the adversary Delphi, written about by Helmer (1994), involves two stages. In the first stage of the adversary Delphi, the moderator and panel completely explore the positions held by two or more opposing sides with respect to a particular issue. During the first stage, each viewpoint may justify its claims. During the second stage, the adversary Delphi seeks consensus or majority opinion (Helmer, 1994).

Variations from the Delphi ideal do exist (Linstone & Turoll, 1975; Martino, 1983). All in all, each of the Delphi variations begins with a relatively open-ended initial questionnaire for soliciting expert panel member feedback on a particular issue(s). However, some Delphi studies—known as the modified Delphi—begin with a structured, research-based questionnaire, rather than an open-ended one (Murry & Hammons, 1995). This questionnaire may be developed based on the literature on a selected topic, providing panelists with pre-existing information, so that ranking takes place in the first round, unlike in the conventional Delphi. The modified Delphi, since it begins its first round with a structured survey rather than the typical open-ended instrument more commonly used in conventional Delphi processes, is usually completed more quickly than traditional studies (Murry & Hammons, 1995). During a modified Delphi

investigation, the researcher-moderator provides panelists with an initial list of statements to be critiqued, eliminating the traditional open-ended questionnaire which is typically used during the first round of surveying (Murray & Hammons, 1995). The majority of modified Delphi studies have used structured first rounds in which event statements—devised by researchers—are presented to panelists for assessment (Rowe & Wright, 1999). In subsequent rounds, the generated data is quantitative in nature. The modified Delphi method expedites the investigative process, enabling the researcher-moderator to maintain control over the range and scope of the issues that are being discussed (Rowe & Wright, 1999).

The appeal of using a modified Delphi process is its flexibility of procedure and the opportunity for participants to alter their responses, if desired (McKillip, 1987). It enables the researcher to focus and guide the communication process as it pertains to a wide array of problems, disciplines, and/or levels of expertise (Flippo, 1998). Linstone & Turoff (1975) verify that the technique can be effectively modified to meet the needs of a given study. The modified Delphi method also allows for respondents to see how closely their responses merge, or not, with other participants' (McKillip, 1987). Two rounds should be sufficient for consensus in a modified Delphi process, while more than four rounds would extend beyond the point in which consensus and response stability present themselves (Brooks, 1979). Lanford has also ascribed that the majority of the convergence around a central idea or consensus occurs between the first and second rounds of the modified Delphi process (1972). No doubt, since its inception in the 1950s, the Delphi method has been implemented in a variety of research situations and in a variety of formats. A modified Delphi will be implemented in this research study of the most effective elements of differentiated instruction.

### *Characteristics and Attributes*

The Delphi method can be described as a communication tool that has certain major characterizations: anonymity, iteration, asynchronicity, controlled feedback, and statistical aggregation of group response (Linstone & Turoff, 1975). The Delphi process is characterized as possessing anonymity, which can reduce the effects of dominant individuals on the panel or group dynamics such as manipulation or coercion to conform to certain viewpoints (Dalkey et al., 1972). While respondents' identities may be known to the Delphi moderator, materials presented to the panel should avoid revealing their identities. When participants' identities are not associated with their responses, they may be more willing to share their position openly (Delbecq et al, 1975). Potentially, anonymity minimizes the effect of panelists' personalities influencing group behavior and decision.

The Delphi method possesses the attribute of iteration. This characteristic allows the participants to refine their views, as well as maintain or change their positions in light of the progress of the group's feedback from round to round (Rowe & Wright, 1999). Specifically, the Delphi is an iterative process used to collect and distill the judgments of experts using a series of questionnaires interspersed with feedback (Adler & Ziglio, 1996).

Controlled feedback is another characteristic of the Delphi process. Controlled feedback reduces noise; that is, the communication which occurs in a group process that can distort the data (Dalkey et al., 1972). Since Delphi is an iterative process, the results of one round of the questionnaire inform the next. The researcher-moderator should provide participants with feedback about the outcomes of previous rounds to inform the current round. Moreover, the control of feedback applies primarily to the

researcher-moderator since he or she controls the style and amount of feedback given to panelists, as well as the timing of the feedback (Murray & Hammons, 1995).

In addition, statistical aggregation of group response is a characteristic of the Delphi process. During the Delphi process, panelists, using a Likert scale, for example, can quantify their qualitative thoughts. Then, during feedback, the panel's viewpoint can be summarized statistically by the moderator, typically using a measure of central tendency, such as the mode, as well as standard deviation (Khorranshahgol et al., 1988). The ability to use statistical analysis techniques is a practice which further reduces the potential for group pressure for conformity (Dalkey et al., 1972). Most importantly, the statistical analysis tools allow for an objective and impartial analysis and summarization of the collected data.

Lastly, the Delphi process also can be asynchronous. Regarding asynchronicity, Turoff and Hiltz (1982) purport that the most important characteristic of a Delphi procedure is the ability of panelists to participate when and how they want to do so. In contrast to face-to-face meetings, in which all participants must discuss issues at the same time, asynchronous communication affords panelists the choice of when and how to respond.

The Delphi also has three attributes which allow it to be distinguished from other methods of arriving at group consensus. First, the Delphi method promotes group interactions and responses. Next, Delphi employs multiple rounds of interaction between the researcher-moderator and the panelists, as well as between each panelist and the entire group's responses. Lastly, the Delphi affords a way to present statistical group responses (Murry & Hammons, 1995).

Additional attributes of the Delphi are the use of an expert panel, carefully structured questionnaires (surveys), and an overall goal of consensus of opinion (Strauss & Ziegler, 1975). The Delphi method hosts the following two basic assumptions: (1) that group decisions carry a greater degree of validity than individual opinions; and (2) that most round-table collaborative processes are interlaced with difficulties (Murry & Hammons, 1995). In other words, group decisions made by a uniform group of experts are even more valid than group decisions made by random or diverse groups (Brooks, 1979). An example of a difficulty of a face-to-face collaborative process could be the surfacing of group coercion of an individual during the process, forcing his or her conformity to the group's viewpoint, which could be avoided in a Delphi process. Ultimately, in addition to being aware of the defining characteristics and attributes of the Delphi methodology, it is important to elaborate upon its strengths.

### *Strengths*

The Delphi method has a number of strengths as a research design. The most compelling strengths of the Delphi process are that it provides a forum that diminishes the influences of dominant personalities, reduces the effects of irrelevant or biased communication, and eliminates the notion that participants are pressured to conform to a preconceived idea regarding the issue being studied (Dalkey, 1972). Since the Delphi method practices anonymity and provides confidentiality in a controlled situation, it creates an advantageous opportunity for panelists to freely and honestly provide input. Indeed, the Delphi technique keeps many of the psychological distractions typically associated with panel discussions from ever becoming part of the research equation (Helmer, 1983).

In addition, the panelists' responses obtained in a Delphi tend to be well-reasoned as they address the issues under consideration throughout the process (Cochran, 1983). Participating in this type of research might prove to be an interesting exercise for panelists as it might stimulate new ideas (McKenna, 1994) or lead to a wider acceptance of results (Beech, 1999).

Another strength of the Delphi is its flexibility, affording participants the opportunity to respond asynchronously, despite the restrictions of their daily schedule and/or geographic location. It is also a rather cost-effective research methodology, as well (Beech, 1999). Researchers purport that some of the most significant strengths of the Delphi are as follows:

- It focuses attention directly upon the issue under examination;
- It provides an equal opportunity for all panelists to be involved in the process;
- It has a structure within which individuals with diverse backgrounds and/or who reside in remote locations can work together on the same issue;
- It minimizes the tendency for panelists to be swayed by dominant personalities during the process;
- It produces precise and documented records of the distillation process through which informed judgment can be achieved (Adler & Ziglio, 1996, p. 22).

Scholars note that the Delphi provides for better processing of judgmental data because it allows participants to stay focused on the issue being examined due to less distraction and group pressure from other panelists (Enzer, 1971).

A survey of the literature indicates that the advantages of using the Delphi technique are as follows:

- It can involve a number of individuals from a wide geographical area while avoiding the disadvantages of the committee method (Campbell & Hitchin, 1968; Clarke & Coutts, 1970; Doyle & Goodwill, 1971);
- The influence of status and forceful individuals among panelists is eliminated (Doyle & Goodwill, 1971);
- The problem of commitment to a publicly stated opinion is avoided (Doyle & Goodwill, 1971)

Overall, using the Delphi permits the researcher-moderator to obtain an objective consensus of the panel's expert judgment on the subject under study. In other words, it makes the rationale underlying a specific prediction explicit for all.

An additional strength of the Delphi methodology is its simplicity. Most calculations are simple and can be completed without a calculator or advanced mathematical skills (Strauss & Ziegler, 1975). The Delphi has the ability to elicit quantitative data similar to other survey research, but also to explore qualitative data such as perceptions, attitudes, and moral judgments (Beech, 1999). The Delphi also has the ability to elicit follow-up research, guide further research, and give direction in a discipline (McKenna, 1994; Cohen et al., 2004). No doubt, the strengths of the Delphi technique demonstrate its unmistakable value for decision-making. By and large, the Delphi, as a research design, possesses a number of strengths that warrant a broader implementation in the future, as ongoing trends indicate (Strauss & Ziegler, 1975).



### *Weaknesses*

Although the Delphi technique is widely used, its scientific merit is often questioned. The Delphi does have its weaknesses as a research design; namely, the success of the method depends upon the quality of the panelists (Linstone & Turoff, 1975). Some of the weaknesses as presented in the literature are logistical in nature, as well. Specifically, Delphi questionnaires can be lengthy and time-consuming and/or they may be misinterpreted by members of the expert panel (Strauss & Ziegler, 1975). The constraining time commitment for participation may also cause some panelists to drop out of the study. Sometimes bias exists in the way questions are written, which may negatively impact a participant's responses (Murry & Hammons, 1995).

Ironically, one of the most outspoken critics of the Delphi process, Sackman (1974), a RAND employee, attacks the Delphi's scientific validity, asserting that it does not have sufficient rigor to be a trusted scientific methodology. He believes the Delphi to be a failed methodology for the following reasons:

- Delphi claims of superiority of group over individual opinion and the superiority of private opinion over face-to-face encounter are unproven generalizations;
- Delphi questions are likely to be vague, responses could be ambiguous, and results may represent compounded ambiguity;
- Delphi's claim to represent valid expert opinion is scientifically untenable and overstated;
- Delphi anonymity could reinforce unaccountability in method and findings;
- Delphi systematically discourages exploratory thinking and inhibits the adversary process;

- Delphi's consensus is specious consensus; it is a compromise position (Linstone & Turoff, 1975); there is a tendency to eliminate extreme positions, forcing a middle-of-the-road consensus (Barnes, 1987);
- Delphi concerns itself with transient collections of snap judgments of polled individuals from unknown samples, as opposed to coherent predictions, analyses, or forecasts of operationally defined and systematically studied behaviors or events;
- Delphi has been characterized by isolation from the mainstream of scientific questionnaire development and behavioral experimentation and has set an undesirable precedent for interdisciplinary science in the professional planning of the policy studies community (Sackman, 1974, p. 51).

Sackman (1974), however, makes no claim to having examined all the literature, particularly all the applications literature. Both Goldschmidt (1975) and Rieger (1986) follow up with rebuttals to Sackman's (1974) Delphi criticisms, stating that Sackman (1974) should not necessarily be accepted as the final arbiter regarding Delphi's scientific respectability.

An additional criticism that is often made of the Delphi study is that it does not always produce results that are better than any other structured communication technique (Rowe et al., 1991). Linstone and Turoff (1975) specify that, in addition to the demanding nature of the Delphi, specific weaknesses of the Delphi design are that it potentially facilitates the researcher-moderator imposing his or her preconceptions of an issue upon the respondent group and/or ignores or does not explore disagreements.

Cited as a failure of many Delphi studies are the poor techniques of summarizing data, interpreting evaluation scales, and presentation of the group's response.

Powell (2003) and Beech (1999) report criticism that indicate that the outcomes of the Delphi technique might, at best, be viewed as subjective opinions regarding problems that cannot otherwise be explored by means of more precise scientific instruments. Wilhelm (2001) agrees that the Delphi has weaknesses as a research design, but he clarifies that many of them are relative problems associated with any group inquiry methodology, even the emergence, in some cases, of regression to the mean. Despite its weaknesses, the Delphi's implementation continues to increase in today's research community.

#### *Application and Appropriateness*

The initial use of the Delphi technique was forecasting. The Delphi has been used in research to identify, develop, validate, and forecast in a wide variety of research areas (Linstone & Turoff, 1975; Adler & Ziglio, 1996; Rowe & Wright, 1999). It is intended for use in judgment and forecasting situations in which pure model-based statistical methods are not practical—or possible, perhaps—because of the lack of appropriate historical / economic / technical data; therefore, some form of human judgmental input becomes necessary (Wright et al., 1996, p. 83).

More recently, the Delphi method has been used as a constructive technique in facilitating controlled, rational group communication to develop knowledge for decision-making. Before deciding whether the Delphi method should be used, however, it is important to consider the context within which the method is to be applied (Delbecq et al., 1975).

Several questions must be asked by the researcher-moderator to determine whether to select or rule out the Delphi as an appropriate technique for use (Adler & Ziglio, 1996). Linstone and Turoff (1975) offer the following considerations for which the Delphi method may be effectively applied:

- The individuals who are needed to contribute to the examination of a broad or complex problem have no history of prior or adequate communication and may represent diverse experience or expertise;
- More individuals are needed than can effectively interact in a face-to-face venue;
- Time and cost make frequent group meetings unlikely;
- The efficiency of face-to-face meetings can be enhanced by a supplemental group communication process;
- Disagreements among individuals are so unpalatable that the communication process must be refereed and/or anonymity must be assured to avoid domination by group coercion or by an overbearing individual (Linstone & Turoff, 1975, p. 4);
- The issue does not lend itself to precise analytical techniques but can be addressed by subjective judgments on a collective basis (p. 154).

An overriding factor in the selection of the Delphi methodology is the appropriateness of the technique for a particular study. Linstone (1978) emphasizes the two circumstances for which the Delphi is generally considered most appropriate:

- The problem does not lend itself to precise analytical techniques but can benefit from collective subjective judgments of experts of varying backgrounds, experiences, and expertise;

- Individuals who need to interact during the process cannot meet in face-to-face exchanges due to time, location, or cost constraints

Other pertinent questions to be answered when deciding upon the use of a Delphi are:

- What kind of group communication process is desirable to explore the specific problem or issue?
  - Who are the people with expertise on the problem or issue and where are they geographically located?
  - What are the alternative techniques available?
  - What results can reasonably be expected from applying the Delphi?
- (Linstone & Turoff, 2002, p. 136)

While the Delphi method has been characterized as a highly flexible problem-solving process, affording researchers and practitioners, alike, the opportunity to problem solve by identifying and prioritizing the most relevant emergent issues and trends, the decision to use the Delphi depends more on the need to use a group communication process than it does on the nature of the intended application (Wilhelm, 2001). Additionally, the Delphi technique is frequently used in situations in which group bias and/or group dynamics—such as power and peer pressure—might play a role in forcing group members to conform to group opinion (Ganssle, 2004). Moreover, the Delphi and other consensus development methods should not be viewed as a scientific method for creating new knowledge, but a process for making the best use of information, whether that is scientific data or the collective wisdom of participant experts (Murphy et al., 1998, p. 5).

Early applications of the Delphi method were in the field of science and technology forecasting. Assessing the direction of long-term trends in science and

technology development—specifically the topics of population control, automation, space progress, war prevention, and weapon systems—was the work of researchers such as Dalkey, Helmer, and Gordon, to name a few (Gordon & Helmer, 1964). Later, the Delphi method was applied to public policy issues, such as economic trends and business forecasting, as well as health, education, and political science (Martino, 1972; Strauss & Ziegler, 1975; Tersine & Riggs, 1976; Brooks, 1979; Helmer, 1983; Ludwig, 1997). Today, with its expanded usage and acceptance as a forecasting tool, the Delphi method continues to be applied in fields such as health care, business management, information technology, education, engineering, environmental, and transportation, as well as military science (Piercy & Sprenkle, 2005).

#### *Researcher-Moderator's Role in the Delphi Process*

Typically, the Delphi method requires a facilitator to initiate the process, focus the panel, manage the feedback, as well as to monitor and close the Delphi rounds, when appropriate. After assembling the panel of experts to address the selected issue or problem, the facilitator, also known as the researcher-moderator, establishes the Delphi framework for the iterative process of questioning, reconsideration, and feedback, which continues until a convergence of panel members' responses occurs and stability is reached (Murray & Hammons, 1995). The researcher-moderator coordinating the Delphi method facilitates the retrieval of responses from expert panelists to address a selected issue or problem in the Delphi process. The researcher-moderator may edit responses, form new questions based on those responses, summarize contributions, and decide on the order and structure of each round (Murry & Hammons, 1995). It is recommended that the researcher-moderator

maintain his or her role as facilitator during the Delphi process, as well as document individual and group decisions to track methodological rigor (Gordon, 1992). Given the methodological complexity of a Delphi study with its multiple rounds of survey design, data collection, data analysis, and reporting, it is critical that the researcher-moderator possess strong administrative skills (Hasson et al., 2000). Some of the administrative duties of the researcher-moderator are survey creation, distribution, and retrieval, analysis, as well as tracking respondents across multiple rounds, creating file systems for participant responses, and preparing the results reports.

It is imperative that the researcher-moderator operate in an efficient and effective manner during the Delphi process to promote participation (Keeney et al., 2001). Indeed, the researcher-moderator controls the interactions among panel members by filtering material not related to the purpose of the group (Martino, 1972). In addition, the typical problems of group dynamics can be bypassed with appropriate facilitation of the group during the Delphi process. Fowles (1978) describes the following twelve tasks of the Delphi process for the researcher-moderator to facilitate:

- Selection of one or more panels, composed of expert members, to participate in the Delphi process;
- Development of the first round Delphi questionnaire, which can be open-ended or structured;
- Optional testing of the questionnaire for quality assurance, using the literature base (Powell Kennedy, 2004);
- Transmission of the first questionnaire to the panelists;
- Analysis of the first round responses with descriptive statistics and dispersion;

- Documentation of feedback from the first round for transmission to panelists in the second round;
- Preparation of the second round questionnaire;
- Transmission of the original questionnaire items and responses, as well as descriptive statistics and dispersion, along with the second round questionnaire (shaped by feedback from the first round) to the panelists who, then, may decide to maintain initial responses or change responses, based upon feedback and statistical data;
- Creation of the opportunity for respondents whose initial responses fell outside the prior round's interquartile range (IQR) to change their initial responses or to maintain their initial responses;
- Analysis of the second round responses with descriptive statistics and dispersion;
- Reiteration of Delphi process and rounds—including transmission of feedback and statistics per round(s)—for as many rounds as necessary to, ultimately, achieve stability and panel consensus;
- Presentation of findings and conclusions of the Delphi to panelists and others

Moreover, in the Delphi process—between rounds—the researcher-moderator completes a statistical analysis of the responses from the panelists' Likert-scale ratings. The statistics frequently calculated include the mean, median, mode, and interquartile range (IQR) (Hasson et al., 2000). Feedback from the researcher-moderator to the panelists in each subsequent round usually includes the initial items and responses, along with descriptive statistical data. Participants are asked, in each round, whether



they desire to maintain their original rating or modify it, given the group's feedback and statistical data presented. Respondents whose initial responses fall outside each round's interquartile range (IQR) and who do not wish to change their responses in a subsequent round are asked to provide justification (often called a minority opinion) for their responses.

Delbecq et al., (1975) purport that the researcher-moderator's most important role in the entire Delphi process is to clarify the Delphi's aim for all participant respondents. The respondents should be well informed by means of facilitator involvement (Hanson & Ramani, 1988). Adler & Ziglio (1996) site the researcher-moderator's effective facilitation of the Delphi process as essential to the success of group communication among a panel of geographically dispersed experts.

#### *Research Instrument Design*

The Delphi exercise can be a mixed methodology, bridging the gap between quantitative and qualitative analyses. With classic Delphi studies, the investigator deals with qualitative data due to the open-ended questions that solicit participants' opinions. Many varieties of Delphi exist, however, ranging from qualitative to quantitative to mixed-method. While the Delphi is typically used as a quantitative technique (Rowe & Wright, 1999), a researcher-moderator can use qualitative techniques with the Delphi (Creswell, 1994).

Therefore, decision parameters must be established prior to the questionnaire design in order to assemble and organize the judgments and insights provided by Delphi subjects (Turoff, 1970). The Delphi method generally involves the circulation of two, three, or four questionnaires consisting of a number of items relative to a specific

topic of interest, often using a combination of pen-and-paper and/or electronic questionnaires (Stahl & Stahl, 1991). Frequently, a Delphi panel utilizes a four-point Likert scale for assessment of the statements on the questionnaire, modeled according to the original importance scale developed by Turoff (1970). In this case, the “4” on the scale represents a rating of *very important* or *significant*, while a “1” on the scale represents a rating of *unimportant* or *none* (Linstone & Turoff, 1975). The other method of scaling commonly used in Delphi studies is the simple ranking scale. Both the simple ranking and the Likert scales are interval scales, which is the type of scale essential for usage in the Delphi process when measuring or comparing values and/or determining the degree of importance (Scheibe et al., 2002).

Initially, the first questionnaire in the first round of the classic Delphi uses open-ended research questions—asking panelists to provide initial input—unless the Delphi method is modified—in which case the questionnaire contains structured statements—frequently research-identified—statements, typically taken from the literature base (Williams & Webb, 1994). Statements for the questionnaire regarding the research topic are frequently generated based upon the available literature and the initial opinions of the expert panel (Williams & Webb, 1994).

Hasson et al. (2000) suggest that a literature review and/or meta-analysis aids in the development of a questionnaire containing structured elements for use in a modified Delphi. Generally, a continuum exists in the questionnaires, however, representing the degree of open-ended questions and/or the degree of focus in the instrument (Adler & Ziglio, 1996). After the first round, the questions become more structured and focused, typically, to guide Delphi participants toward a certain goal by winnowing down the questions in subsequent rounds (Delbecq et al., 1975). Expert feedback is categorized

into objective items to be rated by panelists in the next round. Each panelist responds to each statement in accordance with his or her own expertise and perceptions (Adler & Ziglio, 1996). This anonymous input is summarized within the collective input from the group and then shared in the second round—and in subsequent rounds—with the intention that panel members reconsider any responses that deviate significantly from the group's overall mean, median, or mode—whichever measure of central tendency that the researcher-moderator has selected for the data analysis (Adler & Ziglio, 1996).

### *Components*

Important components of any Delphi study are the selection of the expert panel and the number of rounds that will be used to gather feedback from the panelists, as well as the role of the researcher-moderator. The way in which data is collected and analyzed through the use of various statistical procedures is also an important component. Finally, the method chosen for the reporting of the findings of the Delphi study is extremely important.

### *Panels*

Researchers consider the selection of panel members for implementation of the Delphi methodology process to be a critical component. Choosing appropriate panelists directly relates to the quality of the results generated in the Delphi study (Judd, 1972). Unlike other survey research methods that rely on randomized sampling techniques, the Delphi method involves the purposeful sampling of a small group of participants upon whose expert opinions the study is based (Gordon, 1992). Since the Delphi technique focuses on eliciting expert opinions during the Delphi rounds, the selection of panelists

is generally dependent upon the disciplinary areas of expertise required by the specific issue. Regarding any set of standards to follow in choosing Delphi participants, no exact criterion currently listed in the literature exists (Pill, 1971). However, individuals considered to be eligible to serve in a Delphi study include those with related backgrounds and experiences concerning the target issue, those capable of contributing helpful inputs, and those willing to revise their initial or previous judgments for the purpose of attaining consensus (Pill, 1971). Ultimately, the panel members must possess the knowledge, skills, qualifications, and expertise to qualify them as experts for panel service. Any individual under consideration, as an expert, must possess more knowledge about the subject matter than most people (Hill & Fowles, 1975). Of utmost importance to a study is that the participants chosen are truly deemed to be experts since critics have raised methodological concerns regarding the definition of expertise.

Membership in certain professional organizations can be a qualifying criterion for panel selection (Whitman, 1990). Depending upon the intended application of the Delphi study in question, the method of selection can vary (Adler & Ziglio, 1996). Linstone and Turoff (1975) clarify that an expert panel has stakeholders, experts, and facilitators. The stakeholders are those who are or will be affected; experts are those who have a related specialty or correlated experience; while facilitators are those who have skills in organizing, synthesizing, clarifying, and stimulating. To this end, some scholars advocate using persons on the panel who may be affected by the panel's decisions, as well as those named as experts (Linstone & Turoff, 1975).

Delphi panel members can usually be identified through literature searches and/or recommendations from other recognized experts in the field. Adler and Ziglio (1996) purport that Delphi participants should meet four requirements as experts: (1)

knowledge and experience with the issue(s) being examined; (2) willingness and capacity to participate; (3) sufficient time to participate in a Delphi; and (4) effective communication skills. Often, experts consider themselves to be too busy to participate in a multi-round Delphi, but an engaging, concise, well-written questionnaire can frequently entice their participation; interestingly, their round-by-round responses indicate their commitment to the study despite their time constraints (Keil et al., 2002).

An additional avenue of choosing members for an expert panel is the lead-user method. For instance, when a study relates to a specific group or target population, the lead-user method—which is based on the principle that some end-users will adapt the product to meet their needs—can provide invaluable feedback (Duboff & Spaeth, 2000). Examples of the lead-user method in action would be most frequently found in business and marketing research, but it could be applied in education, too. Lead users in the educational field are curriculum innovators, instructional reformers, critical scholars, creative thinkers, or instructional rebels (Duboff & Spaeth, 2000).

Participant interest is an essential element in the panel selection process. Delbecq et al (1986) states that the panel members should:

- Be personally interested and involved in the problem of concern;
- Have pertinent information to share;
- Be motivated enough about the study to include the Delphi task in tasks to be completed;
- Acknowledge that the aggregation of judgments from the respondent panel will include information and/or feedback of value to them (p. 87)

Typically, the necessary time commitment of a Delphi study is frequently intense; consequently, panelists need to understand what their commitment entails, and

then determine whether they are interested in and motivated by the topic of study enough to persevere throughout the study (Wilhelm, 2001). Moreover, the panel selection cannot be one of preference or convenience; it must follow specific criteria. Thus, Delphi participants are purposefully selected to apply their knowledge and expertise within the context, scope, and aims of a particular study.

### *Panel Sizes*

Delphi studies have been conducted with various sizes of panels. To date, sample size in Delphi studies has been researcher- and situation-specific (Akins et al, 2005). Fitch et al. (2001) states that the earliest RAND panels had nine members. Regarding the appropriate number of panelists to involve in a Delphi process, one team of scholars recommends that researchers should utilize a minimally sufficient number of panelists (Delbecq et al., 1975, 1986). According to Delbecq's (1975) team, they recommend that ten to fifteen subjects could be sufficient if the background of the Delphi subjects is homogeneous. Either heterogeneous or homogeneous panels will work; yet, when a group is homogeneous, a smaller sample of between ten to fifteen subjects may yield sufficient results (Delbecq et al., 1975). Moreover, a Delphi panel could consist of fifteen to twenty individuals from a specific homogenous population and five to ten individuals from a heterogeneous population with a different level of expertise and social or professional stratification who have a high level of knowledge and experience with the problem(s) being studied (Clayton, 1997). Studies by Brockhoff (1984) suggest that even groups as few as four can perform well. In contrast, if various reference groups are involved in a Delphi study, more subjects will, most likely, be needed.

While the existing body of research on the Delphi method offers no optimal panel size as a standard, the literature suggests that the panel should include at least ten members (Parente & Anderson-Parente, 1987), but that little improvement in results can be expected if a panel increases beyond twenty-five to thirty members (Brooks, 1979). Witkin and Altschuld (1995) note that the approximate size of a Delphi panel is generally less than fifty, but that larger panels do exist. (Delbecq, Van de Ven, and Gustafson (1975) assert that “few new ideas are generated within a homogenous group once the size exceeds thirty well-chosen participants” (p. 89). No doubt, if the sample size is too small, the subjects may not be considered as having provided a representative pooling of judgments relative to the target issue. Conversely, if the sample size is too large, the drawbacks inherent within the Delphi technique, such as potentially low response rates, for example, and/or increased time commitment issues for respondents and researcher can become problematic (Linstone & Turoff, 1975). Therefore, determining the appropriate number of panelists to serve as experts during the Delphi process is important to the researcher-moderator.

#### *Number of Rounds*

Conducting a Delphi study can be time-consuming. Particularly, when the instrument consists of a large number of statements, panelists may need to dedicate large blocks of time to completing several rounds of questionnaires. The number of rounds in a Delphi technique is variable, depending upon the purpose of the research and the degree of consensus sought by the investigator (Delbecq et al., 1975, 1986). For this reason, there is no absolute in terms of the number of rounds in a Delphi. Typically, the Delphi method involves the circulation of three or four questionnaires in as

many rounds. Delbecq et al. (1975, 1986) and Ulschak (1983) recommend a minimum of forty-five days for the administration of the rounds in a Delphi study.

Regarding time management suggestions between Delphi rounds, scholars recommend giving panelists two weeks to respond to each round's questionnaire (Delbecq et al., 1975, 1986). Custer et al. (1999) emphasizes that three iterations is usually sufficient to collect the needed information for consensus to be reached. Whitman states that the Delphi should continue until a consensus is reached or until there is adequate convergence of the data to permit the researcher-moderator to present the results in the absence of complete consensus (1990). In some cases, if more than three Delphi rounds transpire, researchers report they often see little or no change in the level of consensus, plus the repetitive nature of the process diminishes panel motivation to continue the study (Linstone & Turoff, 1975). Also, as the number of rounds increases and the participants' input continues, researchers purport they have frequently noted a fall in response rate (Rosenbaum, 1985; Thomson, 1985; Alexander, 2004).

Between the iterative Delphi rounds, the researcher-moderator should examine the degree of variability present in the feedback from the expert panel to determine if it is decreasing (Adler & Ziglio, 1996). Frederick Parente and Janet Anderson-Parente conclude that a decrease in variability over successive rounds translates to accuracy of the group prediction. Iterative rounds continue until variability stabilizes. It is generally assumed that the Delphi rounds should cease when it becomes clear that stability has occurred (Murry & Hammons, 1995).



### *Data Collection, Analysis, and Reporting*

The Delphi has the ability to elicit quantitative data similar to other survey research, but it also has the ability to explore qualitative data such as perceptions, attitudes, and moral judgments (Beech, 1999). Typically, data collection consists of four distinct phases with the participant having varying degrees of feedback flexibility per each round. Initially, an exploration phase characterizes the first one or two rounds of questionnaires in which the issues being investigated are explored by participants. Participants may give as much input as they would like on the topic under consideration. Next, the researcher-moderator accumulates the group input and ascertains the overall group view. Then, the researcher-moderator examines opposing views from various members of the expert panel. The researcher-moderator continues to give panelists feedback throughout the process, particularly after each round. An evaluation phase describes the latter rounds of the investigation. In these latter rounds, panelists evaluate the issues identified in the previous exploration phases. Moreover, the last phase of the data collection process occurs after the feedback is returned to the individual members of the expert panel for their analysis and consideration (Piercy & Sprenkle, 2005).

The major statistics typically utilized in data analysis in the Delphi method are descriptive statistics; that is, measures of central tendency (mean, median, and mode), as well as levels of dispersion (standard deviation, variance, and interquartile range) in order to present the collective judgments of respondents (Hasson et al., 2000). The reliance on small samples associated with most Delphi exercises prohibits the utilization of inferential statistics (Gordon, 1992). With descriptive statistics, the mean score, as a measure of central tendency, is sometimes used, representing the average for the

group of experts (Murray & Jarman (1987). Typically, though, the median and mode are the preferred statistics. In the literature, the use of the mode, based upon a Likert-type scale, is strongly favored (Hill & Fowles, 1975). Greatorex and Dexter (2000) explain that if the instrument's scale is in intervals, a measure of central tendency can represent group agreement, while the standard deviation (as a measure of spread) represents the amount of disagreement. The statistical summaries, analyzed between rounds and prepared for panelist presentation by the researcher-moderator, provide feedback to panelists in subsequent rounds, assisting them in decision-making during the Delphi process (Hasson et al., 2000). Brink (2002) indicates that the Delphi is a data collection method, using several rounds of questions to seek consensus on a particular topic from a group of experts on the topic.

It is important to note that the type of criteria to use to both define and determine consensus in a Delphi study is subject to interpretation (Hasson et al., 2000). Theoretically, the Delphi can be continuously iterated until consensus is achieved. The concept of consensus appears to be subjective, however (Williams & Webb, 1994). According to Hasson et al. (2000), no universal determination of consensus exists; it depends upon the aim of the research, the sample size, and resources. Raskin (1994) identifies an interquartile range (IQR) of 1.00 or less as an indicator of consensus, while Spinelli (1983) considers a change of more than one interquartile range (IQR) point in each successive survey round as the criterion for convergence of opinion. Generally, consensus on an issue can be claimed if a certain percentage of the votes fall within a prescribed range (Powell, 2003; Miller, 2006). Avery et al. (2005), for instance, defines consensus as having been achieved if 90 percent or more of the panelists rated statements as *very important* or *important* after the second round. Ulschak (1983)

recommends that consensus is achieved by having 80 percent of subjects' votes fall within two categories on a seven-point scale, while Green (1982) suggests that at least 70 percent of Delphi subjects need to rate three or higher on a four-point Likert-type scale, and the median has to be at 3.25 or higher. Other studies cite ranges of consensus from 50 to 100 percent (Hasson et al., 2000).

In most studies, consensus is considered *high* if the interquartile range (IQR) is no more than one unit on a 4- or 5-unit scale, while *low* consensus occurs with an interquartile range (IQR) of two units (Wilhelm, 2001). The interquartile range (IQR) represents the middle 50 percent of all responses (Turoff & Linstone, 2002). In other terms, the interquartile range (IQR) is defined as the difference between the upper and lower quartiles (Agresti & Agresti, 1979). Because the interquartile range (IQR) method lacks sensitivity in distinguishing degree of agreement, in some cases, for items with an interquartile range (IQR) of 1.00, a secondary criterion for determining consensus for these items exists. Items with an interquartile range (IQR) of 1.00, for which the percentage of generally positive respondents is between 40 and 60, are determined to indicate lack of agreement and are retained for the second round. Conversely, items with an interquartile range (IQR) of 1.00 that have more than 60 percent of respondents answering either generally positive or generally negative are considered to be in agreement (Hakim & Weinblatt, 1993).

In many Delphi studies, consensus is achieved when a certain percentage of the votes fall within two units on a ten-unit scale (Turoff & Linstone, 2002). In a study by Turoff and Linstone (2002), *high* consensus occurred when at least 80 percent of the study participants completely agreed with a decision, *moderate* consensus occurred—at 60 to 79 percent—and *low* consensus occurred—at less than 60 percent, respectively.

A more reliable alternative, according to Scheibe, Skutsch, and Schofer (1975), is to measure the stability of panelists' responses in successive iterations. In other words, a measure which takes into account the variations from the norm of the respondents' vote distribution curve over successive Delphi rounds is stability (Scheibe et al., 1975). The stability between rounds—the change in opinion—should be determined, given this is also an indication of consensus (Greatorex & Dexter, 2000). Yet, the question of what constitutes stability remains unanswered since no true statistical level has yet been set in the literature (Greenwald, 1968). The concept, though, is that iterative polling of panelists continues until variability has ceased (Parente & Anderson-Parente (1987). Typically, three Delphi rounds are sufficient in denoting stability and consensus.

In some studies, the shift in opinion from the first to the second survey round is assessed using qualitative methods. The McNemar (1947) test may be used to quantify the degree of shift in responses from the first to the second phase. This test, which is from the chi-square tests, determines whether the percentage of respondents who become more positive on a given item differs significantly from the percentage of respondents who become more negative. Furthermore, the Kendall (1955) rank correlation coefficient evaluates the degree of similarity between two sets of ranks given to a same set of objects. This coefficient depends upon the number of inversions of pairs of objects which would be needed to transform one rank order into the other. This coding schema provides a set of binary values which are then used to compute a Pearson correlation coefficient. If measures of central tendency and measures of dispersion are not sufficient enough in terms of being indicators of agreement and/or

disagreement for a study's findings, these additional applications—the McNemar test and the Kendall rank correlation coefficient—may be considered for use.

When reporting Delphi results, the anonymity of members' responses should be maintained within the reporting document. This document presents both areas of agreement and disagreement for panelists' consideration in maintaining or modifying their responses from round to round. The reported conclusions are supported by relevant data from the previous rounds (Wilhelm, 2001). Data reporting usually is presented in both narrative and tabular form (Piercy & Sprenkle, 2005). The main purpose of the final report is to showcase the panelists' collective viewpoints as a group, as well as to assist individual members in understanding others' viewpoints.

### *Validity*

Research methods for establishing validity include completing a thorough review of the literature in order to construct an item pool for a study's questionnaires, as well as achieving expert panel consensus. Murry and Hammons (1995) report that the Delphi method, as a valid research technique, can be implemented when: (1) the logistical constraints make repeated multiple group meetings infeasible; (2) the panelists needed to contribute have diverse backgrounds and no established history of communication; (3) the group process must incorporate too many individuals for a face-to-face group exchange; and (4) the disagreements among individuals are potentially so politically unpalatable that the communication process must be refereed and/or anonymity assured. Regarding the data gathering process in the Delphi, it is executed in a series of rounds (Powell (2003). Williams and Webb (1994) report that this data gathering process during successive rounds facilitates systematic control in a research project,

enhancing the objectivity and validity of the results obtained. Most importantly, the Delphi method and other consensus development tools should not be viewed as a scientific method for creating new knowledge; rather, they are processes for making optimum use of available information—whether that is scientific data or the collective wisdom of experts (Murphy et al., 1998, p. 5).

While convergence of expert opinion, itself, is not enough to validate the Delphi method, it is convergence toward the correct value that counts (Helmer, 1983). Dalkey and Helmer (1968) have well documented that statistically Delphi techniques tend to produce not only convergence, but also that convergence is in the direction of the true value. Furthermore, Helmer (1983), in his studies, showcases explicit evidence of the validity of the Delphi technique in producing relatively reliable forecasts. In addition, per Martino (1983), the results of the Delphi process are only as valid as the opinions of the experts on the panel. Since one of the Delphi goals is consensus, it is essential that experts among whom consensus is being reached represent the appropriate body of experts for the issue being studied.

Panel selection, therefore, is a critical aspect of the Delphi research study's validity. Spencer-Cooke (1989) emphasizes that the composition of the panel relates to the validity of the results of the research. Indeed, the heart of the validity of the study is the manner in which the expert panel is selected. "Throughout the Delphi literature, the definition of [Delphi subjects] has remained ambiguous" (Kaplan, 1971, p. 24). Yet, Delphi subjects should be highly trained and competent within the specialized area of knowledge related to the target issue (Delbecq et al., 1975). Guidelines for selecting Delphi subjects are as follows, according to Pill (1971) and Oh (1974):

- Choose individuals who have related backgrounds and expertise concerning the target issue;
- Select individuals who are capable of contributing helpful inputs and willing to revise initial or previous judgments for the purpose of attaining consensus

In addition, since traditional validity measures are not relevant for the Delphi methodology, it strengthens validity of the study if the panelists' selection guidelines are evaluated by professionals in the field before panel selection occurs (Piercy & Sprenkle, 2005).

In addition, panel size should be considered in the planning stages of the Delphi process. The literature suggests that the acceptable minimum number of participants is dependent upon the study focus and design (Brockhoff, 1984; Akins et al., 2005). Researchers, however, have yet to agree on the optimal Delphi panel size (Parente & Anderson-Parente, 1987). Concerning the appropriate number of panelists to involve in a Delphi process, one team of scholars recommends that researchers should utilize a minimally sufficient number of panelists (Delbecq et al., 1975, 1986). While ten panelists should be the absolute minimum for panel membership, according to Parente and Anderson-Parente (1987), no maximum exists in the research for the number of participants in a Delphi study. Other theorists maintain that the point of diminishing returns emerges with respect to larger panel sizes, at some point, during the Delphi process (Brooks, 1979). Delbecq, Van de Ven, and Gustafson (1975) claim that "few new ideas are generated within a homogenous group once the size exceeds thirty well-chosen participants" (p. 89). Brooks (1979) supports a maximum number of participants of only twenty-five. Yet, a smaller sample of between ten to fifteen subjects may yield sufficient results (Delbecq et al., 1975). Thus, finding the balance between

too many and too few panelists challenges the researcher-moderator seeking to obtain validity in his or her research study.

### *Reliability*

Although what constitutes an upper limit for panel size is debatable in the research community, most scholars support the idea that reliability improves and error is reduced as sample size increases (Cochran, 1983; Powell, 2003). The sample size for a Delphi panel is not a statistically-bound decision, though, and effective results can be obtained by a comparatively small group of homogeneous experts (Adler & Ziglio, 1996). In fact, the study by Akins et al. (2005) establishes that small panels of similarly trained experts in a related field of interest provide reliable criteria to inform judgment and effective decision-making. Representativeness depends upon the qualities of the expert panel rather than on the sample size (Powell, 2003). Since specialized experts in a given field may be limited, the results of Akins's et al. (2005) study suggest that utilization of a small expert sample may be used with confidence.

In the Delphi process, the researcher-moderator must examine the degree of consensus found among the panelists between the initial and subsequent rounds as a measure of reliability. With consensus, it can reasonably be assumed that an acceptable degree of reliability can be inferred (Piercy & Sprenkle, 2005). Per Linstone and Turoff (1975), well-informed individuals, using their insights and expertise, are better equipped to make future predictions than theoretical approaches or extrapolation of trends. In general, researchers view the Delphi technique as a procedure to “obtain the most reliable consensus of opinion from a group of experts through a series of questionnaires interspersed with controlled opinion feedback” (Dalkey & Helmer, 1968,



p. 458). The underlying assumption of the Delphi method, then, is that the informed, collective judgment of a group of experts is more accurate and reliable than individual judgment within dynamic environments where effective decision-making is dependent upon the knowledge and expertise of people (Gordon, 1992; Adler & Ziglio, 1996; Clayton, 1997).

### *Delphi Research Studies*

Since its introduction as a research approach in the 1950s, the Delphi technique has had over one thousand published research utilizations (Adler & Ziglio, 1996). While most of the 1950s and 1960s Delphi studies highlighted technology forecasting, a study conducted by Milkovich et al. (1972) reports the use of the Delphi method in manpower forecasting. Studies by Wissema (1982) and Helmer (1983) continue to support the Delphi method for technology forecasting. Helmer (1983) study, in particular, points to the explicit evidence of the validity of the Delphi technique in producing relatively reliable forecasts. Dalkey and Helmer (1968) have well documented that statistically the Delphi technique tends to produce not only convergence, but also that convergence is in the direction of the true value.

In the late '80s and '90s, a number of the Delphi studies dealt with aspects of research and curriculum development (Sutphin & Camp, 1990; Chizari & Taylor, 1991). Raskin's (1989) national study incorporated a three-phase Delphi to identify the top five research issues in field instruction via an expert panel. The identification of research needs also provided the focus for three more articles in which the Delphi technique was used (Buriak & Shinn, 1993). Furthermore, three articles regarding the Delphi process dealt with an evaluation of perceptions (Blezek & Dillon, 1991). Determination of

competencies was yet another area in which the Delphi found applications during this time (Ruhland, 1993). Other articles utilized the Delphi to establish program objectives (Smith & Kahler, 1987) and to engage internal and external experts in the Delphi process (Buriak & Shinn, 1989, 1993).

Another type of Delphi, other than a conventional Delphi, was used in a high proportion of the studies. Only ten articles employed a Delphi without additional qualification. The majority used modifications and variants of the Delphi technique (Adler & Ziglio, 1996). In general, the Delphi method is useful in answering single-dimension questions. Less support exists for its use to determine complex forecasts concerning multiple factors (Gatewood & Gatewood, 1983).

### *Significance*

In social science research, the Delphi has the potential for many different applications. It can be used as committee input, output, or designed as a committee evaluation tool, as well as for forecasting. Moreover, the Delphi can be developed into a tool to examine the effectiveness of policy processes, for example, as well as a vehicle for formulation, development, and/or assessment (Strauss & Zeigler, 1975). Since its origin at the RAND Corporation in the 1950s, the Delphi method has become a widely used tool for forecasting and decision-making in many arenas (Rowe & Wright, 1999). In fact, its use has spread from its origins in the defense community in the United States to a wide variety of uses in numerous countries (Rowe & Wright, 1999). Its applications have extended from the prediction of long-range trends in science and technology to applications in policy formation and decision-making. A sampling of literature reveals how widespread the Delphi methodology is utilized. From the health

care industry (Hudak et al., 1993), marketing (Lunsford & Fussell, 1993), information systems (Neiderman et al., 1991), transportation and engineering (Saito & Sinha, 1991), to education (Olshfski & Joseph, 1991), the Delphi technique is becoming more widespread as a decision-making tool.

Furthermore, the Delphi's characteristics and its iterative process equip the Delphi to potentially bridge the gap between theory and practice. Moreover, the Delphi makes it possible to survey experts about important issues and get practical feedback because the Delphi does not require large samples, intense statistical analysis, or high-cost budgets. Its central rationale offers that the collective judgment and wisdom of participating experts is better than the estimates and/or predictions of any one expert individually (Strauss & Ziegler, 1975). As Enzer et al. (1971) observe, Delphi studies are usually better than other methods for eliciting and processing judgmental data since they (1) maintain attention directly on the issue; (2) provide a framework within which panelists with diverse backgrounds and/or in remote locations can work together on the same issues; and (3) produce precise documented records that track and report the process and outcomes. Indeed, the Delphi technique can be used to solicit interpretations, predictions, or recommendations. The ultimate value of the Delphi method pertains to its use for structuring group interaction and generating possible solutions to complex issues or problems.

### **Summary**

The Delphi portion of the literature review has defined the Delphi method, giving its historical background, goals and objectives, types of Delphi, as well as characteristics and attributes. In addition, this part of the literature review has examined

the instrument design, application, process, strengths and weaknesses of this research method, as well as its specific components such as panels, rounds, along with its data collection, analysis, and reporting features. It has also addressed the issues of validity, reliability, research studies, and significance. The Delphi method is the research design of choice for this dissertation study regarding the determination of which research-identified differentiated instructional elements are the most effective for improving student performance.

No doubt, differentiated instruction is the subject of a wealth of literature. Understanding the historical perspectives of differentiated instruction, the basis for the claims regarding the contribution of differentiated instruction to student success, and the methodological characteristics of the Delphi method are important for successful implementation of the research proposed. The research framework presented in this chapter will prove to be useful in the development of a Delphi questionnaire that will effectively measure principals' perceptions regarding the degree of effectiveness of research-identified differentiated instruction elements in improving student performance.

## **CHAPTER III**

### **METHODOLOGY AND PROCEDURES**

#### **Introduction**

This chapter describes the research methodology and procedures that were implemented in this study of the effectiveness of research-identified differentiated instructional elements in terms of improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas. Overall, Chapter III includes four major sections: design, population, procedures and process.

#### **Research Design**

Since its inception in the 1950s, the Delphi methodology has been implemented in a variety of research studies, garnering consensus and expanding in application. The Delphi has the ability to elicit quantitative data similar to other survey research, but also has the ability to explore qualitative data such as perceptions, attitudes, and moral judgments (Beech, 1999). Its potential equips the Delphi to potentially bridge the gap between theory and practice. According to Adler & Ziglio (1996), the Delphi method is based upon a structured process for collecting and distilling knowledge from a selected group of experts by means of a series of questionnaires—using multiple iterations—that are interspersed with controlled opinion feedback as a method for consensus-building (p. 10). Interestingly, Linstone (1978) emphasizes two circumstances for which the Delphi is most appropriate, described as follows: (1) The problem does not lend itself to precise analytical techniques but can benefit from collective subjective judgments of

experts of varying backgrounds, experiences, and expertise; and (2) Individuals who need to interact during the process cannot meet in face-to-face exchanges due to time, location, or cost constraints. Since both of these circumstances apply to this study, the researcher-moderator selected the modified Delphi method as the research design. Granted, the Delphi method should not be viewed as a scientific method for creating new knowledge; rather, it is a process for making optimum use of available information—whether that is scientific data or the collective wisdom of experts (Murphy et al., 1998, p. 5).

The appeal of using a Delphi process is its flexibility in procedure, as well as the opportunity for participants to alter their responses, if needed, during the iterative process (McKillip, 1987). A benefit of the Delphi methodology is that it allows respondents to see how closely their responses merge, or not, with other participants' (McKillip, 1987). One of the main strengths of the Delphi is that it allows an expert panel to give responses and/or comments on issues—with anonymity—without being subjected to potentially disagreeable group dynamics sometimes associated with collaborative projects. With its asynchronous nature, the Delphi also spares the panelists from not being able to participate due to time, location, or cost constraints.

The application of the Delphi methodology in this research study utilized a variant of the conventional (classical) Delphi. With a conventional Delphi, the initial round's questionnaire is typically open-ended. Generally, the expert panel's task is to identify critical issues, concerns, and/or needs regarding the research topic with which they are presented. Conversely, for this modified Delphi study, in the first round, panelists were presented with thirteen research-identified differentiated instructional elements in questions #5 through #8 to rate, via a four-point Likert-type scale, according

to their perception of the degree of effectiveness of each element in improving student performance. The prioritization choices on the four-point Likert-type scale were a “4” (*significant*), “3” (*moderate*), “2” (*minimal*), or a “1” (*none*) for ranking the degree of effectiveness of the thirteen research-identified differentiated instructional elements in terms of improving student performance. Principals, in question #9, had an open-ended opportunity in the first round to add any differentiated instructional elements that had not already been identified in existing research that they perceived to be critical for student success. Thus, this study—as a modified Delphi—began where a conventional Delphi study would usually have begun in Round Two of the process.

In the second round, the researcher-moderator provided principals with feedback on the collective and individual data analysis, which was representative of their input from the first round. For data analysis, the researcher-moderator used measures of central tendency and dispersion to analyze the data. Specifically, for this study, the measure of central tendency utilized was the mode (defined as the most frequent value of a frequency distribution), and the measures of dispersion (spread) used were the standard deviation, variance, and the interquartile range (IQR). Grotorex and Dexter (2000) explain that if the instrument’s scale is in intervals, measures of central tendency provide representation of agreement, while measures of dispersion provide representations of disagreement. Since the interquartile range (IQR) is an indicator of consensus, the researcher-moderator calculated the interquartile range (IQR) for each of the survey elements’ (questions #5 through #8) responses to determine consensus. The interquartile range (IQR) represents the middle 50 percent (Turoff & Linstone, 2002). The interquartile range (IQR) of the data was calculated by finding the difference between the upper (75<sup>th</sup> percentile) and lower (lower 25<sup>th</sup>

percentile) quartiles (Agresti & Agresti, 1979), which is the middle 50 percent. Furthermore, Raskin (1994) identifies an interquartile range (IQR) of 1.00 or less as an indicator of consensus. Because the interquartile range (IQR) frequently lacks sensitivity in distinguishing degree of agreement—and it did in this study—the mode was used, as well, for determining consensus.

This researcher-moderator selected these aforementioned descriptive statistics for this study, but many Delphi studies utilize the median as the measure of central tendency of choice, while sometimes the mean is used. The mean represents the average of a range of numbers or values, while the median represents the midpoint (Murray & Jarman, 1987). Descriptive statistics are commonly used in Delphi studies because the reliance on small samples associated with most Delphi exercises prohibits the utilization of inferential statistics (Gordon, 1992).

Neither the median nor mean were utilized as measures of central tendency for this study, however, because the mode proved to be a definitive representation of the most frequent values of the frequency distribution of each of the number rankings (“4’s,” “3’s,” “2’s,” “1’s”) of the thirteen research-identified differentiated instructional elements (questions #5 through #8) that principals submitted during the three Delphi survey rounds in this study. To ultimately reach consensus, it was essential to determine the mode for each element in order to ascertain the ranking (“4,” “3,” “2,” “1”) that the greater percentage of principals had given to each element (questions #5 through #8).

In addition to viewing the collective data from the entire panel after each survey round, panel members were also shown by the researcher-moderator their individual statements in the survey that were answered outside of the interquartile range (IQR) and mode. In subsequent rounds—after receiving feedback from each previous round



from the researcher-moderator—panelists could either modify their response(s) to be within the identified interquartile range (IQR) and mode, or they could maintain their response(s), providing justification as to why they perceived their response(s) was (were) appropriate. This justification was shared, as feedback, with the entire panel for consideration in the subsequent round of the Delphi process.

Overall, this iterative Delphi process, repeated itself for two rounds, after the conclusion of the first round, until the expert panel reached consensus in the third round. It is important to note that the type of criteria to use to both define and determine consensus in a Delphi study is subject to interpretation. Theoretically, the Delphi can be continuously iterated until consensus is achieved. The concept of consensus appears to be subjective, however (Williams & Webb, 1994). According to Hasson et al. (2000), no universal determination of consensus exists; it depends upon the aim of the research, the sample size, and resources. The researcher-moderator used the interquartile range (IQR) of 1.00 or less as a determinant of consensus, as well as the mode—plus calculated the variance and standard deviation—for each element in questions #5 through #8.

Furthermore, a measure which takes into account the variations from the norm of the respondents' vote distribution curve over successive Delphi rounds is known as stability (Scheibe et al., 1975). The concept of stability—the change in opinion—infers that iterative polling of panelists continues until variability has ceased (Parente & Anderson-Parente (1987). Typically, three Delphi rounds are sufficient in denoting stability and consensus. This Delphi study engaged in three iterative rounds to reach consensus and stability.

### Research Population

Of utmost importance to this Delta study is the fact that the participants chosen to be the research population must be experts in their field. Unlike other survey research methods that rely on randomized sampling techniques, the Delphi method involves the purposeful sampling of a small group of participants upon whose expert opinions the study is based (Gordon, 1992). Spencer-Cooke (1989) emphasizes that the composition of the panel relates to the validity of the results of the research. Indeed, the heart of the validity of the study is the manner in which the expert panel is selected. Depending upon the intended application of the Delphi study in question, the method of selection can vary (Adler & Ziglio, 1996). Any individual under consideration, as an expert, must possess more knowledge about the subject matter than most people (Hill & Fowles, 1975). Taking these facts into consideration, the thirty-four eligible “experts” for this study were Texas public high school principals with at least three years’ tenure, who were employed on 2A to 5A “Exemplary” campuses, designated as such by the Texas Education Agency 2009 *Academic Excellence Indicator System (AEIS)*.

Specifically, the eligibility categories for participating as an expert on this research study’s panel included the Texas Education Agency campus accountability ratings, school size and composition, and the principal’s tenure. Potential participants were qualified for the research study by being a principal for three years or more in a 2A, 3A, 4A, or 5A district—serving in a traditional public high school that is comprehensive in nature, rather than in an academy or magnet school—with a Texas Education Agency’s *Academic Excellence Indicator System (AEIS)* “Exemplary” campus accountability rating for 2009. The Texas Education Agency rates every

campus in Texas with an accountability rating each year via the *Academic Excellence Indicator System (AEIS)*. These accountability ratings include the rankings of “Exemplary,” “Recognized,” “Academically Acceptable,” and “Academically Unacceptable.” Thus, principals of schools receiving a campus accountability rating of “Exemplary” on their 2009 *AEIS* report were identified as possible participants for the research study, pending qualification within the other eligibility criteria.

The school size eligibility criterion for potential participants was based on the University Interscholastic League’s (UIL’s) conference designation for each Texas public high school. Biennially, the University Interscholastic League (UIL) designates a conference (1A, 2A, 3A, 4A, 5A) within which a member school participates, based upon the number of students enrolled in grades 9 through 12 on the *Public Education Information Management System (PEIMS)* “Snapshot Day” (the last Friday in October) in a given school year. An eligibility criterion for this study was for potential participants to have been employed as a principal in a 2A, 3A, 4A, or 5A school district in Texas during the 2008-2009 school year in a public high school campus that received an “Exemplary” campus rating for 2009. During 2008-2009, a Conference 5A high school enrolled at least 1985 students, a Conference 4A school enrolled at least 950 students, a Conference 3A school enrolled at least 475, and a Conference 2A enrolled at least 250. In this research study, the twenty-four principals represented 2A (7 for 29%), 3A (5 for 21%), 4A (3 for 12%), and 5A (9 for 38%). Appendix I displays a list of the principals in this study with their University Interscholastic League designations. Beyond utilizing the school size as a qualifier, the school’s composition was deemed to be an important factor for validity of the study. The principals serving in a traditional public high school that is comprehensive in nature, rather than in an academy or

magnet school, for example, were deemed to have been more likely to have had experiences dealing with all aspects of the accountability spectrum. Thus, the rationale in imposing the school size and composition criterion was to ensure that participating principals were leaders in Texas public high schools who had the knowledge, experience, and expertise to serve on this study's homogeneous expert panel.

Lastly, to qualify as a potential participant, a principal on an "Exemplary" public high school campus needed to have had a minimum of three years' principal's experience. The rationale underlying this criterion was to validate that the participant principal would be knowledgeable, experienced, and invested in the student performance aspects on his or her campus, rather than having inherited a high degree of student academic success, so as not to skew the results of the study. With these considerations, the decision was made that a principal would need to have been in his or her current position for at least three years to be eligible for participation in this study. Collectively, the principals in this study have 233 years of experience, averaging 9.7 years of experience for each principal in the study. Of the twenty-four principals in this study, ten had from three to five years' of experience (42%), nine had from seven to fourteen years' of experience (38%), and five had from fifteen to thirty years' of experience (20%) (Figure 1).

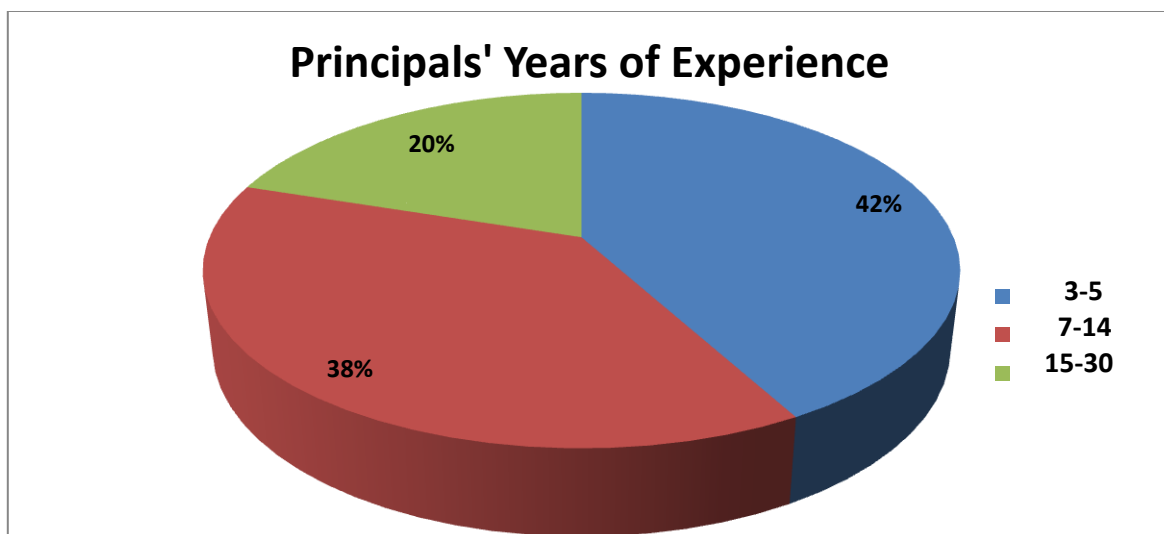


Figure 1. Principals' Years of Experience

Appendix I displays a list of the principals in this study, their years' of experience, and by what means they acquired the majority of their knowledge and training regarding differentiated instruction, whether via on-the-job training, professional development, coursework, independent study, or with a mentor.

Regarding the tenure eligibility criterion, however, three exceptions were made in selecting the expert panel for this study. One principal, who met the other two eligibility criteria for the study, had been the high school principal for the previous five years, but he was assigned as the junior high school principal during the school year of this study. In a telephone interview between the researcher-moderator and the potential participant, it was determined that he was knowledgeable, experienced, and invested enough in his high school to serve as an expert on this study's panel. Additionally, two principals had two years, rather than three, of principal experience on their campuses, but both had served as assistant principals on their respective campuses the previous two and three years, respectively. Both also met the other two

eligibility criterion, so, after a telephone interview as verification regarding each of them, it was determined by the researcher-moderator to include them in this research study, as well.

The eligibility criterion regarding the time each principal had served in his or her current principal's role on campus was investigated. Including the three who were the aforementioned exceptions to this criterion, thirty-four principals were identified as eligible participants to serve on the expert panel for this study. Given the small number of individuals meeting the eligibility criteria, the researcher-moderator decided to invite all to participate, rather than to perform any sampling procedures. While it was anticipated that all of the identified principals would agree to participate in the study, the researcher-moderator framed the study to include no less than fifteen participants in order to provide representativeness.

Since traditional validity measures are not relevant for the Delphi methodology, to strengthen the validity of this study, the panelists' eligibility criteria were evaluated by professionals in the field—both at the Texas Education Agency and at Texas A&M University—before the panel selection occurred, adhering to the literature-based advice of Piercy and Sprenkle (2005). While the existing body of research on the Delphi method offers no optimal panel size as a standard, the literature suggests that the panel should include at least ten members (Parente & Anderson-Parente, 1987), but that little improvement in results can be expected if a panel increases beyond twenty-five to thirty members (Brooks, 1979). Thus, this study's eligibility criteria were applied to the 1,235 school districts in Texas to obtain an expert panel. Examining the Texas Education Agency's *Academic Excellence Indicator System (AEIS)* "Exemplary" campus accountability ratings for 2009, the researcher-moderator ascertained that 135 Texas

high schools were rated as “Exemplary.” Therefore, 135 Texas high schools satisfied the initial eligibility criterion based upon their “Exemplary” accountability rating for 2009. Yet, when the school size / composition criterion was applied to these 135 schools, it was determined that only 49 Texas public high schools were eligible for participation, given their University Interscholastic League conference designation of 2A, 3A, 4A, or 5A, as well as school composition. When the three-year tenure criterion was applied, by means of email inquiry and/or telephone interviews, 34 principals of the 49 were identified as eligible participants to serve on the expert panel for this study. Contact information for principals of “Exemplary” public high schools in Texas for 2009 was obtained via the online *Texas School Directory*. Of the 34 eligible principals, 24 principals participated in all three rounds in this research study for a seventy-one percent (71%) participation rate.

### **Research Procedures**

Determining the most effective research-identified differentiated instructional elements for improving student performance as perceived by secondary principals of “Exemplary” public high schools in Texas in 2009, was the research focus of this study. The research methodology utilized was the Delphi technique. The Delphi technique employed the use of iterative rounds of questionnaires which were sent to the participants to solicit, evaluate, and tabulate independent expert opinion, based on principals’ perceptions, to reach consensus. Given that questions #5 through #8 of this study’s Round One questionnaire were structured statements to reflect the literature, rather than being open-ended, the Delphi process utilized in this study was considered to be modified, rather than conventional. The Delphi methodology used was not viewed

by the researcher-moderator as a scientific method for creating new knowledge (Murphy et al., 1998, p. 5); rather, it was viewed as a process for making optimum use of available information that could potentially contribute to evidence-based education and the current knowledge base by ascertaining which research-identified differentiated instructional elements are the most effective for improving student performance, according to principals of “Exemplary” 2A to 5A public high schools in Texas in 2009.

Initially, a survey invitational letter and email—along with the *Differentiated Instruction’s Impact: Texas Principals’ Perceptions Survey*, research packet materials, and a stamped, addressed envelope—was sent to qualifying panelists to request their participation in the research study. See Appendix A for the *Informed Consent* form, including the survey participation preference options. Contact information for principals of “Exemplary” public high schools in Texas for 2009 was obtained via the online *Texas School Directory*. The *Informed Consent* form, as approved by Texas A&M University’s Institutional Review Board (IRB), was sent in order to inform eligible principals of the study’s guidelines and to obtain written consent and participation.

In addition, participants were informed via the *Informed Consent* form’s survey participation preference options that they could choose to participate, or not, (1) by receiving an emailed copy of the questionnaire and emailing their survey responses back to the researcher-moderator or (2) by completing the print copy of the questionnaire mailed to them and mailing their survey responses back to the researcher-moderator. The survey participation preference options were included in the Round One research packet for each participant to communicate their preference as to how they desired to respond, or not, to the surveys: (1) emailed survey / emailed response return or (2) print copy survey / postal service return. Four follow-up emails



inviting research study participation were sent to those qualifying participants who did not promptly respond to the initial Round One questionnaire (Appendix A). In addition, a telephone call inviting research study participation was made, if necessary, to those qualifying participants who did not promptly respond to the initial Round One questionnaire (Appendix A).

As panel experts, the eligible participants were Texas high school campus principals who were employed on 2A to 5A “Exemplary” campuses. The high school campus principals participating in the research study were selected in partnership with the Texas Education Agency (TEA) and the University Interscholastic League (UIL), using the criteria that (1) the campus will be an “Exemplary” rated public high school via the 2009 *Academic Excellence Indicator System (AEIS)*; (2) the high school will be a Texas public high school that is traditional and comprehensive in nature with a University Interscholastic League (UIL) conference designation for a school size of 2A, 3A, 4A, or 5A; and (3) the campus principal will have at least three years’ experience.

Specifically, then, the research study consisted of eligible principals who were qualified to serve as experts in the study, given they had been in a principal leadership role for at least three years on a 2A, 3A, 4A, or 5A Texas public high school campus that received an accountability rating of “Exemplary” in 2009.

Round One of the Delphi process presented respondents with a ten-question survey regarding research-identified differentiated instructional elements. Targeted high school principal survey participants used the questionnaire’s four-point Likert scale to rate—according to their perception and determination as a principal—each research-identified differentiated instructional element’s (on questions #5 through #8) degree of effectiveness for improving student performance. The ten-question survey consisted of

a principal profile section—for the initial question—which sought to determine how many years each participant had been a principal. Question #2 requested that the participants identify the source(s) from which they had learned the most about differentiated instruction. Survey questions #3 and #4 asked participants about their teachers' frequency of usage of differentiated instructional elements during the school year. The next set of survey questions (#5 through #8)—which were structured statements extracted from the literature—requested that the participants rank—via a four-point Likert scale—the effectiveness of their teachers' usage of research-identified differentiated instructional elements in improving their students' Spring 2009 TAKS performances. Extracted from the literature on differentiated instruction, the survey questions, #5 through #8, addressed such research-identified differentiated instructional elements as curriculum compacting, flexible grouping, varied instructional strategies, tiered assignments, student choice in learning contracts, higher-order questioning, problem-based learning, and assessment options within the contexts of content, process, and product. Question #9—an open-ended question—requested participants to identify differentiated instructional elements that had not already been identified in existing research that they perceived to be critical to students success. Finally, in question #10, panelists were asked to rate—according to their perceptions—the impact of using differentiated instruction on their campus to enhance their students' Spring 2009 TAKS performances.

To recap, in Round One, the ten-question survey consisted of four questions for which participants ranked each research-identified differentiated instructional element's degree of effectiveness for improving their students' Spring 2009 TAKS performances, plus one open-ended question (#9), in addition to three principal profile questions and

two questions relative to the frequency of differentiated instructional element usage by teachers. The four-point Likert scale used for several questions (#4 through #8, and #10) in the survey consisted of the following choices for participants to use to rank the degree of effectiveness of research-identified differentiated instructional elements for improving their students' Spring 2009 TAKS performances:

- *Significant* (4)
- *Moderate* (3)
- *Minimal* (2)
- *None* (1)

Round Two informed each participant of the entire group's collectively ranked responses to the structured questionnaire. Participant responses to individual survey questions in Round One which fell outside the mode and interquartile range (IQR) of responses for the entire group were also presented confidentially to individuals, along with the variance and standard deviation, with the opportunity in Round Two for panelists to either maintain or modify (with justification) any of their initial responses. In each round, the prioritized list of most effective research-identified differentiated instructional elements reflected the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*), or "1's" (*none*)—in descending order—as indicative of the principals' utilization of the four-point Likert scale. In Round Two, panelists were asked to approve or change the prioritized list of most effective research-identified differentiated instructional elements presented, as emanating from the panelists' input in Round One, in terms of each element's degree of effectiveness for improving student performance. Round Two also presented any differentiated

instructional elements identified by principals in Round One on question #9 that had not already been identified in existing research that principals perceived to be critical for student success. In Round Two, participants were presented with the opportunity to approve or modify the ranked entries.

Next, respondents received the follow-up group survey results, as well as their individual input, from Round Two in Round Three. Participant responses to individual survey questions in Round Two which fell outside the mode and interquartile range (IQR) of responses for the entire group were presented confidentially to individuals in Round Three, along with the opportunity for these panelists to either maintain or modify any of their Round Two responses. In each round, the prioritized list of most effective research-identified differentiated instructional elements reflected the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of “4’s” (*significant*), “3’s” (*moderate*), “2’s” (*minimal*), or “1’s” (*none*)—in descending order—as indicative of the principals’ utilization of the four-point Likert scale. Individual respondents were asked to approve the prioritized list of most effective research-identified differentiated instructional elements or to make changes. Round Three presented any additional differentiated instructional elements identified by principals in Round One and/or those potentially added or edited in Round Two. In Round Three, participants were presented with another opportunity to approve or modify the ranked entries.

The iterative process continued for three rounds, in the aforementioned format, until convergence became consensus, and stability was achieved. Final prioritized lists of the most effective research-identified differentiated instructional elements—those

emanating from the literature and those identified as additional differentiated instructional elements—were distributed to the expert panel for review.

### **Research Process**

On December 10, 2009, the Institutional Review Board (IRB) of the Office of Research Compliance at Texas A&M University issued a Category Two exemption, indicating approval to proceed with this research project, Protocol Number 2009-0851. Subsequently, the researcher-moderator, referred to as the Principal Investigator on the approved *Informed Consent* form approved by the Institutional Review Board (IRB), began the preparations to implement the research study described in Chapter I of this dissertation (Appendix A). The researcher-moderator used the study's approved selection criteria to identify thirty-four eligible principals who had at least three years' tenure as the principal on a 2009 "Exemplary" 2A, 3A, 4A, or 5A public Texas high school campus.

On Friday, December 11, 2009, the research packets for Round One of the Delphi study were mailed to the thirty-four eligible Texas principals at their school addresses (Appendix A). Their school addresses and contact data were retrieved from the online *Texas School Directory*. On Friday, December 11, 2009, the research packets for Round One of the Delphi study were also emailed to the thirty-four eligible Texas principals. The mailed research packets included a survey invitational letter, along with the *Differentiated Instruction's Impact: Texas Principals' Perceptions Survey*, the *Informed Consent* form, plus a survey participation preference form, and a stamped, addressed envelope. Examples of these research packet items can be found in Appendix A. The emailed research packets included the same items as those that were

mailed, except for the stamped, addressed envelopes. The Round One survey associated with the emailed research packets was electronically emailed to eligible principals via the Qualtrics.com website. Since Texas A&M University has a subscription with Qualtrics, graduate students are allowed to design a survey that is affiliated with an approved research study, input panelists and email addresses, and distribute the questionnaire electronically for panelists' responses, which this researcher-moderator did for Round One of the Delphi process via Qualtrics survey software on the Qualtrics.com website.

The purpose of the study, along with a brief explanation of the Delphi research design and the anticipated timeframe for the study, as well as the potential benefits of participation were clarified in the survey invitational letter, plus instructions were given to principals relative to returning the completed and signed *Informed Consent* form, the survey participation preference form, and the *Differentiated Instruction's Impact: Texas Principals' Perceptions Survey*, if they elected to participate, by Thursday, December 17, 2009, if possible, given that the Christmas school holidays were about to begin for the principals on Friday, December 18, 2009 (Appendix A). Typically, more time would have initially been allotted for the principals' responses, but their Christmas school holidays were imminent, in this case. Consequently, the researcher-moderator followed up after the Christmas school holidays with eligible principals to remind them to participate.

In addition to the survey, the *Informed Consent* form, as approved by Texas A&M University's Institutional Review Board (IRB), was sent in the research packets in order to inform eligible principals of the study's guidelines and to obtain written consent and participation (Appendix A). In addition, participants were informed via the survey

participation preference form of the options that they had for receiving and returning surveys if they elected to participate. The first option for them was to receive emailed surveys, with the option of emailing their survey responses back to the researcher-moderator, while the second option was for them to receive and return their surveys by mail to the researcher-moderator.

On Tuesday, December 15, and Friday, December 18, 2009, two follow-up emails inviting research study participation were sent to the qualifying participants who did not promptly respond to the initial Round One questionnaire. Examples of these emails can be found in Appendix B and C, respectively. In addition, a telephone call encouraging research study participation was made on Friday, December 18, 2009, to the qualifying participants who did not promptly respond to the initial Round One questionnaire. An example of the telephone script can be found in Appendix D.

As a result of the research packet invitations being mailed and emailed to the thirty-four eligible principals on December 11, 2009, seven completed and signed *Informed Consent* forms, survey participation preference forms, and completed surveys were returned via email and the mail during the week of December 14 through 18, 2009 (Appendix A). The participation rate for this group of respondents was 21 percent of the thirty-four eligible principals. Of the seven returned surveys, four were mailed and three were emailed.

After the two-week Christmas holiday school break, the principals returned to their campuses on Monday, January 4, 2010. The researcher-moderator followed up with eligible principals on that day by email (Appendix E) to provide a reminder to those who had not yet responded to participate in the research study since they had only had the week of December 14 through 18, 2009, to respond, initially. Therefore, during the

two weeks of January 4-8 and January 11-15 seventeen additional principals completed and signed *Informed Consent* forms, survey participation preference forms, and completed surveys, which were returned via email and the mail to the researcher-moderator (Appendix A). The participation rate of this group of respondents was 50 percent of the thirty-four eligible principals. Of the seventeen respondents in January for Round One, two returned their response by mail and fifteen returned their response by email.

At this point, for Round One, the researcher-moderator had received a total of twenty-four participant responses in Round One, for a 100 percent return rate of survey responses from the twenty-four active participants, and a 71 percent participation rate, overall, considering twenty-four of the initial thirty-four eligible principals decided to participate. Of the total participant responses in December and January during Round One, six were mail responses and eighteen were email responses. Preferences were expressed in writing on the survey participation preference forms that six (25%) of the twenty-four responding principals returned, indicating that they desired to receive and return surveys via mailed documents, while eighteen (75%) of the twenty-four responding principals indicated they wished to receive and return surveys via email.

An additional email reminder to the ten non-participating principals (29%) of the initial thirty-four eligible principals was sent on Monday, January 11, 2010, (Appendix F) with the hopes that the non-respondents would decide to participate, after all, but the researcher-moderator received no response from any of them through Friday, January 15, 2010. At that point, the expert panel for the study consisted of twenty-four (71%) of thirty-four principals of high-performing Texas public high schools. Therefore, the researcher-moderator declared Round One to be closed on Friday, January 15, 2010,



so that the data analysis of Round One's input could be analyzed in preparation for Round Two.

The data from Round One was entered into an Excel spreadsheet, using the data analysis tool for statistics. Each of the thirteen research-identified differentiated instructional element statements, representative of questions #5 through #8 of the structured section of Round One's survey, contained a prompt that represented a research-identified differentiated instructional element that was to be rated for degree of effectiveness by each of the principals on the expert panel. Panelists used a four-point Likert scale to rate each prompt from questions #5 through #8. Rating choices were: "4" (*significant*), "3" (*moderate*), "2" (*minimal*), or "1" (*none*). Descriptive statistics were calculated for each of the thirteen statements, including a measure of central tendency (mode) and then levels of dispersion, including variance, standard deviation, and the interquartile range (IQR). With the data analysis, the thirteen statements were prioritized according to the collective input of the expert panel. This resultant prioritized list of most effective research-identified differentiated instructional elements was added to the instrument for Round Two. All twenty-four (100%) panelists submitted input in this section of the Round One survey.

The second section of Round One's questionnaire had an open-ended statement, which was question #9. This open-ended question allowed each panelist to list any differentiated instructional elements that had not already been presented in existing research that principals perceived to be critical for student success. Only five (21%) of the twenty-four Round One participants responded in this section of the survey. Their inputs were added to the Round Two questionnaire for consideration by

the expert panel. Data for questions #1 through #4 and #10 were also analyzed after Round One (Appendix J for a report with graphs, charts, and data tables).

The researcher-moderator examined the Round One results both collectively and individually. The interquartile range (IQR), which is a critical statistic in the Delphi method, as well as the mode, variance, and standard deviation were examined in preparation for Round Two. In contrast to the identical surveys that were sent to panelists during Round One of the study, the Round Two instruments were individualized for each participant, displaying their confidential input in Round One for consideration in Round Two (Appendix G). Specifically, each individual Round Two survey included a presentation of the mode, variance, and standard deviation, plus the interquartile range (IQR) from Round One of the entire group's responses for any of the questions #5 through #8 (the thirteen research-identified differentiated instructional element statements) for which the individual's responses were outside the interquartile range (IQR) and mode of the group so that the individual could decide to maintain his or her initial response(s) or modify his or her initial response(s). In other words, both the group's response and the individual's response were presented to each individual panelist relative to questions (#5 through #8) when an individual's response was outside the group's interquartile range (IQR) and mode.

With the data analysis after Round One, the principals' responses to the thirteen statements from the first section in Round One were prioritized according to the collective input of the expert panel, utilizing the mode. The prioritized list of most effective research-identified differentiated instructional elements reflected the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*)

or “1’s” (*none*)—in descending order—as indicative of the principals’ utilization of the four-point Likert scale in the survey.

This resultant prioritized list of most effective research-identified differentiated instructional elements was added to the instrument for Round Two. Therefore, in Round Two, panelists were asked to decide to maintain the ranked list (from principal input during Round One), as presented in Round Two, or modify it.

The second section of the Round Two survey utilized all of the individual inputs from the five responding members (21%) of the twenty-four member panel from Round One on question #9 to form a ranked list, based on items mentioned from the five panelists—in the order of most mentioned to least mentioned—relative to any differentiated instructional elements that had not already been identified in existing research that they perceived to be critical for student success. Thus, in the second section of the Round Two survey, panelists were asked to decide to maintain the ranked list (from principal input during Round One) or modify it. The Round Two instruments can be found in Appendix G of this dissertation.

The research packets containing the aforementioned instruments for Round Two were either mailed or emailed on January 16, 2010, so that Round Two began on Tuesday, January 19, 2010. These instruments consisted of an individualized Round Two questionnaire with instructions to the participants explaining what was being asked for them to do during Round Two, plus a data display, revealing each panelist’s response in relation to the group mode and the interquartile range (IQR), plus the variance and standard deviation, for any of the questions # 5 through #8 for which the individual’s response fell outside the interquartile range (IQR) and mode for the group. The data from Round One, as presented in Round Two, revealed that three

statements—identified as questions #5A, #6A, and #7F—had interquartile ranges (IQRs) of “2,” “2,” and “1.25,” respectively, while the other ten statements were within consensus, having interquartile ranges (IQRs) of “1” or less. With the receipt in Round Two of Round One’s prioritized list of research-identified differentiated instructional elements, each panelist could decide to maintain his or her response(s) to any of the items for which his or her response(s) was outside the interquartile range (IQR) and mode of the group’s collective responses or modify his or her response(s) for questions #5 through #8. Finally, panelists were asked in Round Two to review the ranked list of additional differentiated instructional elements, as well, and decide to maintain this ranked list as presented from the findings after Round One or modify it.

The instruments, including another copy of the *Informed Consent* form, were emailed separately to the panelists who requested to participate via email and were mailed separately to those who desired to participate by mail (Appendix A). Separate distribution to each panel member ensured the confidentiality and anonymity of each participant. These instruments for Round Two can be viewed in Appendix G of this dissertation.

All twenty-four (100%) panelists responded to Round Two between January 19 and 27, 2010, by email or mail, according to their preferences as established earlier in the study. Only two principals needed a brief telephone call on January 27, 2009, as a reminder to participate in Round Two. With 100 percent participation rate for Round Two, the researcher-moderator determined that Round Two was closed on January 27, 2010.

The researcher-moderator examined the Round Two results both collectively and individually. The interquartile range (IQR), as well as the mode, variance, and

standard deviation were examined from Round Two in preparation for Round Three. Each individual Round Three survey included a presentation of the mode, variance, standard deviation, plus the interquartile range (IQR) from Round Two of the entire group's responses for any of the questions #5 through #8 (the thirteen research-identified differentiated instructional element statements) for which the individual's responses were outside the interquartile range (IQR) and mode of the group so that the individual could decide to maintain his or her initial response(s) or modify his or her initial response(s). In other words, both the group's response and the individual's response were presented to each individual panelist relative to questions (#5 through #8) when an individual's response was outside the group's interquartile range (IQR) and mode (Appendix H).

With the data analysis after Round Two, the principals' responses to the thirteen statements from the first section in Round Two were prioritized according to the collective input of the expert panel, utilizing the mode. The prioritized list of most effective research-identified differentiated instructional elements reflected the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*) or "1's" (*none*)—in descending order—as indicative of the principals' utilization of the four-point Likert scale in the survey.

This resultant prioritized list of most effective research-identified differentiated instructional elements was added to the instrument for Round Three. Therefore, in Round Three, panelists were asked to decide to maintain the ranked list (from principal input during Round Two), as presented in Round Three, or modify it.

The second section of the Round Three survey utilized all of the individual inputs from the five responding members (21%) of the twenty-four member panel from Round Two on question #9 to form a ranked list—in the order of most mentioned to least mentioned—relative to any differentiated instructional elements that had not already been identified in existing research that they perceived to be critical for student success. Thus, in the second section of the Round Three survey, panelists were asked to decide to maintain the ranked list (from principal input) or modify it. The Round Three instruments can be found in Appendix H of this dissertation.

After concluding the Round Two data analysis, the Round Three survey was prepared for distribution to panelists by email or mail, per their preferences. On Friday, January 29, 2010, the instruments, including another copy of the *Informed Consent* form (Appendix A), were emailed separately to the panelists who requested to participate via email and were mailed separately to those who desired to participate by mail. Separate distribution to each panel member ensured the confidentiality and anonymity of each participant. These instruments consisted of an individualized Round Three survey with instructions to the participants explaining what was being asked for them to do during Round Three, plus a data display, revealing each panelist's response in relation to the mode, interquartile range (IQR), variance, and standard deviation for any of the questions # 5 through #8 for which the individual's response fell outside the interquartile range (IQR) and mode for the group. After Round Two inputs from principals, questions #5A and #7F were now in consensus. Thus, the intent for the Round Three instruments was for the participants with previous outlier responses for question #6A (interquartile range of 1.75) in Round Two to have an opportunity to

choose to maintain (with justification) their previous response or to modify it, which could bring question #6A into consensus in Round Three.

Participants returned their surveys more quickly in Round Three than in either of Rounds One or Two. Only one principal needed a brief telephone call on February 4, 2010, as a reminder to participate in Round Three. For purposes of data analysis, the researcher-moderator examined the Round Three results both collectively and individually. The interquartile range (IQR), as well as the mode, variance, and standard deviation were examined after Round Three. With the data analysis after Round Three, the principals' responses to the thirteen statements (questions #5 through #8) from the first section in Round Three were prioritized according to the collective input of the expert panel, utilizing the mode. The prioritized list of most effective research-identified differentiated instructional elements reflected the rank order evolving from the data analysis for each round relative to which of the elements received the greater percentages of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*) or "1's" (*none*)—in descending order—as indicative of the principals' utilization of the four-point Likert scale in the survey.

After data analysis for Round Three, the prioritized list of the most effective research-identified differentiated instructional elements was found to be the same as in Round Two, with the exception that questions #6A and #8A had switched positions so that #6A was now in consensus. Regarding the ranked list of additional differentiated instructional elements (from Round One and Two), the principals—in follow-up telephone interviews with the researcher-moderator after the Round Three surveys were distributed—validated that they perceived the additional differentiated instructional elements to be merely extensions of the initial thirteen research-identified differentiated

instructional elements. They came to consensus that the research-identified differentiated instructional elements were comprehensive and sufficient for implementation for improving student performance without the addition of additional differentiated instructional elements. In essence, they concluded that no principals' had added any new elements to the research-base through their survey inputs. Therefore, due to the stability of responses, it was decided by the researcher-moderator that a fourth round would not be necessary. Thus, the data collection period for this Delphi study of most effective differentiated instructional elements was declared complete by the researcher-moderator on Friday, February 5, 2010.

In summary, the timeline for completion of this study ranged from the approval of the Institutional Review Board (IRB) at Texas A&M University on December 10, 2009, and the beginning of Round One on December 14, 2009, to the completion of the Round Three data collection on February 5, 2010. The Delphi process consisted of three rounds and three instrument sets, with the first questionnaire containing a structured (questions #1-8, 10) and an unstructured section (question #9) which was completed by the members of the expert panel in Round One. Follow-up instruments in Rounds Two and Three consisted of a prioritized list of the most effective research-identified differentiated instructional elements formulated from principal input from Rounds One, Two, and Three until consensus was reached on a final prioritized list. Twenty-four (71%) of the thirty-four eligible principals of high-performing Texas public high schools completed all three rounds of the study. Their input has proven invaluable in identifying the most effective differentiated instructional elements for student success.



## **CHAPTER IV**

### **DATA ANALYSIS AND RESULTS**

#### **Introduction**

The purpose of this study was to determine which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas. The study used the Delphi methodology to collect data from December 2009 to February 2010. Twenty-four principals on high-performing Texas public high school campuses participated as members of the expert panel for this modified Delphi study. This chapter describes the data gathered throughout the three rounds of this Delphi study and presents it as it relates to each of the following research questions:

1. Which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 “Exemplary” public high schools in Texas?
2. What differentiated instructional elements that have not already been identified in existing research are perceived by this study’s targeted principals as being critical for student success?

These questions, and the data gathered in an attempt to answer them, are beneficial in that they may impact the practices of current administrators by providing them with a “practitioner proven model” for student success to utilize and share with others. Furthermore, the significance of a research study of this nature is that the

answers to these research questions may also be invaluable in meeting staff development needs of educators, as well as to inform principal preparation programs.

The remainder of this chapter will be divided into four sections: a synopsis of the data received in each individual round, a discussion of the data relevant to each of the two research questions, and a summary of the findings from the data.

### **Raw Data Synopsis**

The Round One survey was sent to thirty-four Texas public high school principals who were eligible as panelists for the study. They met the established criteria for eligibility in the areas of campus accountability rating, school enrollment, and the principal's tenure in his or her current assignment. Twenty-four (71%) principals responded to the questionnaire in Round One and agreed to participate in the study (Appendix I). This research project took the form of a modified Delphi study. The initial questionnaire was not entirely open-ended, as in a conventional Delphi. The thirteen statements (represented by questions #5 through #8) in the first section of the Round One survey presented research-identified differentiated instructional elements to which panelists were asked to respond (Appendix A). Specifically, the participating principals were asked to rank the effectiveness of each of the research-identified differentiated instructional elements as presented in the study and as represented by the thirteen statements (questions #5 through #8) on a four-point Likert scale. On the scale, the "4" represented *significant*, the "3" represented *moderate*, the "2" represented *minimal*, and the "1" represented *none*. Next, the second section of the Round One survey instrument afforded the participants an opportunity to provide open-ended feedback via question #9 (Appendix A). In this section, respondents were asked to write any

differentiated instructional elements that had not already been identified in existing research that they perceived to be critical for student success.

Principals were also requested to respond to questions #1, #2, #3, #4, and #10, which included three principal profile questions and two differentiated instruction usage questions. The first question asked principals to relate how many years they had been principals on their respective campuses. Appendix I includes a list of the twenty-four participating principals and their high school and district identifiers, plus a graphic representation of their years of service, which illustrates the principals' answers to question #1 in the Round One survey. Collectively, the principals have 233 years of experience, averaging 9.7 years of experience for each principal in the study. The ranges of their years' of experience are: Three to Five Years (10 for 42%); Seven to Fourteen Years (9 for 38%); and Fifteen to Thirty Years (5 for 20%).

The second question sought to ascertain from which source principals perceived they had obtained the most knowledge about differentiated instruction. At 55 percent, principals related that they had learned the most about differentiated instruction on the job. See Appendix J for graph and pie chart illustrations of the participants' responses to question #2. Specifically, question #2 asked participants to identify the source from which they learned the most about differentiated instruction, and the principals' responses were as follows:

- 55% On the Job [13 principals]
- 25% In-District Professional Development [6 principals]
- 8% Out-of-District Professional Development [2 principals]
- 8% Mentor [2 principals]
- 4% Independent Study [1 principal]

No principals responded that they had learned the most about differentiated instruction from the following sources:

- Graduate Courses
- Undergraduate Courses

Question #3 of the Round One questionnaire asked principals if the majority of their teachers (those with at least one year's prior teaching experience), as a whole, frequently (weekly) used differentiated instruction in their classrooms in 2008-2009. Their responses are as follows:

- 79% Yes [19 principals]
- 21% No [5 principals]

Question #3 requested that principals relate whether their teachers utilized differentiated instruction on their campuses during 2008-2009 frequently; that is, on a weekly basis, to which principals primarily responded with a "yes" (79%).

Question #4 of the Round One questionnaire asked principals to rate the degree of usage (frequency of usage) of differentiated instruction on their campus by their teachers, as a whole, during 2008-2009. Principals' responses were as follows:

- Significant: 17% [4 principals]
- Moderate: 75% [18 principals]
- Minimal: 8% [2 principals]

Collectively, then, principals reported a 75 percent (moderate) usage of differentiated instruction, overall, on their campuses.

Lastly, question #10 asked principals to rate, according to their perceptions, the degree of impact of their teachers' usage of differentiated instruction on their students' performances on the 2009 *Texas Assessment of Knowledge and Skills (TAKS)* test.

See Appendix J for the participants' responses, along with statistics, graphs, and charts that are representative of their answers. Principals' responses for question #10 regarding their perceptions of the impact of their teachers' usage of differentiated instructional elements during 2008-2009 on their students' performances on the 2009 TAKS tests are as follows:

- Significant: 29% [ 7 principals]
- Moderate: 58% [14 principals]
- Minimal: 13% [ 3 principals]

All twenty-four of the members of the expert panel in this research study responded to all of the questions in the Round One survey, except for question #9—the open-ended question—to which only five (21%) of the participants responded. Appendix J includes a survey report containing statistics, graphs, and tables illustrating the participants' responses to these questions #2, #3, #4, and #10. More discussion will follow in this dissertation regarding the findings from the data analysis for questions #5 through #8, as well as question #9, which are also illustrated by statistics, graphs, and tables in Appendix J, as well.

Each of the thirteen statements (represented by questions #5 through #8) in the first section of the Round One questionnaire corresponded to differentiated instructional elements that were supported by the existing body of literature. Corresponding phrases (prompts)—used to identify each of the survey questions #5 through #8—representing the thirteen items (questions #5 through #8) being examined in this research study can be viewed in Table 1, along with each complete questionnaire statement.

TABLE 1. Round One Questionnaire Statements and Corresponding Phrases

Item	Complete Questionnaire Statements	Corresponding Phrases
5A	Teachers diagnose students' readiness levels prior to specific instruction.	Student Readiness
5B	Teachers assess students' interests, multiple intelligences, and learning styles to inform differentiation.	Interests / Learning Profile
6A	Teachers pretest and posttest students to determine mastery levels to decide on approach to student learning [i.e., Curriculum compacting is used.]	Curriculum Compacting
6B	Teachers differentiate major concepts and generalizations for differing student abilities and needs.	Differentiating Concepts
6C	Teachers employ a variety of instructional resources in addition to standard text.	Variety of Resources
7A	Teachers incorporate flexible grouping opportunities based upon students' readiness, interests, and learning profiles.	Flexible Grouping
7B	Teachers use a variety of instructional strategies to address learner variance.	Variety of Strategies
7C	Teachers provide activities at different levels of difficulty, such as tiered assignments, to build upon students' varying degrees of prior knowledge and skills, in order to scaffold their learning.	Tiered Assignments
7D	Teachers grant students choices in completing Tasks [i.e., learning contracts]	Student Choice
7E	Teachers engage students in varying degrees of higher-order questioning techniques.	Higher-Order Questions
7F	Teachers present students with opportunities to solve relevant problems at different levels of complexity [i.e., problem-based learning]	Problem-Based Learning

Table 1. Continued

Item	Complete Questionnaire Statements	Corresponding Phrases
8A	Teachers give students assessment options from a variety of product choices for demonstration of mastery.	Assessment Options
8B	Teachers use authentic forms of formative and summative evaluation to assess student progress.	Authentic Evaluation

With twenty-four (71%) of the thirty-four initial questionnaires having been returned, Round One of the Delphi process was declared to be concluded on January 15, 2010, by the researcher-moderator, after having begun on December 14, 2010. The researcher-moderator then examined the Round One results with descriptive statistics by initially calculating the mode of the collective responses from the principals for each of the thirteen statements (questions #5 through #8) in the first section of the Round One survey (Table 2). Next, the principals' responses to these thirteen statements from the first section of the Round One survey were prioritized by the researcher-moderator, according to the mode (most frequent number or value in the data set) per each of the thirteen items—in descending order (Table 2). In other words, responses to the first survey round were grouped by their frequency of occurrence and presented in descending order. Since some of the elements had the same mode, it was necessary to further prioritize the list of most effective research-identified differentiated instructional elements according to which elements received greater percentages of ratings of “4’s” (*significant*), then “3’s” (*moderate*), then “2’s” (*minimal*), then “1’s” (*none*)—in descending order (Table 2).

TABLE 2. Descriptive Statistics (Mode and Percentages of Ratings) for Round One

Item	Corresponding Phrases	Mode	Percentages of Ratings
6C	Variety of Resources	4	59% (4's = Significant)
7B	Variety of Strategies	4	59% (4's = Significant)
8B	Authentic Evaluation	3	71% (3's = Moderate)
7E	Higher-Order Questions	3	67% (3's = Moderate)
6B	Differentiating Concepts	3	58% (3's = Moderate)
7C	Tiered Assignments	3	58% (3's = Moderate)
7A	Flexible Grouping	3	50% (3's = Moderate)
8A	Assessment Options	3	46% (3's = Moderate)
7F	Problem-Based Learning	3	42% (3's = Moderate)
5A	Student Readiness	3	42% (3's = Moderate)
5B	Interests / Learning Profile	3	42% (3's = Moderate)
6A	Curriculum Compacting	4/3/2	33% (4's/3's/2's = S / M / Min)
7D	Student Choice	2	46% (2's = Minimal)

After Round One, the interquartile range (IQR) was also calculated, as well as the variance and standard deviation, which are measures of dispersion, for the thirteen statements (for questions #5 through #8) of the research-identified differentiated instructional elements presented in Round One (Table 3). The interquartile range (IQR) is the absolute value of the difference (middle 50%) between the 75<sup>th</sup> and 25<sup>th</sup> percentiles, with smaller values indicating higher degrees of consensus. Raskin (1994)



identifies an interquartile range (IQR) of 1.00 or less to be an indicator of consensus. For this study, consensus was considered to have been obtained at an interquartile range (IQR) of 1.00 or less. Table 3 shows the interquartile range (IQR) for each item, as well as their variance and standard deviation. Generally, a decreasing variance and a decreasing standard deviation calculation is an indication of agreement.

TABLE 3. Round One Interquartile Range (IQR) and Measures of Dispersion

Item	Corresponding Phrases	IQR	Variance	Standard Deviation
6C	Variety of Resources	1.00	.43	.66
7B	Variety of Strategies	1.00	.43	.66
8B	Authentic Evaluation	0.00	.30	.55
7E	Higher-Order Questions	1.00	.28	.53
6B	Differentiating Concepts	0.25	.43	.65
7C	Tiered Assignments	0.00	.40	.70
7A	Flexible Grouping	0.50	.50	.70
8A	Assessment Options	1.00	.42	.65
7F	Problem-Based Learning	1.75	.60	.78
5A	Student Readiness	2.00	.74	.86
5B	Interests / Learning Profile	1.00	.59	.77
6A	Curriculum Compacting	2.00	.70	.83
7D	Student Choice	1.00	.49	.70

Panelists' Round One responses were analyzed to prepare the Round Two survey instruments. Three questions—items #5A, #6A, and #7F—had interquartile ranges (IQR) of 2.00, 2.00, and 1.75, respectively, indicating non-consensus (Table 3), so Round Two was needed. Furthermore, even though the other items indicated consensus—with interquartile ranges (IQR) of 1.00 or less—two questions' (#6C and #7B) rankings needed to be re-examined in Round Two due to their tied status in Round One. Essentially, #6C (59% of “4’s”) and #7B (59% of “4’s”) were tied in their percentage of rating received from principals, plus their mode, variance, standard deviation, and interquartile range (IQR). Of interest were the tied percentages of ratings for #6B (58% of “3’s”), #7C (58% of “3’s”), and #7F (42% of “3’s”), #5A (42% of “3’s”), and #5B (42% of “3’s”). Table 4 displays the data for Round One for the prioritized list of research-identified differentiated instructional elements, giving their percentages of ratings received, plus mode, variance, standard deviation, and interquartile range (IQR).

TABLE 4. Round One Statistics for Prioritized Differentiated Instructional Elements

Rank	Item	Item Description	Rating	% of Rating	Mode	Var	SD	IQR
1	6C	Variety of Resources	4's	59	4	.43	.66	1
1	7B	Variety of Strategies	4's	59	4	.43	.66	1
2	8B	Authentic Evaluation	3's	71	3	.30	.55	0
3	7E	Higher-Order Questions	3's	67	3	.28	.53	1
4	6B	Differentiating Concepts	3's	58	3	.43	.65	.25
5	7C	Tiered Assignments	3's	58	3	.40	.70	0
6	7A	Flexible Grouping	3's	50	3	.50	.70	.50
7	8A	Assessment Options	3 / 2's	46	3	.42	.65	1
8	7F	Problem-Based Learning	3's	42	3	.60	.78	1.75
9	5A	Student Readiness	3's	42	3	.74	.86	2
10	5B	Interests /Learning Profile	3's	42	3	.59	.77	1
11	6A	Curriculum Compacting	4 /3 /2	33	4/3/2	.70	.83	2
12	7D	Student Choice	2's	46	2	.49	.70	1

Note: 4 = Significant; 3 = Moderate; 2 = Minimal; 1 = None

In Table 4, the items (#7F, #5A, and #6A) highlighted in yellow were not in consensus since they did not have an interquartile range (IQR) of 1.00. The items highlighted in purple (#6C and #7B) represent the items that were tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR). The items highlighted in brown (#6B, #7C, #7F, #5A, and #5B) represent two sets (#6B / #7C; and #7F / #5A / #5B) that each have the same percentage of ratings of “3’s.” Due to non-consensus for #7F, #5A, #6A and the number of ties in percentages of ratings for #6C, #7B, #6B, #7C, #7F, #5A, #5B, the need for Round Two was established.

In question #9 of the second section of the Round One survey, members of the expert panel were asked to include any additional differentiated instructional elements that they perceived to be critical to student success which might have been omitted from the research-identified differentiated instructional elements in the first section. Only five panelists (21%) suggested additional differentiated instructional elements which they perceived to be critical for student success (Table 5).

TABLE 5. Additional Differentiated Instructional Elements Suggested in Round One

Input	Suggestions
#5	Tutorial groups, cooperative learning strategies, hands-on labs using small groups (science), peer editing, peer tutoring, and discussion
#9	Intensive tutoring targeting specific skills
#10	Science—lots of lab time—math teachers used tutorials based on individual student weaknesses
#17	Consistent benchmarking each six weeks and grouping of students in classes

Table 5. Continued

Input	Suggestions
#21	Our teachers keep track daily of each student's progress as they teach above what is required on the TAKS

Round One of the Delphi process closed on January 15, 2010. Appendix J includes a report of statistics, graphs, and tables illustrating the panelists' responses and the data analysis regarding all three survey rounds, from which the data can be viewed for Round One. The data analysis from Round One was used to prepare the Round Two survey instruments since consensus was not totally reached in Round One.

Round Two of the Delphi process was from January 19 to January 27, 2010. The Round Two survey informed each participant of the entire group's collectively ranked responses to the thirteen research-identified differentiated instructional elements (represented by questions #5 through #8). Participants' responses to individual survey questions in Round One which fell outside the interquartile range (IQR) and mode of the group's responses were presented confidentially to individuals, along with the opportunity in Round Two for these panelists to either maintain or modify (with justification) any of their initial responses. Round Two also presented a list of the additional differentiated instructional elements suggested by principals in Round One that came from the open-ended question #9, along with the opportunity to approve or modify this ranked list.

Upon receipt of all twenty-four (100%) responses, Round Two was closed and data analysis began. The researcher-moderator used the same descriptive statistics

(mode, percentages of ratings, variance, standard deviation, and interquartile range) as in Round One. The principals' responses to the prioritized list from Round One were re-prioritized after Round Two by the researcher-moderator, according to the mode and percentages of ratings—in descending order—for the thirteen items (Table 6).

TABLE 6. Descriptive Statistics (Mode and Percentages of Ratings) for Round Two

Item	Corresponding Phrases	Mode	Percentages of Ratings
6C	Variety of Resources	4	63% (4's = Significant)
7B	Variety of Strategies	4	63% (4's = Significant)
8B	Authentic Evaluation	3	83% (3's = Moderate)
6B	Differentiating Concepts	3	79% (3's = Moderate)
7A	Flexible Grouping	3	79% (3's = Moderate)
7C	Tiered Assignments	3	75% (3's = Moderate)
7E	Higher-Order Questions	3	71% (3's = Moderate)
7F	Problem-Based Learning	3	67% (3's = Moderate)
8A	Assessment Options	3	50% (3's = Moderate)
6A	Curriculum Compacting	3	42% (3's = Moderate)
5B	Interests / Learning Profile	3/2	46% (3's = Moderate)
5A	Student Readiness	3/2	46% (3's/2's = Moderate/Minimal)
7D	Student Choice	2	46% (2's = Minimal)

Some elements had the same mode, so it was necessary to also prioritize the list according to which elements received greater percentages of ratings of “4’s” (*significant*), “3’s” (*moderate*), “2’s” (*minimal*), or “1’s” (*none*), as shown in Table 6.

The interquartile range (IQR) was also calculated, as well as the variance and standard deviation, for the research-identified differentiated instructional elements in Round Two. Table 7 shows the interquartile range (IQR), variance, and standard deviation for each item.

TABLE 7. Round Two Interquartile Range (IQR) and Measures of Dispersion

Item	Corresponding Phrases	IQR	Variance	Standard Deviation
6C	Variety of Resources	1.00	.24	.49
7B	Variety of Strategies	1.00	.24	.49
8B	Authentic Evaluation	0.00	.17	.41
6B	Differentiating Concepts	0.00	.22	.46
7A	Flexible Grouping	0.00	.20	.50
7C	Tiered Assignments	0.00	.30	.50
7E	Higher-Order Question	1.00	.22	.46
7F	Problem-Based Learning	1.00	.23	.48
8A	Assessment Options	1.00	.34	.58
6A	Curriculum Compacting	1.75	.60	.78
5B	Interests / Learning Profile	1.00	.42	.65
5A	Student Readiness	1.00	.42	.65
7D	Student Choice	1.00	.49	.70

In Round One, the interquartile ranges (IQRs) of three items—#5A, #6A, and #7F—were 2.00, 2.00, and 1.75, respectively, indicating they had not reached an interquartile range (IQR) of 1.00 for consensus. In Round Two, only #6A had a 1.75 interquartile range (IQR), indicating non-consensus (Table 7).

In Round Two, panelists were asked to approve (accept) or modify the prioritized list of most effective research-identified differentiated instructional elements as presented from Round One. Round Two informed each participant of the entire group's collectively ranked responses to the research-based section of the survey (questions #5 through #8). Table 8 displays the data representative of panelists' responses.

TABLE 8. Round Two Statistics for Prioritized Differentiated Instructional Elements

Rank	Item	Item Description	Rating	% of Rating	Mode	Var	SD	IQR
1	6C	Variety of Resources	4's	63	4	.24	.49	1
1	7B	Variety of Strategies	4's	63	4	.24	.49	1
2	8B	Authentic Evaluation	3's	83	3	.17	.41	0
3	6B	Differentiating Concepts	3's	79	3	.22	.46	0
4	7A	Flexible Grouping	3's	79	3	.20	.50	0
5	7C	Tiered Assignments	3's	75	3	.30	.50	0
6	7E	Higher-Order Questions	3's	71	3	.22	.46	1
7	7F	Problem-Based Learning	3's	67	3	.23	.48	1
8	8A	Assessment Options	3's	50	3	.34	.58	1
9	6A	Curriculum Compacting	3's	42	3	.60	.78	1.75
10	5B	Interests /Learning Profile	3 / 2's	46	3 / 2	.42	.65	1
11	5A	Student Readiness	3 / 2's	46	3 / 2	.42	.65	1
12	7D	Student Choice	2's	46	2	.49	.70	1

Note: 4 = Significant; 3 = Moderate; 2 = Minimal; 1 = None

In Table 8, #6A is highlighted in yellow since it was not yet in consensus with its interquartile range (IQR) of 1.75. The items highlighted in purple (#6C and #7B)

represent the items that were still tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR). The items highlighted in brown (#5B and #5A) tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR). The items highlighted in green (#6B, #7A, #7E, #7F, and #8A) moved in rank order from Round One to Round Two. Due to non-consensus for #6A, the tie between #5B and #5A, as well as the positional movement in items #6B, #7A, #7E, #7F, and #8A, the need for Round Three was determined by the researcher-moderator, even though #7F and #5A reached consensus in Round Two.

The second section of the Round Two survey asked participants to consider the additional differentiated instructional elements that were added via question #9 from the five respondents during Round One. For Round Two, these inputs from the five respondents to question #9 in Round One were listed in ranked order, according to repetition and concept similarity. See Table 9 for the list of additional differentiated instructional elements that evolved from Round One, representative of the perceptions of five members (21%) of the expert panel.

TABLE 9. Additional Differentiated Instructional Elements for Round Two

Input	Suggestions
#5, #9	Tutorial Groups: Cooperative Learning, Peer Learning, Bubble Groups
#10	Hands-On Science Labs
#17	Benchmarking
#21	Teaching Beyond TAKS



In Round Two, panelists were given the opportunity to approve the list of additional differentiated instructional elements as being critical for student success, in the ranked order as presented in the second section of the Round Two survey, or they could modify the list during Round Two. In addition, a request for comments was provided in Round Two for panelists to give feedback. Only two (8%) participants provided feedback in Round Two. These two comments are displayed in Table 10.

TABLE 10. Comments in Round Two Relative to Question #9 in Round One

Input	Comments
#4	It appears that these are just examples of the initial differentiated instructional elements already mentioned.
#23	Combine the inputs that are alike and reduce the list.

One response indicates that the panelist believed that the Round One inputs of these additional differentiated instructional elements were merely extensions of the research-identified differentiated instructional elements already mentioned in Round One in the first section of the survey. The other comment was a suggestion to combine the similar inputs to reduce the length of the list.

Round Two of the Delphi process closed on January 27, 2010. A copy of the Round Two instruments can be viewed in Appendix G. Appendix J includes a report containing statistics, graphs, and tables illustrating the participants' responses and subsequent data analysis regarding all three survey rounds, from which the data can be

viewed for Round Two. The data analysis from Round Two was used to prepare the Round Three survey instruments.

Round Three of the Delphi process occurred from January 29, 2010, to February 5, 2010. Round Three's survey informed each panelist of the group's collectively ranked responses via a prioritized list of the thirteen research-identified differentiated instructional elements (questions #5 through #8). Panelists could confidentially examine any of their Round Two responses that were outside the interquartile range (IQR) and mode for the group and either approve or modify the rankings in Round Three. Panelists were also asked in Round Three to approve or modify the ranked list of additional differentiated instructional elements that had been condensed in Round Two with the merging of the listed items that were repetitious and/or similar in concept.

The data collection period for Round Three of the Delphi exercise ended on Friday, February 5, 2010, with the receipt of all twenty-four (100%) participants' surveys. Data analysis in Round Three included the same descriptive statistics (mode, percentages of ratings, variance, standard deviation, and interquartile range) as in Round Two. The data analysis of the mode, as well as the percentages of ratings of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*), or "1's" (*none*) of the research-identified differentiated instructional elements that the principals addressed in Round Three (approved or modified) are indicated in Table 11. Panelists validated with their votes of "approval" in Round Three that they agreed that #6C (Variety of Resources) and #7B (Variety of Strategies) should remain tied for the first ranked position, as well as they approved the rest of the prioritized list (Table 11). Follow-up telephone interviews with panelists after Round Three confirmed their support for Round Three's prioritized list of most effective research-identified differentiated instructional elements.

TABLE 11. Descriptive Statistics (Mode and Percentages of Ratings) for Round Three

Item	Corresponding Phrases	Mode	Percentages of Ratings
6C	Variety of Resources	4	63% (4's = Significant)
7B	Variety of Strategies	4	63% (4's = Significant)
8B	Authentic Evaluation	3	83% (3's = Moderate)
6B	Differentiating Concepts	3	79% (3's = Moderate)
7A	Flexible Grouping	3	79% (3's = Moderate)
7C	Tiered Assignments	3	75% (3's = Moderate)
7E	Higher-Order Questions	3	71% (3's = Moderate)
7F	Problem-Based Learning	3	67% (3's = Moderate)
6A	Curriculum Compacting	3	67% (3's = Moderate)
8A	Assessment Options	3	50% (3's = Moderate)
5B	Interests / Learning Profile	3/2	46% (3's/2's = Moderate/Minimal)
5A	Student Readiness	3	46% (3's/2's = Moderate/Minimal)
7D	Student Choice	2	46% (2's = Minimal)

For each element, the interquartile range (IQR) was calculated to determine consensus (1.00 or less), plus the variance and standard deviation were also calculated to check for continued agreement from Round Two to Round Three (Table 12). All research-identified differentiated instructional elements were in consensus after Round Three, including #6A, which was not in consensus in Round Two.

TABLE 12. Round Three Interquartile Range (IQR) and Measures of Dispersion

Item	Corresponding Phrases	IQR	Variance	Standard Deviation
6C	Variety of Resources	1.00	.24	.49
7B	Variety of Strategies	1.00	.24	.49
8B	Authentic Evaluation	0.00	.17	.41
6B	Differentiating Concepts	0.00	.22	.46
7A	Flexible Grouping	0.00	.20	.50
7C	Tiered Assignments	0.00	.30	.50
7E	Higher-Order Question	1.00	.22	.46
7F	Problem-Based Learning	1.00	.23	.48
6A	Curriculum Compacting	1.00	.23	.48
8A	Assessment Options	1.00	.34	.58
5B	Interests / Learning Profile	1.00	.42	.65
5A	Student Readiness	1.00	.42	.65
7D	Student Choice	1.00	.49	.70

In Round Three, panelists were asked to approve or modify the prioritized list of most effective research-identified differentiated instructional elements as presented. Round Three informed each participant of the entire group's collectively ranked responses to the research-based section of the survey (questions #5 through #8). See Table 13 for the prioritized list for Round Three, representative of the responses of the expert panel (100%) who participated in all three rounds of this Delphi process.

TABLE 13. Round Three Statistics for Prioritized Differentiated Instructional Elements

Rank	Item	Item Description	Rating	% of Rating	Mode	Var	SD	IQR
1	6C	Variety of Resources	4's	63	4	.24	.49	1
1	7B	Variety of Strategies	4's	63	4	.24	.49	1
2	8B	Authentic Evaluation	3's	83	3	.17	.41	0
3	6B	Differentiating Concepts	3's	79	3	.22	.46	0
4	7A	Flexible Grouping	3's	79	3	.20	.50	0
5	7C	Tiered Assignments	3's	75	3	.30	.50	0
6	7E	Higher-Order Questions	3's	71	3	.22	.46	1
7	7F	Problem-Based Learning	3's	67	3	.23	.48	1
8	6A	Curriculum Compacting	3's	67	3	.23	.48	1
9	8A	Assessment Options	3's	50	3	.34	.58	1
10	5B	Interests /Learning Profile	3 / 2's	46	3 / 2	.42	.65	1
11	5A	Student Readiness	3 / 2's	46	3 / 2	.42	.65	1
12	7D	Student Choice	2's	46	2	.49	.70	1

Note: 4 = Significant; 3 = Moderate; 2 = Minimal; 1 = None

In Table 13, no items are yellow-highlighted since all items are in consensus (1.00 or less). The items highlighted in purple (#6C and #7B) represent the items that continued to be tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR) in all three survey rounds. The items highlighted in brown (#5B and #5A) continued to be tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR) in all three survey rounds. The items highlighted in red (#7F and #6A) tied in percentage of rating, mode, variance, standard deviation, and interquartile range (IQR) in Round Three.

After data analysis for Round Three, only one item changed (#6A) after Round Two. Essentially, #6A moved into consensus which caused a minor switch in prioritized positions of items #6A and #8A on the list of research-identified differentiated instructional elements in Round Three (Table 13). No other items changed in Round Three, indicating stability. Follow-up telephone polling after Round Three confirmed

that the expert panel (100%) supported this final prioritization of most effective research-identified differentiated instructional elements.

During this research study, the anonymity of members' responses was maintained by the researcher-moderator. Table 14 displays examples of some of the comments from panelists during the rounds regarding their changes made and/or examples of their justifications for their choices to maintain or modify previous responses.

TABLE 14. Sample Justifications From Panelists Who Maintained Responses

Input	Justifications
#3	I changed it from a 2 to a 3 which I believe to be accurate.
#5	My responses were correct for my campus.
#17	Maintain individual responses.
#22	My two questions still remain the same, thus outliers.
#22	I agree with most. I disagree that #5A is after #7A

A reliable measure to determine movement toward consensus, according to Scheibe, Skutsch, and Schofer (1975), is to measure the stability of panelists' responses in successive iterations. In other words, a measure which takes into account the variations from the norm of the respondents' vote distribution curve over successive Delphi rounds is stability (Scheibe et al., 1975). The stability between rounds—the change in opinion—should be determined, given this is also an indication of consensus

(Greatorex & Dexter, 2000). Yet, the question of what constitutes stability remains unanswered since no true statistical level has yet been set in the literature (Greenwald, 1968). The concept, though, is that iterative polling of panelists—typically three rounds—continues until variability has ceased (Parente & Anderson-Parente (1987). Table 15 indicates the changes in panelists' collective responses during the survey rounds for the initial thirteen elements (questions #5 through #8) of the surveys.

TABLE 15. Changes in Responses During Rounds One to Two and Two to Three

Item	Corresponding Phrases	Round One to Two	Round Two to Three
5A	Student Readiness	2	0
5B	Interests / Learning Profile	0	0
6A	Curriculum Compacting	2	1
6B	Differentiating Concepts	1	0
6C	Variety of Resources	0	0
7A	Flexible Grouping	2	0
7B	Variety of Strategies	0	0
7C	Tiered Assignments	0	0
7D	Student Choice	0	0
7E	Higher-Order Questions	3	0
7F	Problem-Based Learning	1	0
8A	Assessment Options	1	1
8B	Authentic Evaluation	3	0

Spinelli (1983) considers a change of more than one interquartile range (IQR) point in each successive round as the criterion for convergence of opinion. The interquartile range (IQR) of #7F (1.75) in Round One changed to 1.00 in Round Two. The interquartile ranges (IQRs) of #5A (2.00) and #6A (2.00) in Round One changed to 1.00 and 1.75, respectively, in Round Two. The interquartile range (IQR) of #6A (1.75) in Round Two changed to 1.00 in Round Three. Table 16 displays changes in the interquartile range (IQR) of elements for Rounds One, Two, and Three.

TABLE 16. Changes in Interquartile Range (IQR) for Rounds One, Two, and Three

Item	Corresponding Phrases	Round One	Round Two	Round Three
5A	Student Readiness	2	1	1
5B	Interests / Learning Profile	1	1	1
6A	Curriculum Compacting	2	1.75	1
6B	Differentiating Concepts	.25	0	0
6C	Variety of Resources	1	1	1
7A	Flexible Grouping	.50	0	0
7B	Variety of Strategies	1	1	1
7C	Tiered Assignments	0	0	0
7D	Student Choice	1	1	1
7E	Higher-Order Questions	1	1	1
7F	Problem-Based Learning	1.75	1	1
8A	Assessment Options	1	1	1
8B	Authentic Evaluation	0	0	0



These changes in interquartile ranges (IQRs)—from 2.00 to 1.00 (#5A and #6A) and 1.75 to 1.00 (#7F) over successive rounds indicates trends of convergence and movement toward consensus (Table 16).

Research relates that the reliance on small samples associated with most Delphi exercises prohibits the utilization of inferential statistics (Gordon, 1992). This study represented a small sample, so descriptive statistics, rather than inferential statistics, were utilized for data analysis for Rounds One, Two, and Three. The measure of central tendency utilized was the mode, while the levels of dispersion were the variance, standard deviation and the interquartile range (IQR). The percentages of ratings of “4’s” (*significant*), “3’s” (*moderate*), “2’s” (*minimal*), or “1’s” (*none*) by principals during the three rounds were also calculated. The data analysis prepared between rounds for panelist presentation in subsequent rounds by the researcher-moderator provided feedback to panelists, assisting them in decision-making during the Delphi process (Hasson et al., 2000).

With descriptive statistics, the mean score is frequently used, representing the average for the group of experts (Murray & Jarman, 1987). Yet, the mode was utilized in this study since the panelists’ responses in each round to the thirteen research-identified differentiated instructional element statements (questions #5 through #8) in the first section of each of the surveys were grouped—during data analysis—by their frequency of occurrence, indicating that this study was based upon the mode, which is a measure of central tendency. Greatorex and Dexter (2000) relate that if the instrument’s scale is in intervals, the mode is a preferred statistic. In this study, a four-point Likert scale was utilized for principals to rate the degree of effectiveness for each of the thirteen statements (questions #5 through #8) in the first section of the surveys in

the three rounds. The researcher-moderator calculated which research-identified differentiated instructional elements had higher percentages of ratings of “4’s” (*significant*), “3’s” (*moderate*), “2’s” (*minimal*), or “1’s” (*none*) in each of the rounds for purposes of ranking the elements in a prioritized list of most effective research-identified differentiated instructional elements. These levels of statistics were completed to validate the findings of the study.

According to Hasson et al. (2000), no universal determination of consensus exists; it depends upon the aim of the research, the sample size, and resources. For this study, an interquartile range (IQR) of 1.00 or less was used to determine consensus (Raskin, 1994). Generally, consensus on an issue can be claimed if a certain percentage of the votes fall within a prescribed range (Powell, 2003; Miller, 2006). Green (1982) suggests that at least 50 percent of Delphi subjects need to rate three or higher on a four-point Likert scale. In some studies, consensus is considered *high* if the interquartile range is no more than one unit on a four-point Likert scale, while *low* consensus occurs with an interquartile range of two units (Wilhelm, 2001). In this research study, consensus is considered *high* since the interquartile range (IQR) is no more than one unit on a four-point Likert scale for all thirteen items (questions #5 through 8). After Round Three, items #6C, #7B, #7E, #7F, #6A, #8A, #5B, #5A, and 7D have an interquartile range (IQR) of 1.00, indicating *high* consensus. Interestingly, ranked items #8B, #6B, #7A, and #7C have an interquartile range (IQR) of 0.00, indicating *very high* consensus, as well.

In addition, the researcher-moderator completed telephone interviews after Round Three to validate the outcomes from Round Three. Confirmations from these telephone interviews indicated that the principals agreed with the prioritized list of the

most effective research-identified differentiated instructional elements (questions #5 through #8). However, regarding question #9, which asked if there were any differentiated instructional elements that had not already been identified in existing research that principals perceived to be critical to student success, principals wholeheartedly acknowledged in the interviews that the suggestions that the five principals had made in response to question #9 in Round One were merely restatements of the initial thirteen statements (questions #5 through #8) in the first section of the initial survey. Earlier in Round Two, principals had supported the idea of combining repetitious and/or similar items on the list of additional differentiated instructional elements. In Round Two, they had actually approved the combining of “Tutorial Groups” and “Benchmarking,” for example, and ranked “Tutorial Groups” as more important than “Hands-On Science Labs” or “Teaching Beyond TAKS” (Table 17).

TABLE 17. Additional Differentiated Instructional Elements for Round Three

Input	Suggestions
#5, #9, #17	Tutorial Groups: Cooperative, Peer, Bubble Groups with Benchmarking
#10	Hands-On Science Labs
#21	Teaching Beyond TAKS

The synopsis of feedback from the interviewed principals in Round Three, overall, was that they believed there was actually nothing new presented in the initial inputs for question #9, after all, and that the five members’ inputs should actually be incorporated into the initial thirteen statements (questions #5 through #8).

In this study, the twenty-four participating principals were also asked in the final question of the Round One survey to rate, according to their perceptions, the degree of impact of their teachers' usage of differentiated instruction on their students' performances on the 2009 *Texas Assessment of Knowledge and Skills (TAKS)* test (Figure 2). Principals' responses were as follows: *Significantly*: 29 percent [7 principals]; *Moderately*: 58 percent [14 principals]; *Minimally*: 13 percent [3 principals].

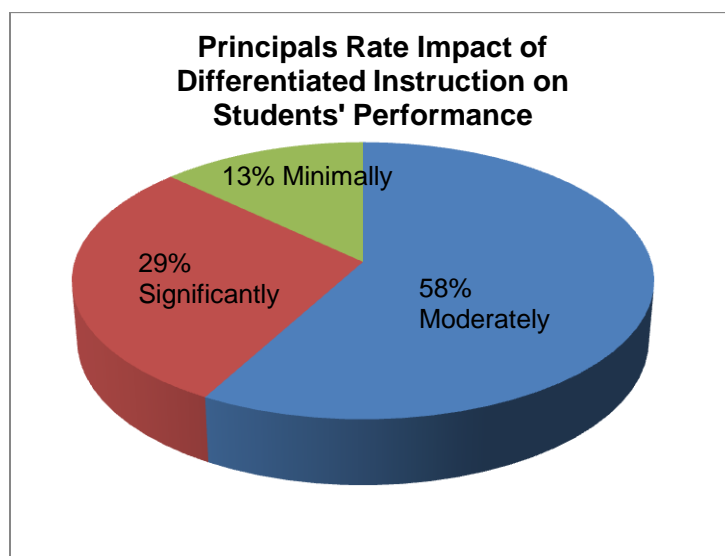


Figure 2. Principals Rate Impact of Differentiated Instruction on Students' Performance

After the data collection and analysis period for Round Three of the Delphi study concluded on Friday, February 5, and consensus was obtained, it was determined that no further rounds would be needed, given the stability within the panel as demonstrated in the outcomes for Round Three. A copy of the Round Three instruments can be viewed in Appendix H. Appendix J includes a survey report containing statistics, graphs, and tables illustrating the participants' responses and subsequent data analysis regarding all three survey rounds, from which the data can be viewed for Round Three. All twenty-four (100%) of the members of the expert panel in this research study responded to all three rounds during the Delphi process and are to be commended for their interest, participation, and expertise. The next section of this chapter will explore the data relevant to each of the two research questions guiding the study.

### **Research Question One**

*Which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 "Exemplary" public high schools in Texas?*

The first research question in this study sought to determine which research-identified differentiated instructional elements were the most effective in improving student performance. The answer to this question can potentially impact practice, professional development, as well as principal and teacher preparation programs. In this study, the mode was utilized in all three rounds of the Delphi process to analyze principals' responses regarding their prioritizations of the most effective research-identified differentiated instructional elements. The researcher-moderator calculated which elements had higher percentages of ratings (i.e., 63% of "4's" versus 83% of "3's"

versus 46% of “2’s”), which were indicative of *significant* versus *moderate* versus *minimal* ratings, respectively. The interquartile range (IQR) was used to determine consensus, and the decreasing measures of variance and standard deviation were used to determine increasing agreement. By analyzing the items (questions #5 through #8) according to their mode, percentages of ratings, interquartile range (IQR), variance, and standard deviation, a prioritized list of the most effective research-identified differentiated instructional elements was developed.

Table 18 presents the prioritized list of the most effective research-identified differentiated instructional elements as perceived by the twenty-four principals in this study. In essence, this prioritized list answers the first research question for this study. The first research question asked which research-identified differentiated instructional elements were the most effective in improving student performance. The list of differentiated instructional elements, prioritized from items #6C to #7D, represents the principals’ perceptions of the most effective elements.

Yet, #6C (Variety of Resources) and #7B (Variety of Strategies) are truly the most effective research-identified differentiated instructional elements as perceived by the twenty-four principals in this study, according to their inputs during Rounds One, Two, Three, plus their follow-up interviews, in which #6C and #7B were consistently ranked together—tied for the top-ranked position on the prioritized list of research-identified differentiated instructional elements for improving student performance. Table 18 highlights #6C and #7B in the color of purple to showcase their tied status as being the top-ranked elements.

Table 18 displays each prioritized item, along with its percentages of ratings—whether a “4” (*significant*), a “3” (*moderate*), or a “2” (*minimal*)—plus its mode, variance,

standard deviation, and interquartile range (IQR). Note each item's interquartile ranges (IQRs) of 1.00 and/or 0.00, indicating the consensus of the panelists that all the elements listed are considered to be effective; however, the panelists consider some of the elements to be more effective than others, as illustrated by those items with higher percentages of "4's" or "3's".

TABLE 18. Prioritized List of the Most Effective Differentiated Instructional Elements

Rank	Item	Item Description	Rating	% of Rating	Mode	Var	SD	IQR
1	6C	Variety of Resources	4's	63	4	.24	.49	1
1	7B	Variety of Strategies	4's	63	4	.24	.49	1
2	8B	Authentic Evaluation	3's	83	3	.17	.41	0
3	6B	Differentiating Concepts	3's	79	3	.22	.46	0
4	7A	Flexible Grouping	3's	79	3	.20	.50	0
5	7C	Tiered Assignments	3's	75	3	.30	.50	0
6	7E	Higher-Order Questions	3's	71	3	.22	.46	1
7	7F	Problem-Based Learning	3's	67	3	.23	.48	1
8	6A	Curriculum Compacting	3's	67	3	.23	.48	1
9	8A	Assessment Options	3's	50	3	.34	.58	1
10	5B	Interests /Learning Profile	3 / 2's	46	3 / 2	.42	.65	1
11	5A	Student Readiness	3 / 2's	46	3 / 2	.42	.65	1
12	7D	Student Choice	2's	46	2	.49	.70	1

Of importance is a discussion of the top five ranked differentiated instructional elements. Two items (#6C and #7B) in the study tied for the highest rating for the first place distinction, as designated by the expert panel. Each of these items—#6C and #7B—received 63 percent "4's" for a rating of *significant*. Each of them had a mode of 4.00, a variance of .24, and a standard deviation of .49, along with an interquartile range (IQR) of 1.00, indicating consensus among the twenty-four principals regarding their significance in improving student performance. Item #6C represents the differentiated instructional element of *Variety of Resources*, while item #7B represents

*Variety of Strategies*. These were the only two of the elements to rate a “4” for *significant* effectiveness. These items represent the elements of differentiated instruction that received 63 percent “4’s” and had interquartile ranges (IQRs) of 1.00, indicating *high* consensus for elements having *significant* effectiveness, according to the perceptions of the principals in the study. These items are highlighted in gray in Table 19.

Four other items—#8B, #6B, #7A, and #7C—were ranked as “3’s” at 83 percent, 79 percent, 79 percent, and 75 percent, respectively, representative of *moderate* effectiveness. Item #8B represents the differentiated instructional element of *Authentic Evaluation* and has a mode of 3.00, a variance of .17, and a standard deviation of .41, along with an interquartile range (IQR) of 0.00. Item #6B represents *Differentiating Concepts* and has a mode of 3.00, a variance of .22, a standard deviation of .46, and an interquartile range (IQR) of 0.00. Item #7A represents *Flexible Grouping* and has a mode of 3.00, a variance of .20, a standard deviation of .50, and an interquartile range (IQR) of 0.00. Lastly, item #7C represents *Tiered Assignments* and has a mode of 3.00, a variance of .30, a standard deviation of .50, and an interquartile range (IQR) of 0.00. These items represent the elements of differentiated instruction that received from 75 percent to 83 percent “3’s” and had interquartile ranges (IQRs) of 0.00, indicating *high* consensus for elements having *moderate* effectiveness, according to the perceptions of the twenty-four principals in the study. In fact, a consensus of 0.00 for items #8B, #6B, #7A, and #7C indicates a stronger agreement of the principals regarding the *moderate* elements than their agreement on the *significant* elements. Items #8B, #6B, #7A, and #7C are highlighted in yellow in Table 19.



TABLE 19. Top Five Most Effective Differentiated Instructional Elements

Rank	Item	Item Description	%	of #'s	Rating	Mode	Var	SD	IQR
1	6C	Variety of Resources	63	4's	S	4.00	.24	.49	1
1	7B	Variety of Strategies	63	4's	S	4.00	.24	.49	1
2	8B	Authentic Evaluation	83	3's	M	3.00	.17	.41	0
3	6B	Differentiating Concepts	79	3's	M	3.00	.22	.46	0
4	7A	Flexible Grouping	79	3's	M	3.00	.20	.50	0
5	7C	Tiered Assignments	75	3's	M	3.00	.30	.50	0

Table 20 displays the increases in percentages of frequency of “4’s” and “3’s” for Items #6C, #7B, #8B, #6B, #7A, and #7C from Round One to Rounds Two and Three. The ratings of “4” (*significant*) by principals for items #6C and #7B both increased from 59 percent to 63 percent from Round One to Round Two and maintained the 63 percent of a “4” rating in Round Three. Items #6C and #7B are highlighted in gray in Tables 19 and 20 to emphasize the principals’ perceptions that these items were tied for first place with a *significant* rating as the top choices for the most effective research-identified differentiated instructional elements. Item #8B increased its “3” rating from 71 to 83 percent from Round One to Rounds Two and Three. Item #6B increased its “3” rating from 58 to 79 percent, while item #7A increased its “3” rating from 50 to 79 percent from Round One to Rounds Two and Three. Lastly, item #7C increased its “3” rating from 58 to 74 percent from Round One to Rounds Two and Three. Items #8B, #6B, #7A, and #7C are highlighted in yellow in Tables 19 and 20 to emphasize the principals’ perceptions that these items received a *moderate* rating, along with a second, third, fourth, and fifth position, respectively, on the prioritized list of the most effective research-identified differentiated instructional elements.

TABLE 20. Increases in Percentages of Ratings From Round One to Two and Three

Item	%	#	IQR	RD	%4's	%3's	%2's	RD	%4's	%3's	%2's	RD	
6C	63	4's	1	1	59	33	8	2	63	37	0	3	Same
7B	63	4's	1	1	59	33	8	2	63	37	0	3	as
8B	83	3's	0	1	17	71	12	2	13	83	4	3	RD
6B	79	3's	0	1	25	58	17	2	13	79	8	3	2
7A	79	3's	0	1	25	50	25	2	8	79	13	3	
7C	75	3's	0	1	21	58	21	2	13	74	13	3	

These five items discussed in the preceding paragraphs represent the most effective research-identified differentiated instructional elements, as rated by the twenty-four participating principals. It should be noted, however, that the other elements of the initial thirteen in the study are also considered to be effective in improving student performance. Thus, the distinctions made between the top five prioritized elements presented (#6C / #7B, #8B, #6B, #7A, and #7C) and the remaining seven are negligible since all the elements improve student performance, according to the perceptions of the principals in this study. It is also important to note that the research is well represented in the prioritized list of most effective research-identified differentiated instructional elements, as determined by the expert panel.

### Research Question Two

*What differentiated instructional elements that have not already been identified in existing research are perceived by this study's targeted principals as being critical for student success?*

This study's foundation was a thorough review of the literature on differentiated instructional elements that improve student performance. After the completion of the Delphi exercise and an analysis of the data from its three rounds, it was ascertained by

the researcher-moderator that the perceptions of the participating principals as to what constituted effective differentiated instruction did, indeed, match what has emanated from the research base. This study's first research question assumed that the research-identified differentiated instructional elements presented in this study were essential to improving student performance; yet, it asked if there were any differentiated instructional elements that had not already been identified in existing research that principals perceived to be critical for student success. Determining an answer to this question involved five steps: (1) reviewing the literature; (2) examining the section of the Delphi instrument designed to assist in answering this research question; (3) analyzing the results from the second section of the Round One survey; (4) analyzing the results from the second section of the Round Two survey; and (5) analyzing the results from the second section of the Round Three survey, plus the results from the follow-up telephone interviews. The components of differentiated instruction found in the existing body of educational research were discussed in detail in the literature review in Chapter II of this dissertation, but a follow-up examination of them was important in answering this research question.

The second section of the Delphi surveys was aimed at answering the second research question for this study. This section asked respondents to address an open-ended question (question #9) in Round One and provide input regarding differentiated instructional elements that had not already been identified in existing research that principals perceived to be critical for student success. Only five (21%) members of the expert panel addressed question #9 to answer the second research question for this study. This open-ended section was unanswered by nineteen (79%) of the twenty-four members of the expert panel who completed the Round One survey.

Despite the fact that all (100%) panelists responded in the second section of Round Three, giving their approval for the ranked list of the additional differentiated instructional elements in Round Three via their returned surveys, the researcher-moderator completed telephone interviews to validate the outcomes from Rounds One, Two, and Three relative to answering the study's second research question. Outcomes from this polling indicated that the principals agreed that the five members' inputs (21%) could actually be incorporated into the initial thirteen statements (questions #5 through #8) in the survey rounds. The fact that only five of the panelists chose to suggest any additional differentiated instructional elements, initially, infers that the first section of the first survey presented the research-identified differentiated instructional elements accurately. Of most importance, the synopsis of feedback from the interviewed principals in Round Three was that they believed the suggested differentiated instructional elements for question #9 were merely restatements of the initial thirteen statements (questions #5 through #9). Therefore, the researcher-moderator concluded the answer to the second research question, based upon the collective input from the expert panel, was that there were not any additional differentiated instructional elements viewed as being critical for student success that have not already been identified by the existing research.

### **Summary of Findings**

Thirty-four principals were invited to participate in this study. Twenty-four (71%) principals completed the three rounds of the study from December 14, 2009, to February 5, 2010. There are two major findings from this study. First, a variety of resources and a variety of strategies top the prioritized list of the most effective

research-identified differentiated instructional elements as perceived by secondary principals of 2A to 5A 2009 “Exemplary” Texas public high schools. Secondly, the differentiated instructional elements already identified in existing research, as presented in this study, are comprehensive and sufficient for improving student performance. Next, Chapter V will provide a summary of findings, conclusions, and recommendations for further study.

## **CHAPTER V**

### **SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS**

#### **Introduction**

Chapter V presents a summary of the findings of this study, as well as conclusions, and recommendations for further study. This research study provides valuable insights for practitioners, professional development providers, as well as principal and teacher preparation programs regarding the use of the most effective research-identified differentiated instructional elements for improving student performance as perceived by principals of 2009 “Exemplary” public high schools in Texas. Overall, this research study seeks to link differentiation, best practice, and student performance.

#### **Summary**

The primary purpose of this study was to determine which of the research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals in 2A to 5A 2009 “Exemplary” public high schools in Texas. A secondary purpose of this study was to determine what differentiated instructional elements that have not already been identified in existing research are perceived by this study’s targeted principals as being critical for student success. A Delphi panel of twenty-four secondary principals participated in all three survey rounds of the study.

During the three rounds of the Delphi study, the twenty-four members of the expert panel provided input, as well as feedback, for both the researcher-moderator and

other panel members regarding which research-identified differentiated instructional elements they perceived to be the most effective for improving student performance. The differentiated instructional elements presented in the survey were based upon a sound theoretical framework resulting from a review of existing research on differentiated instruction. At the completion of Round Three, it was determined that consensus had been reached among the members of the panel, and the data collection period ended. Each of the surveys used in the study, as well as the relevant statistical analysis, graphs, and tables can be found in the appendices of this dissertation.

The findings of the study determined the most effective research-identified differentiated instructional elements for improving student performance. Panelists' final ranking, at the end of three survey rounds, of the thirteen differentiated instructional elements presented from the literature showcased their consensus regarding the degree of effectiveness of each of the research-identified differentiated instructional elements presented in the study. Specifically, using a variety of resources and a variety of strategies were the top-ranked research-identified differentiated instructional elements that the targeted principals perceived to be the most effective for improving student performance. In addition, panelists agreed that the differentiated instructional elements already identified in existing research, as presented in this study, are comprehensive and sufficient for improving student performance.

No doubt, the conclusions and recommendations of this study could extend the current knowledge base by promoting the use of the most effective research-identified differentiated instructional elements to improve student performance. Furthermore, the study's conclusions and recommendations will be invaluable for ongoing professional

development, principal and teacher preparation programs, as well as those in the field seeking to improve their daily educational practices for student impact.

Through the first research question, this study sought to determine the most effective research-identified differentiated instructional elements for improving student performance as perceived by secondary principals in 2A to 5A 2009 “Exemplary public high schools in Texas. Through the second research question, this study sought to determine what differentiated instructional elements that had not already identified in existing research did principals perceive to be critical for student success.

A modified Delphi procedure was chosen as the methodology for this study. The rationale for this choice was that the Delphi technique provides an opportunity for a collaborative process without actually having to meet in a group or committee process, which can be negatively impacted by issues such as member dominance, peer pressure, or exclusion. The expert panel for the Delphi study consisted of twenty-four principals of 2A to 5A 2009 “Exemplary” Texas public high school campuses. The eligibility criteria used in the selection process were campus accountability ratings, school size and composition, and principal tenure.

Thirty-four high school principals were originally invited to participate in Round One of the study on December 14, 2009. Twenty-four principals completed the Round One survey and agreed to participate in the study. This response rate of seventy-one percent yielded an acceptable number of participants for the study. The survey used in this round presented thirteen research-identified differentiated instructional elements in the first section to be rated by the participants on a four-point Likert scale relative to their degree of effectiveness in improving student performance. The second section of the survey provided the expert panel with an open-ended opportunity to give feedback



regarding any differentiated instructional elements that had not already been identified in existing research that they perceived to be critical for student success.

When Round One ended on January 15, 2010, after beginning on December 14, 2009, the researcher-moderator analyzed the twenty-four panelists' Round One results with descriptive statistics, such as the mode—including the percentages of ratings of “4’s” (*significant*), “3’s” (*moderate*), “2’s” (*minimal*), or “1’s” (*none*)—as well as the variance, standard deviation, and interquartile range (IQR) in order to produce a prioritized list of the most effective research-identified differentiated instructional elements as perceived by the targeted principals in this study, plus to develop the Round Two survey instruments.

Round Two of the Delphi began on January 19, 2010. The Round Two survey, like Round One’s, was also divided into two sections. In the first section of Round Two’s survey, participants were able to confidentially view their responses from Round One for any questions (#5 though #8) which were outside of the interquartile range (IQR) and mode for the group, for the purpose of maintaining or modifying their responses. Also provided in the first section of Round Two’s survey was data analysis information from Round One, such as the mode, the variance, standard deviation, and interquartile range (IQR). Rating choices on the four-point Likert scale provided in each survey round were: “4” (*significant*), “3” (*moderate*), “2” (*minimal*), or “1” (*none*). In addition, a prioritized list of the most effective research-identified differentiated instructional elements was presented in each round for panelists’ approval or modification.

The second section of the survey in Round Two displayed the ranked input from the second section of the survey in Round One with regard to any differentiated

instructional elements that had not already been identified in existing research that principals perceived to be critical to student success and had added to question #9 in the Round One survey. Principals were asked to approve or modify the input for question #9 and were invited to make comments regarding the information presented and/or to provide additional differentiated instructional elements that they perceived to be critical for student success. At the end of Round Two on January 27, 2010, twenty-four principals again returned their surveys to continue participating in the study. Data analysis after Round Two indicated fewer response changes occurred than in Round One, indicating movement toward stability and consensus.

After data analysis for Round Two was completed, utilizing the mode, percentages of ratings, variance, standard deviation, and interquartile range (IQR) as used in the data analysis after Round One, the researcher-moderator incorporated the data results into the survey instrument for Round Three of the Delphi study which began on January 29, 2010. The Round Three survey, like Round Two's, was presented in two sections. In the first section, panelists could confidentially view any of their Round Two responses that were outside the interquartile range (IQR) and mode for the group and either approve or modify the rankings in Round Three. In Round Three, the prioritized list of the most effective research-identified differentiated instructional elements was presented for approval or modification, based on the mode, percentages of ratings, variance, standard deviation, and interquartile range (IQR). The prioritized list specifically reflected the percentages of ratings of "4's" (*significant*), "3's" (*moderate*), "2's" (*minimal*), or "1's" (*none*) from the survey's four-point Likert scale.

The second section of the survey in Round Three displayed the ranked input regarding any differentiated instructional elements that principals had approved or

modified relative to open-ended question #9 during Round Two. In Round Three, however, via telephone polling, principals acknowledged that that they believed the suggested differentiated instructional elements for question #9 were merely restatements of the initial thirteen statements (questions #5 through #9).

All of the twenty-four Round Three surveys were completed by Friday, February 5, 2010. Data analysis after Round Three indicated that one item's (#6A) interquartile range (IQR) had changed from 1.75 to 1.00—indicating stability and consensus; all other items were already in consensus after Round Two. Therefore, it was determined by the researcher-moderator that three rounds of the Delphi process had proven to be sufficient for the expert panel to reach consensus in the study.

### **Findings**

The findings of this study are important because they answer the two research questions that were presented for consideration. In answering the first research question relative to which are the most effective research-identified differentiated instructional elements for improving student performance, a variety of resources and a variety of strategies top the list, according to the perceptions of the principals of 2A to 5A 2009 “Exemplary” public high schools in Texas. In answering the second research question relative to what differentiated instructional elements that have not already been identified in existing research are perceived by this study’s targeted principals as being critical for student success, the panelists agreed that there are none that have not already been identified in the existing research. The answers to these questions can potentially impact educational practice, professional development, as well as principal

and teacher preparation programs. Each of these findings is discussed further in the following section.

A finding of importance in this study is the prioritization of the most effective research-identified differentiated instructional elements by the expert panel. The first research question for this study asked which research-identified differentiated instructional elements were the most effective for improving student performance. After Rounds One and Two in the Delphi process when panelists had the opportunity to rank each of the research-identified thirteen statements (questions #5 through #8), the researcher-moderator completed data analysis to determine the outcomes of their input. The interquartile range (IQR) was used to determine consensus, and the decreasing measures of variance and standard deviation were used to determine increasing agreement. The researcher-moderator also calculated which elements had higher percentages of ratings (63 percent “4’s” versus 83 percent “3’s”), which were indicative of *significant* versus *moderate* ratings, respectively. Data analysis procedures by the researcher-moderator included ranking the items according to their interquartile range (IQR) to determine consensus, then by their decreasing variance and standard deviation, and then by their mode and higher percentages of ratings (63 percent “4’s” versus 83 percent “3’s”) in order to produce a prioritized list of the most effective research-identified differentiated instructional elements, according to the perceptions of the targeted principals in the study.

After three rounds in the Delphi process, a variety of resources (item #6C) and a variety of strategies (#7B) topped the prioritized list of most effective research-identified differentiated instructional elements as perceived by secondary principals of 2A to 5A 2009 “Exemplary” Texas public high schools. It should be noted that #6C—a variety of

resources—and #7B—a variety of strategies—tied for the first position on the prioritized list by the principals, as evidenced by their identical interquartile ranges (IQRs), modes, variances, standard deviations, and high percentages of ratings given to them by the expert panel. These were the only two of the differentiated instructional elements to rate a “4” for *significant* effectiveness. Principals consistently rated these two items as the only two to receive “4’s” (*significant*) throughout the three survey rounds in the study.

Of importance, as well, are the findings for the rest of the most effective research-identified differentiated instructional elements. Eight items—#8B, #6B, #7A, #7C, #7E, #7F, #6A, and #8A—were ranked as “3’s,” representative of *moderate* effectiveness in improving student performance, according to the perceptions of the twenty-four principals in the study. Two items—#5B and #5A—were ranked as an equal combination of “3’s” (*moderate*) and “2’s” (*minimal*), representative of a split vote by principals—half of whom perceived #5B and #5A to be “3’s” (*moderate*), with the other half perceiving #5B and #5A to be “2’s” (*minimal*). While items #8B, #6B, #7A, #7C, #7E, #7F, #6A, and #8A displayed movement up and down in the rankings during the three survey rounds, they were consistently in the middle section of the prioritized list throughout all three survey rounds in the study. Items #5B and #5A were consistently in the bottom section of the prioritized list throughout the three survey rounds of the study. In essence, then, in answering the first research question relative to which are the most effective research-identified differentiated instructional elements for improving student performance, a variety of resources and a variety of strategies top the list.

The finding relative to the second research question is not surprising. The fact that very few (five) of the panelists chose to suggest any differentiated instructional elements that had not already been identified in existing research in Round One of the Delphi process potentially suggests that the first section of the first survey presented the research-identified differentiated instructional elements accurately and sufficiently for the principals' consideration for prioritization in terms of effectiveness. Panelists had three rounds of opportunities to comment and/or discuss the aspect of the inclusion, or not, of additional differentiated instructional elements that they perceived to be critical for student success. The fact that there were no additional differentiated instructional elements ultimately supported by respondents affirms the conjecture that the literature base already presents a comprehensive list.

In Round One, only five (21%) of twenty-four participants provided any feedback at all regarding the addition of differentiated instructional elements that had not already been identified in existing research that principals perceived to be critical for student success and that were not represented initially in the thirteen statements (questions #5 through #8) in the first section of the Round One survey. With follow-up feedback from principals during the telephone interviews after Round Three, panelists acknowledged to the researcher-moderator that the additional differentiated instructional elements suggested by the five principals in Round One were not representative of any new and additional differentiated instructional elements; rather, they were merely extensions of the initial research-identified thirteen statements (questions #5 through #8) in the first section of the Round One survey. Regarding the answer to the second research question in this study, then, panelists determined that the differentiated instructional

elements already identified in existing research, as presented in this study, are comprehensive and sufficient for improving student performance.

### **Conclusions**

This research study determined the most effective research-identified differentiated instructional elements for improving student performance as perceived by secondary principals in 2A to 5A 2009 “Exemplary” public high schools in Texas. In addition, this research study sought to ascertain what differentiated instructional elements that had not already been identified in existing research principals perceived to be critical for student success. Thus, the researcher-moderator—after completing the data collection and analysis—concludes the following:

1. As perceived by secondary principals of 2A to 5A 2009 “Exemplary” Texas public high schools, a variety of resources and a variety of strategies top the list of the most effective research-identified differentiated instructional elements for improving student performance.
2. According to the targeted principals in this study, there are no differentiated instructional elements that have not already been identified in existing research that principals perceive to be critical for student success.

Piaget (1978) proposed that understanding develops in learners through the process of taking in new information and making learning connections in order to construct knowledge. Dewey (1938) advocated that teacher instruction should be aligned with student needs. Vygotsky (1962) elaborated upon the concept of the social, interactional relationship between teacher and student as instrumental for learning to occur. Bruner (1961), another proponent of constructivism, also forged the way for the

differentiated instructional model, which promotes an active, student-centered, meaning-making approach to teaching and learning. Indeed, with the top-ranked most effective research-identified differentiated instructional elements—as determined in this study—to be the use of a variety of resources and a variety of strategies, these findings embrace Piaget’s (1978), Dewey’s (1938), Vygotsky’s (1962), and Bruner’s (1961) constructivist theories for instruction to be aligned to a learner’s needs so that knowledge can be constructed by the student within an active, student-centered, interactional relationship between the teacher and learner. Indeed, a teacher’s use of a variety of resources and a variety of strategies potentially serves to address student differences in order to optimize learning. Linking these top-ranked most effective research-identified differentiated instructional elements to the constructivist theories promoted by Piaget (1978), Dewey (1938), Vygotsky (1962), and Bruner (1961) lends credibility to this study’s findings.

Differentiation, typically defined as responsive teaching that acknowledges student differences, embraces the social constructivist learning theory of Russian psychologist, Lev Vygotsky (1962) as central to instructional improvement. This working definition of differentiated instruction—and the findings in this study—reflects Vygotsky’s sociocultural theory (1962), the main tenet of which emphasizes the social, interactional relationship between teacher and student (Tomlinson, 2004). The sociocultural theory of learning—with its premise that the learner must be studied within a particular social and cultural context—evolved primarily from the works of Vygotsky (1962), who also promoted the importance of moderately challenging the learner within his or her zone of proximal development in order to improve learning (Vygotsky, 1978). Differentiated instruction views the learning experience as social and collaborative,



involving teachers and learners, collectively (Tomlinson, 2004). Furthermore, differentiated instruction supports the classroom as a community focused upon accommodating differences (Lawrence-Brown, 2004). The basic idea of constructivism is that knowledge must be constructed within the learner and is a dynamic process that requires the active engagement of the learner (Piaget, 1954). These constructivist theories are foundational to the use of a variety of resources and a variety of strategies.

Brain-based research (Caine & Caine, 1991; Howard, 1994; Jensen, 1998), learning styles (Dunn, 1996), and multiple intelligences (Gardner, 1983, 1993) are additional bodies of research that are foundational for this study's findings relative to using a variety of resources and a variety of strategies for improving student performance. Brain-based research (Howard, 1994; Jensen, 1998) purports that each learner's brain is unique, and educators must provide diverse opportunities for varied learners to make sense of ideas and information to extract meaning (Caine & Caine, 1991). Current brain research claims that students should work at a level of moderate challenge for learning to occur (Howard, 1994; Jensen, 1998). Providing a variety of resources, as well as a variety of strategies in the classroom serves to challenge and reach diverse learners at varying levels of readiness, interests, and abilities. Learning styles research, as well as multiple intelligences research, supports differentiation with its emphasis upon facilitating student learning via varied approaches to instruction. Learning styles theory suggests that individual preferences impact learning (Dunn, 1996), while multiple intelligences research emphasizes that learners achieve better when instruction addresses their multiple intelligences (Gardner, 1983, 1993). Providing a variety of resources, as well as a variety of strategies in the classroom serves to address the varied learning styles and multiple intelligences of students of

diverse backgrounds, preferences, interests, and abilities. No doubt, linking these top-ranked most effective research-identified differentiated instructional elements to the research by Howard (1994), Jensen (1998), Dunn (1996), and Gardner (1983, 1993) lends credibility to this study's findings.

These conclusions are valid, based upon the input of a panel of similarly trained experts—selected according to established and approved criteria—who possess knowledge and understanding in the field. Experts who have similar training and a general understanding in the field of interest allow for effective and reliable utilization of a small sample from a limited number of experts in the field of study (Delbecq et al., 1975). In addition, due to the stability of panel responses after three survey rounds, the findings from the data collection and analysis, as completed in this study, can inform judgment and support effective decision-making. The number of experts (24) utilized in this study was sufficient to ensure reliability for a Delphi study (Akins et al., 2005).

Ultimately, the Delphi method should not be viewed as a scientific method for creating new knowledge; rather, it is a process for making optimum use of available information—whether that is scientific data or the collective wisdom of experts (Murphy et al., 1998, p. 5). The Delphi method has been characterized as a highly flexible problem-solving process, affording researchers and practitioners, alike, the opportunity to problem solve by identifying and prioritizing the most relevant emergent issues and trends. Indeed, in this research study, the Delphi process provided an effective methodology, providing a systematic, effective, and comprehensive technique for administering a group communication process that enabled a collection of knowledgeable individuals to reach a consensus.

### **Implications and Recommendations for Further Study**

Since scant research exists on the effectiveness of differentiating instruction to improve secondary students' performance, the findings of this research study may contribute to evidence-based education and the current knowledge base by having determined which research-identified differentiated instructional elements are the most effective for improving student performance as perceived by secondary principals of 2A to 5A 2009 "Exemplary" 2A to 5A public high schools in Texas. This study also ascertained that the targeted principals in this study acknowledged that the differentiated instructional elements already identified in existing research, as presented in this study, are comprehensive and sufficient for improving student performance.

With these findings in mind, targeted principals' perceptions can be shared, relating their consensus regarding which research-identified differentiated instructional elements they perceive to be the most effective for improving student performance. No doubt, educators share "best practices" for improving student performance in educational conferences, workshops, as well as in the field; consequently, the findings in this study—relative to using a variety of resources and a variety of strategies—can be shared, as well, with others as a "best practice" for improving student performance.

The implications of this research are that public high school principals in Texas on campuses—which are rated as "Exemplary" by the 2009 *Academic Excellence Indicator System (AEIS)*—will have a "practitioner proven model" for student success to share with others. In essence, principals in this study that learn—from the findings in this study—that the top-ranked most effective research-identified differentiated instructional elements are using a variety of resources and a variety of strategies can encourage and facilitate their teachers' implementations of these two most effective

research-identified differentiated instructional elements into their classrooms in order to improve student performance. They can also share this study's findings with other principals and teachers in order to impact student learning on other campuses. Furthermore, knowing that the top-ranked most effective research-identified differentiated instructional elements for improving student performance are using a variety of resources and a variety of strategies can assist developers of professional development. Guiding professional development for the purpose of increasing teachers' usage of these top-ranked elements could ultimately improve student performance on many campuses.

Not only can the information from this study be shared with other campus principals and teachers to impact daily practice and guide professional development, but it can also inform principal training and teacher preparation programs. Principal training programs must make a commitment to develop leaders who understand and value differentiated instruction because of its impact on student success. Furthermore, with the findings from this research study, teacher preparation programs should be able to provide new teachers with additional insights regarding which research-identified differentiated instructional elements are the most effective for improving student performance. Principal and teacher preparation programs utilizing the findings from this study regarding the top-ranked most effective research-identified differentiated instructional elements could be beneficial to those in such training programs who are preparing to impact student learning. Knowing that the top-ranked most effective research-identified differentiated instructional elements are a variety of resources and a variety of strategies—as determined in this study from the perceptions of the targeted principals in the study—could serve to better equip principals and teachers for working

in the educational field on secondary campuses after completing such training programs that implement and facilitate “best practice.”

Beginning with enhancing the knowledge and skills of principals and teachers coming out of training programs that implement and facilitate “best practice,” such as the findings in this study, the impact of their enhanced knowledge and skills can be translated into a benefit for students. It can be argued that introducing new teachers to student-centered views of instruction, providing them with practitioner models for implementing the most effective research-identified differentiated instructional strategies, and giving them the tools and confidence to impact student success, early on, may be necessary to break the one-size-fits-all conception of teaching that many a novice teacher adopts just to survive (Tomlinson, Callahan, Moon, Tomchin, Landrum, Imbeau, Hunsaker, & Eiss, 1995). Research suggests that teacher preparation programs too often fall short in their efforts to prepare novice teachers for the inevitability of academically diverse classrooms (Tomlinson, Callahan, & Kelli, 1997). Tomlinson’s (1999) research reveals that, generally speaking, new teachers seldom, if ever, experience differentiated instruction in their teacher education classes. Indeed, the quality of tomorrow’s classrooms relies upon today’s preparation of the next generation of teachers, so pushing the envelope to investigate which research-identified differentiated instructional elements are the most effective for improving student performance and, subsequently, implementing them in classrooms of academic diversity brings research into practice for student benefit. No doubt, ongoing studies to determine how best to meet student needs warrants more attention; there is no shortage of students with diverse academic needs (Leithwood & Riehl, 2003). Yet, the

findings in this study regarding the utilization of a variety of resources and a variety of strategies can be beneficial for improving student performance.

The Delphi study conducted in this research project obtained information according to the perceptions of principals of 2A to 5A 2009 “Exemplary” Texas public high schools with regard to the most effective research-identified differentiated instructional elements that improve student performance. At the conclusion of this study, the researcher-moderator submits the following as recommendations for further study:

1. Demographic Study: The results of this study represent the perceptions of participants based upon specific eligibility criteria, excluding certain demographic variables. A follow-up study to further analyze the results of this Delphi exercise, considering the participating principals’ responses according to various demographic variables might prove to be a worthwhile study.
2. Turnaround Study: The findings of this study were obtained from established high school principals of “Exemplary” campuses. It might prove interesting to assess the perceptions of newly-assigned principals to low-performing campuses who have implemented the top two most effective differentiated instructional elements, as determined in this study, on their campuses to improve student performance.
3. Teacher-Leaders Study: The findings of this study were obtained from established high school principals of “Exemplary” campuses. It might prove worthwhile to assess the perceptions of teacher-leaders who have

implemented the top two most effective differentiated instructional elements, as determined in this study, on their campuses to improve student performance.

4. **Random Sample Study:** This study used a purposefully selected expert panel. Comparing the findings of this study with those of another Delphi study with a randomly selected panel of principals, using the same instrumentation, would be an interesting and, perhaps, impacting study.
5. **National Sample Study:** This study consisted of public high school principals in Texas and is only generalizable to this population. A follow-up national study could prove beneficial.
6. **Varied Methodology Study:** A follow-up study utilizing other statistics, such as the Kendall rank correlation coefficient or the McNemar test to quantify the degree of shift in responses would be an interesting study to compare to the current study's findings.

Differentiated instruction is the subject of a wealth of literature. Understanding the historical perspectives of differentiated instruction, the basis for the claims regarding the contribution of differentiated instruction to student success, and the methodological characteristics of the Delphi method are important for successful implementation of the research proposed. In closing, the significance of a research study of this nature can also be found in that its conclusions will be invaluable for principals and teachers seeking to improve their daily educational practices for student impact (Hallinger & Heck, 1996; Riehl, 2000).

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**APPENDIX A**  
**ROUND ONE RESEARCH PACKET MATERIALS**

**TERESA ANN DURRETT, PRINCIPAL INVESTIGATOR**

December 11, 2009

Principal's Name

\_\_\_\_\_ High School

Principal's Address

Dear Principal:

Greetings! You are to be commended as a principal of an "Exemplary" public high school in Texas, as designated by the 2009 *Academic Excellence Indicator System (AEIS)* report. Hence, you are invited to participate in a brief research study beginning December 14, 2009, whose primary purpose is to determine which research-identified differentiated instructional elements were the most effective in improving student performance on your campus.

The proposed research study will utilize the *Delphi* procedure. This survey process—of which there could be three rounds—relies upon a panel of experts to provide individual input and, ultimately, arrive at a group consensus without actually meeting as a group. For example, in *Round One*, which is enclosed, you are being asked to complete and return a brief survey, in which you rate the degree of effectiveness of research-identified differentiated instructional elements utilized by your teachers in 2008-2009 to facilitate improved student performance on your campus. The objective of the second and subsequent survey rounds will be to develop a consensus, overall, among panel members across school districts with regard to the ranking of answers given in the first survey. An approximate time estimate for you to complete each survey round is five to ten minutes, or less. The timeframe of the study is eight weeks. You will receive feedback after each round.

Knowing you are a busy administrator, I thank you, in advance, for taking a few minutes to complete and return the enclosures. Please complete and return the *Informed Consent* form, survey, and survey preference form by Thursday, December 17, given the Christmas holidays are imminent. Indeed, your input could very likely impact educational administration decision making for the incorporation of effective differentiated instructional elements in classrooms across Texas and, perhaps, beyond!

No doubt, our shared commitment, as dedicated educators, is to facilitate student performance! Thank you for your consideration of this research study.

Respectfully, Teresa Ann Durrett  
Principal Investigator, Texas A&M University  
4226 TAMU, EAHR Department  
College Station, Texas 77843-4226  
Enclosures

## INFORMED CONSENT

### Introduction

The purpose of this form is to provide you information that may affect your decision as to whether or not to participate in this research study on the Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study. If you decide to participate, this form will document your consent.

You have been asked to participate in a research project studying the effectiveness of using research-identified differentiated instructional elements and their impact on student performance. The purpose of this study is to determine which of the research-identified differentiated instructional elements are the most effective in improving student performance as perceived by secondary principals in 2009 “Exemplary” public high schools in Texas? You were selected to be a possible participant since you have been a principal for at least three years and are employed on a Texas 2A to 5A “Exemplary” public high school secondary campus, according to the 2009 Texas Education Agency ratings in the *Academic Excellence Indicator System*.

### What will I be asked to do?

If you agree to participate in this study, you will be asked to complete and return the *Informed Consent* form by mail to the principal investigator (A stamped, addressed envelope will be provided). If you choose to participate in this study, the three brief surveys of the research study that you will receive can be returned to the principal investigator either by email or mail during the study. The initial survey has ten short questions to which participants will be requested to respond by selecting a multiple-choice answer—selected according to each participant’s own perceptions of the degree of effectiveness of each research-identified differentiated instructional element presented—with one question of the ten providing for an open-ended response. The initial survey may take approximately 5 to 10 minutes to complete. The two follow-up surveys will request that participants prioritize (rank) the research-identified differentiated instructional elements displayed in terms of which the survey participants consider to be the most effective in improving student performance. Each of the two follow-up surveys may take approximately 5 minutes to complete. The timeframe for this study—beginning December 14—will be approximately eight weeks and will involve your receipt and submission of three brief 5-to-10-minute surveys.

### What are the risks involved in this study?

The risks associated in the study are minimal—not greater than risks ordinarily encountered in daily life.

### What are the possible benefits of this study?

The possible benefits of participation are that the study’s findings could prove beneficial to participants, plus other secondary principals, teachers, and students. Specifically, the implications of this study are that public high school principals will have a “practitioner proven model” for student success to share. The significance of this study is that its conclusions will be invaluable for principals and teachers seeking to improve their daily educational practices for impacting student performance. Its conclusions will also be invaluable in terms of informing principal and teacher trainings, as well as teacher preparation programs.

### Do I have to participate?

No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected. You may also choose to decline to answer any survey question, as well.

### Who will know about my participation in this research study?

This research study is confidential. To ensure confidentiality of participants' responses, each participating principal's responses received by the principal investigator will be confidentially and individually obtained, recorded, and stored. The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. In presenting data and findings, the principal investigator will display collective and prioritized survey responses regarding which will be determined to be the most effective differentiated instructional elements via the surveys that are used for improving student performances at 2009 "Exemplary" Texas public high schools, rather than the principal investigator displaying individual input from participant campuses. While it is possible that research participants can be identified since there is open access to the 2009 "Exemplary" Texas public high schools' Spring 2009 TAKS data and school leadership contact information, the principal investigator will strive to keep each participant's information and input protected and confidential, with the research study records being confidentially filed, securely stored, and accessible only by the principal investigator.

**Whom do I contact with questions about the research?**

If you have questions regarding this study, you may contact Teresa Ann Durrett, Principal Investigator, at 4226 TAMU, College Station, TX. 77843-4226, [teresa-ann-parish@tam.u.edu](mailto:teresa-ann-parish@tam.u.edu) or Dr. John Hoyle, Texas A&M University Doctoral Committee Chair, [jhoyle@tam.u.edu](mailto:jhoyle@tam.u.edu), 979-845-2748.

**Whom do I contact about my rights as a research participant?**

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at 979-458-4067 or [irb@tam.u.edu](mailto:irb@tam.u.edu).

**Signature**

Please be sure you have read the above information, asked questions and received answers to your satisfaction. By signing below, you consent to participate in this study and will receive a copy of this form for your records. If you agree to participate, please return this completed, signed form in the enclosed stamped, addressed envelope by 12/17/09, if possible.

**Signature of Participant:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**Survey Participation Preference Form:**

\_\_\_\_\_ I choose to participate electronically. Please send all future correspondence to me at the following email address: \_\_\_\_\_

\_\_\_\_\_ I choose to participate via print copy through the mail. Please send all research study materials to this address: \_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_ I do not wish to participate in the research study.

**Signature of Person Obtaining Consent:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Name:** \_\_\_\_\_



## SURVEY ONE

### Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study

#### *Differentiated Instruction's Impact: Texas Principals' Perceptions*

**CONFIDENTIAL SURVEY FOR \_\_\_\_\_**

**PURPOSE OF STUDY:** Thank you for participating in this Texas A&M University doctoral survey on Differentiated Instruction. The purpose of the survey is to obtain information relative to the perceptions of secondary principals in Texas public high schools rated “Exemplary” in 2009 regarding some of the key research-identified elements associated with differentiation.

Differentiated Instruction is a teaching approach designed to address learner variance in readiness, interests, and learning profiles with regard to content, process, and product to maximize learning opportunities (Tomlinson et al., 2004). References to supporting research on Differentiated Instruction are included. The survey may take approximately 10 minutes to complete. The panelist may elect not to respond on certain questions. A response to Question 2, however, would be especially appreciated. Your input will be greatly appreciated!

**BEGIN SURVEY:** According to your perceptions as a principal of a 2A to 5A Texas public high school rated “Exemplary” in 2009, please rate in the following survey the degree of usage and effectiveness of research-identified Differentiated Instructional elements utilized, as a whole, on your campus in 2008-2009 by your teachers (those who had at least one prior year of teaching experience) for improving student performance.

1. Please complete the principal profile questions.

How many completed years have you been a principal on your campus?

2. Identify the source from which you have learned the most about Differentiated Instruction?
- On the Job
  - Mentor
  - In-District Professional Development
  - Out-of-District Professional Development
  - Graduate Courses
  - Undergraduate Courses
  - Independent Study

3. According to your perceptions, did the majority of your teachers (those with at least one year's prior teaching experience), as a whole, frequently (weekly) utilize Differentiated Instruction in their classrooms in 2008-2009?

- 3=Yes  
 2=No  
 1=Don't Know  
 0=Not Used

4. According to your perceptions, rate the degree of usage (in terms of frequency) of Differentiated Instruction by your teachers, as a whole, during the 2008-2009 school year.

- 4=Significant  
 3=Moderate  
 2=Minimal  
 1=None

Differentiated Instructional Elements as Perceived by Principals on "Exemplary" Campuses for 2009

5. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified Differentiated Instructional elements.

	4=Significant	3=Moderate	2=Minimal	1=None
<p><b>A. READINESS:</b>            Teachers diagnose students' readiness levels prior to specific instruction (Vygotsky, 1962; Csikszentmihalyi et al., 1993; Tomlinson et al., 2004).</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p><b>B. INTERESTS &amp; LEARNING PROFILES:</b>            Teachers assess students' interests, multiple intelligences, and learning styles to inform differentiation (Gardner, 1983; Campbell &amp; Campbell, 1999; Collins &amp; Amabile, 1999; Barrell, 2001; Dunn, Denig, &amp; Lovelace, 2001).</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified differentiated instructional elements utilized to differentiate **CONTENT**.

	4=Significant	3=Moderate	2=Minimal	1=None
<b>A.</b> Teachers pretest and posttest students to determine mastery levels to decide on approach to student learning [i.e., curriculum compacting is used] (Reis & Renzulli, 1992; Heacox, 2002; Earl, 2003; Tomlinson & McTighe, 2006).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>B.</b> Teachers differentiate major concepts and generalizations for differing student abilities and needs (Tomlinson, 2004).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>C.</b> Teachers employ a variety of instructional resources in addition to standard text (Tomlinson, 2001).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified differentiated instructional elements utilized to differentiate **PROCESS**.

	4=Significant	3=Moderate	2=Minimal	1=None
<b>A.</b> Teachers incorporate flexible grouping opportunities based upon students' readiness, interests, and learning profiles (Lou et al., 1996; Tomlinson, 2003).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>B.</b> Teachers use a variety of instructional strategies to address learner variance (Tomlinson, 1999).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>C.</b> Teachers provide activities at different levels of difficulty, such as tiered assignments, to build upon students' varying degrees of prior knowledge and skills, in order to scaffold their learning (Tomlinson, 2003).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	4=Significant	3=Moderate	2=Minimal	1=None
D. Teachers grant students choices in completing tasks [learning contracts] (Tomlinson, 2001).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Teachers engage students in varying degrees of higher-order questioning techniques (Rosenshine et al., 1996).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Teachers present students with opportunities to solve relevant problems at different levels of complexity [i.e., problem-based learning] (McDaniel & Schlager, 1990).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified differentiated instructional elements utilized to differentiate **PRODUCT**.

	4=Significant	3=Moderate	2=Minimal	1=None
A. Teachers give students assessment options from a variety of product choices for demonstration of mastery (Tomlinson & McTighe, 2006).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Teachers use authentic forms of formative and summative evaluation to assess student progress (Wiggins, 1993; Black & Wiliam, 1998).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. If your teachers used any Differentiated Instructional elements in 2008-2009 that have not already been identified in existing research that you perceive were critical for student success on the Spring 2009 TAKS tests, please list them, beginning with the most effective. If not, enter, "Not Applicable."

**10. According to your perceptions as a principal of an "Exemplary" public high school in Texas for 2009, to what degree did your teachers' usage of Differentiated Instruction, overall, during 2008-2009 positively impact your students' Spring 2009 TAKS performances?**

**4=Significant**

**3=Moderate**

**2=Minimal**

**1=None**

Rate the impact of usage of Differentiated Instruction on your campus during 2008-2009 on your students' Spring 2009 TAKS performances.



*Thank you for completing and returning this survey to Teresa Ann Durrett at 4226 TAMU, EAHR Department, College Station, TX. 77843-4226 or to [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu)*

**APPENDIX B**

**INITIAL FOLLOW-UP EMAIL AFTER ROUND ONE**

**TERESA ANN DURRETT, PRINCIPAL INVESTIGATOR**

December 15, 2009

Principal's Name  
\_\_\_\_\_ High School  
Principal's Address

Dear Principal:

On December 11, 2009, I mailed a research packet to your school address. Hopefully, you have received it, at this point. I am currently working on my dissertation at Texas A&M, College Station, Texas, and I am following up to request your invaluable response to a brief survey regarding research-identified differentiated instructional elements utilized on your campus in 2008-2009 since you are a principal of an "Exemplary" public high school in Texas for 2009.

Please examine the research packet materials and choose to participate in the research study. To this email, I have attached another copy of the *Round One* survey. Please complete and return it by December 17, if possible. If you would prefer to complete and return the survey by mail, I included a stamped, addressed envelope in my first distribution on December 11 for your use. Please be sure to mail me the completed and signed *Informed Consent* form in the stamped, addressed envelope I have provided for you. For participating, you will receive invaluable and timely feedback during this eight-week study in which three brief surveys are to be completed in a Delphi process.

If you have any questions about the research study, please do not hesitate to contact me. Thank you for your response and assistance.

Teresa Ann Durrett  
Principal Investigator, Texas A&M University  
4226 TAMU, EAHR Department  
College Station, TX. 77843-4226  
teresa-ann-parish@tamu.edu  
Attachment

- Note: This research study has been reviewed by the Institutional Review Board – Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board via Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, at 979-458-4067 or [mcilhaney@tamu.edu](mailto:mcilhaney@tamu.edu).

**APPENDIX C**

**SECOND FOLLOW-UP EMAIL FOR ROUND ONE PARTICIPATION**



**TERESA ANN DURRETT, PRINCIPAL INVESTIGATOR**

December 18, 2009

Principal's Name

\_\_\_\_\_ High School

Principal's Address

Dear Principal:

I mailed a research packet to your school address on December 11, 2009, requesting your participation in a research study regarding research-identified differentiated instructional elements utilized on your campus, which has been determined to be an "Exemplary" high school in Texas, as designated by the 2009 *Academic Excellence Indicator System (AEIS)* report.

To accomplish the research study component of my dissertation requirement at Texas A&M University, I desire to obtain the input of principals, like you, across the state whose public high school campus has been designated as "Exemplary." As one of 34 potential participants, your perception of which research-identified differentiated instructional elements you perceive to be the most effective in improving student performance is invaluable to my research study and, potentially, to future research and educational efforts.

I have attached a copy of the first survey to this email for your convenience in returning your responses to me this week. Another option is that you may complete the survey no later than by December 18 and return it to me in the stamped, addressed envelope provided in the original December 11 research packet. Please be sure to complete, sign, and return the *Informed Consent* form to me by mail. If you have already returned your completed survey and *Informed Consent* form to me, please disregard this email reminder. Thank you for your response and assistance.

Teresa Ann Durrett  
Principal Investigator, Texas A&M University  
4226 TAMU, EAHR Department  
College Station, TX. 77843-4226  
teresa-ann-parish@tam.u.edu  
Attachment

- This research study has been reviewed by the Institutional Review Board – Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board via Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, at 979-458-4067 or [mcilhaney@tam.u.edu](mailto:mcilhaney@tam.u.edu).

**APPENDIX D**

**FOLLOW-UP TELEPHONE SCRIPT FOR ROUND ONE PARTICIPATION**

**FOLLOW-UP TELEPHONE SCRIPT FOR ROUND ONE PARTICIPATION**

December 18, 2009

Hello, \_\_\_\_\_:  
Principal's Name

On December 11, I mailed a research packet to your school address. Hopefully, you have received it, at this point. (Determine receipt or ascertain if another research packet needs to be sent.)

As a principal of an "Exemplary" public high school in Texas for 2009, your input in my surveys for my research study at Texas A&M about research-identified differentiated instructional elements used in classrooms to improve student performance would be highly valuable and could make a difference for other principals.

In the first survey, which only has ten questions, you will be asked to take 5 to 10 minutes or less to rate the degree of effectiveness of research-identified differentiated instructional elements utilized by your teachers in 2008-2009 to facilitate improved student performance on your campus.

The objective of the second and subsequent survey rounds will be to develop a consensus among the surveyed principals regarding the rankings of their answers in the first survey. Ultimately, group consensus can be reached without actually meeting as a group since this study utilizes a Delphi research design.

Each of the three surveys will only take five to ten minutes or less to complete. As a participant, you will receive invaluable feedback, and your input can help other principals.

(Ask for participation. Remind participant, upon receipt of research packet, to complete, sign, and return the *Informed Consent* form [by mail] and the first survey [by mail or email]. )

I can be reached at [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu) (Teresa Ann Durrett)

Thank you, \_\_\_\_\_, for your participation. Have a great day!  
Principal's Name

**APPENDIX E**

**THIRD FOLLOW-UP EMAIL FOR ROUND ONE PARTICIPATION**

**TERESA ANN DURRETT, PRINCIPAL INVESTIGATOR**

January 4, 2010

Principal's Name

\_\_\_\_\_ High School

Principal's Address

Dear Principal:

Thank you, in advance, for participating in my research study regarding your perceptions of the most effective research-identified differentiated instructional elements used by your teachers on your campus in 2008-2009 for improving student performance on the 2009 Spring TAKS test.

Since I have not yet received your survey submission, most likely, due to the recent Christmas holidays, I have attached another copy of the current survey in this research study for Round One for your convenience in emailing your survey responses to me this week. Another option is that you may return the completed survey by mail. If you have already emailed or mailed your completed survey to me, please disregard this reminder. Thank you for your response and assistance.

Remember, your perceptions of which are the most effective research-identified differentiated instructional elements on your campus for improving student performance is invaluable to my research study and, potentially, to future research and educational efforts, overall.

I look forward to receiving your response and your signed *Informed Consent* form.

Teresa Ann Durrett  
Principal Investigator, Texas A&M University  
4226 TAMU, EAHR Department  
College Station, TX. 77843-4226  
teresa-ann-parish@tamu.edu  
Attachment

- This research study has been reviewed by the Institutional Review Board – Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board via Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, at 979-458-4067 or [mcilhaney@tamu.edu](mailto:mcilhaney@tamu.edu).

**APPENDIX F**

**FOURTH FOLLOW-UP EMAIL FOR ROUND ONE PARTICIPATION**

**TERESA ANN DURRETT, PRINCIPAL INVESTIGATOR**

January 11, 2010

Principal's Name

\_\_\_\_\_ High School

Principal's Address

Dear Principal:

Since I have not yet received your survey submission, I have attached another copy of the current survey in this research study for Round One, which will end on Friday, January 15, 2009. You can either email your survey responses to me this week, or you may return the completed survey by mail, if you prefer. If you have already emailed or mailed your completed survey to me, please disregard this reminder. Thank you for your response and assistance.

Remember, your perceptions of which are the most effective research-identified differentiated instructional elements on your campus for improving student performance is invaluable to my research study and, potentially, to future research and educational efforts, overall.

I look forward to receiving your response and your signed *Informed Consent* form.

Teresa Ann Durrett  
Principal Investigator, Texas A&M University  
4226 TAMU, EAHR Department  
College Station, Texas 77843-4226  
Attachment

- This research study has been reviewed by the Institutional Review Board – Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board via Ms. Melissa McIlhaney, IRB Program Coordinator, Office of Research Compliance, at 979-458-4067 or [mcilhaney@tamu.edu](mailto:mcilhaney@tamu.edu).

**APPENDIX G**  
**ROUND TWO RESEARCH INSTRUMENTS**



## SURVEY TWO

### Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study **CONFIDENTIAL INFORMATION FOR \_\_\_\_\_**

**Purpose of Survey:** (1) To obtain feedback from targeted principals in order to reach consensus regarding what they perceive to be the **most effective** research-identified differentiated instructional elements, as presented from Survey One, for improving student performance; (2) To obtain feedback from targeted principals in order to reach consensus regarding what they perceive to be effective differentiated instructional elements not previously identified by research that are critical for student success, as well.

**Part I Instructions:** Choose to either **Approve Rankings**  **OR** **Offer Alternative Rankings** for the prioritized list of the **most effective** research-identified differentiated instructional elements which evolved from your responses to questions 5-8 in Survey One. **(An analysis of the collective responses from all participants to questions 5-8 in Survey One established the rankings, as presented here, with 6C being 1<sup>st</sup> and 7D being 13<sup>th</sup>).** Collective group rankings approval will constitute consensus in Part I.

**Approve Rankings**

**OR**

**Offer Alternative Rankings**

(Add an **X** at the end of the list to the left of **Approval**) (Add a ranking number to the right of listed items)

- Question 6C: Variety of Instructional Resources
- Question 7B: Variety of Instructional Strategies
- Question 8B: Authentic Evaluation (Formative and Summative)
- Question 7E: Higher Order Questioning
- Question 6B: Differentiating Major Concepts for Student Variance
- Question 7C: Tiered Assignments
- Question 7A: Flexible Grouping for Student Variance
- Question 8A: Assessment Options for Mastery Demonstration
- Question 7F: Problem-Based Learning
- Question 5A: Student Readiness for Instruction Diagnosed
- Question 5B: Student Interests and Learning Profiles Assessed for Instruction
- Question 6A: Curriculum Compacting
- Question 7D: Student Choice in Task Completion (Learning Contracts)

**Approval** (For approval, add **X** to the left of **Approval**)

**Part II Instructions:** Choose to either **Approve Rankings**  **OR** **Offer Alternative Rankings** for the ranked list of differentiated instructional elements not previously identified by research that you perceive to be **critical** for student success per your "write-ins" in open-ended question 9 from Survey One. **(An analysis of the collective responses from participants established the rankings, as presented here.)** **Comment**, if you like, with your feedback regarding these "write-ins" and their relationship to the differentiated instructional elements presented above in Part I of Survey Two. Collective group rankings approval will constitute consensus in Part II.

**Approve Rankings**

**OR**

**Offer Alternative Rankings**

(Add an **X** at the end of the list to the left of **Approval**) (Add a ranking number to the right of listed items)

Tutorial Groups: Cooperative Learning, Peer Learning, Bubble  
Student Groups

Hands-On Science Labs

Benchmarking

Teaching Beyond TAKS

**Approval** (For approval, add **X** to the left of **Approval**)

Comments: \_\_\_\_\_  
**Return completed survey to Teresa Ann Durrett at [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu)**

## SURVEY TWO

### Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study **CONFIDENTIAL INFORMATION FOR \_\_\_\_\_**

**Table I** is a display of your individual responses to particular **Survey One** questions that have been analyzed with the other participants' responses. These individual responses to particular questions are "outside" of the *Delphi* Method's interquartile range of the data set of responses in terms of consensus.

**Part III Instructions: Review** your individual responses from **Survey One** that analysis indicates are considered as "outside" (outliers that reside in the 25<sup>th</sup> or the 75<sup>th</sup> percentile of the data set) of the interquartile range (middle or 50<sup>th</sup> percentile of the data set)—the range of consensus—for the survey group. **Survey Two Choices:** (1) **Modify** your individual responses by changing them to a response within the interquartile range of responses, indicating your consensus with the group; **OR** (2) **Maintain** your individual response. For modifications, please include your justifications.

**TABLE I: Individual Responses to Survey One Questions and Their Consensus Status**

Question	Individual Response	Group Mode	Variance	StdDev	Interquartile Range (IQR) (If 1 or less, consensus exists within group)	Individual Response Consensus (Y) or (N)	Modify (Add New Response)	Maintain (Enter Original Response)
7F	2	3	.60	.78	4 - 2.25 = 1.75	N		

**Likert Scale for Responses: 4=Significant; 3=Moderate; 2=Minimal; 1=None**

**REFERENCE to Survey One Section Question #7:** According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified Differentiated Instructional element:

7F. PROCESS: Teachers present students with opportunities to solve relevant problems at different levels of complexity [i.e., problem-based learning] (McDaniel & Schlager, 1990).

Return completed survey to Teresa Ann Durrett at [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu)

**APPENDIX H**  
**ROUND THREE RESEARCH INSTRUMENTS**

### SURVEY THREE

**Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by  
Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study**  
**CONFIDENTIAL INFORMATION FOR \_\_\_\_\_**

**Purpose of Survey:** (1) To obtain feedback from targeted principals in order to reach consensus regarding what they perceive to be the **most effective** research-identified differentiated instructional elements, as presented from Survey Two, for improving student performance; (2) To obtain feedback from targeted principals in order to reach consensus regarding what they perceive to be differentiated instructional elements not previously identified by research that are critical for student success, as well.

**Part I Instructions:** Choose to either **Approve Rankings**  **OR** **Offer Alternative Rankings** for the prioritized list of the **most effective** research-identified differentiated instructional elements which evolved from your responses to questions 5-8 in Survey Two. **(An analysis of the collective responses from all participants to questions 5-8 in Survey Two established the rankings, as presented here, with 6C being 1<sup>st</sup> and 7D being 13<sup>th</sup>). Bold indicates changes in rankings that occurred between Round One to Round Two for consideration in Round Three.** Collective group rankings approval will constitute consensus in Part I.

**Approve Rankings**

**OR**

**Offer Alternative Rankings**

(Add an **X** at the end of the list to the left of Approve) (Add a ranking number to the right of listed items)

- |                     |   |
|---------------------|---|
| Question 6C:        | Variety of Instructional Resources                                      |
| Question 7B:        | Variety of Instructional Strategies                                     |
| Question 8B:        | Authentic Evaluation (Formative and Summative)                          |
| <b>Question 6B:</b> | <b>Differentiating Major Concepts for Student Variance</b>              |
| <b>Question 7A:</b> | <b>Flexible Grouping for Student Variance</b>                           |
| <b>Question 7C:</b> | <b>Tiered Assignments</b>   |
| <b>Question 7E:</b> | <b>Higher Order Questioning</b>   |
| <b>Question 7F:</b> | <b>Problem-Based Learning</b>   |
| <b>Question 6A:</b> | <b>Curriculum Compacting</b>  |
| <b>Question 8A:</b> | <b>Assessment Options for Mastery Demonstration</b>                     |
| <b>Question 5B:</b> | <b>Student Interests and Learning Profiles Assessed for Instruction</b> |
| <b>Question 5A:</b> | <b>Student Readiness for Instruction Diagnosed</b>                      |
| Question 7D:        | Student Choice in Task Completion (Learning Contracts)                  |

Approval (For approval, add **X** to the left of Approval)

**Part II Instructions:** Choose to either **Approve Rankings**  **OR** **Offer Alternative Rankings** for the prioritized list of the differentiated instructional elements not previously identified by research that you perceive to be **critical** for student success per your “write-ins” in open-ended question 9 from Survey One. **(An analysis of the collective responses from participants established the rankings, as presented here.) Comment**, if you like, with your feedback regarding these “write-ins” and their relationship to the differentiated instructional elements presented above in Part I of Survey Three. **Bold indicates changes in rankings that occurred between Round One to Round Two for consideration in Round Three** Collective group rankings approval will constitute consensus in Part II.

**Approve Rankings**

**OR**

**Offer Alternative Rankings**

(Add an **X** at the end of the list to the left of Approval) (Add a ranking number to the right of listed items)

**Tutorial Groups: Cooperative Learning, Peer Learning, Bubble  
Student Groups with Benchmarking  
Hands-On Science Labs  
Teaching Beyond TAKS**

Approval (For approval, add **X** to the left of Approval)

Comments: \_\_\_\_\_

**Return completed survey to Teresa Ann Durrett at [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu)**

### SURVEY THREE

**Effective Differentiated Instructional Elements for Improving Student Performance as Perceived by  
Secondary Principals in Exemplary Public High Schools in Texas: A Delphi Study**  
**CONFIDENTIAL INFORMATION FOR \_\_\_\_\_**

**Table II** is a display of your individual response to particular **Survey Two** questions that have been analyzed with the other participants' responses. This individual response to particular questions is "outside" of the *Delphi* Method's interquartile range of the data set of responses in terms of consensus.

**Part III Instructions: Review** your individual response from **Survey Two** that analysis indicates is considered as "outside" (outliers that reside in the 25<sup>th</sup> or the 75<sup>th</sup> percentile of the data set) of the interquartile range (middle or 50<sup>th</sup> percentile of the data set)—the range of consensus—for the survey group. **Survey Three Choices:** (1) **Modify** your individual response by changing it to a response within the interquartile range of responses, indicating your consensus with the group;  **OR** (2) **Maintain** your individual response. For modifications, please include your justifications.

**TABLE II: Individual Response to Survey Two Questions and Its Consensus Status**

Question	Individual Response	Group Mode	Variance	StdDev	Interquartile Range (IQR) (If 1 or less, consensus exists within group)	Individual Response Consensus (Y) or (N)	Modify (Add New Response)	Maintain (Enter Original Response)
6A	2	3	.60	.78	4-2.25=1.75	N		

**Likert Scale for Responses: 4=Significant; 3=Moderate; 2=Minimal; 1=None**

**REFERENCE to Survey One Section Questions #6:** According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified Differentiated Instructional element:

6A. CONTENT: Teachers pretest and posttest students to determine mastery levels to decide on approach to student learning [i.e., curriculum compacting is used] (Reis & Renzulli, 1992; Heacox, 2002; Earl, 2003; Tomlinson & McTighe, 2006).

**Return completed survey to Teresa Ann Durrett at [teresa-ann-parish@tamu.edu](mailto:teresa-ann-parish@tamu.edu)**

**APPENDIX I**

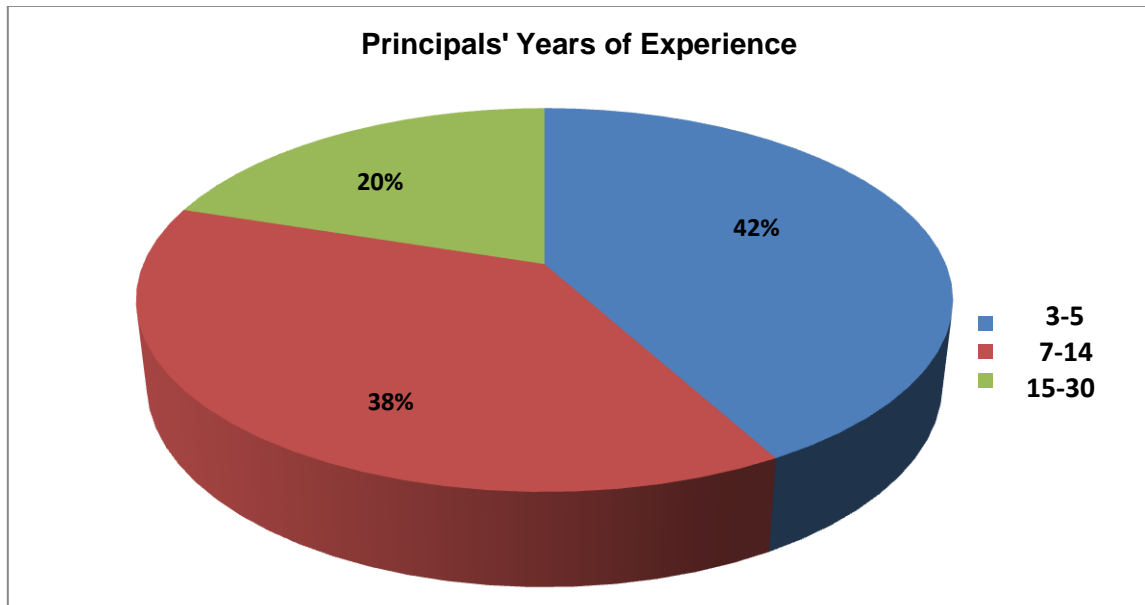
**PRINCIPALS' INFORMATION FOR DIFFERENTIATED INSTRUCTION STUDY**

**PRINCIPALS' INFORMATION FOR DIFFERENTIATED INSTRUCTION STUDY**

<b>District</b>	<b>School</b>	<b>UIL</b>	<b>Principal's Name</b>	<b>Years</b>	<b>D. I.</b>
Alief	Kerr	5 A	Greg Freeman	4	ODPD
Canton	Canton	3 A	Joe Nicks	12	OTJ
Carroll	Carroll Senior	5 A	Dr. Mike Rhodes	20	OTJ
Carroll	Carroll	5 A	P.J. Giamanco	4	MTR
China Spring	China Spring	3 A	Mike Compton	3	OTJ
Cisco	Cisco	2 A	Craig Kent	7	OTJ
Clear Creek	Clear Lake	5 A	Dr. Christopher Moran	9	OTJ
Crawford	Crawford	2 A	Don Harris	30	IS
Franklin	Franklin	2 A	Stacy Ely	4	INDPD
Friendswood	Friendswood	4 A	Mark Griffon	3	INDPD
Frisco	Centennial	4 A	Randy Spain	11	INDPD
Gunter	Gunter	2 A	Kelly Teems	11	OTJ
Hamshire-Fannett	Hamshire-Fannett	3 A	Jon Burris	3	OTJ
Highland Park	Highland Park	4 A	Patrick Cates	14	INDPD
Holliday	Holliday	2 A	Kent Lemons	14	OTJ
Katy	Seven Lakes	5 A	Christie Whitbeck	17	INDPD
Kountze	Kountze	2 A	Eldon Franco	7	OTJ
Lewisville	C Douglas	5 A	Robert Shields	3	OTJ
Lewisville	Hebron	5 A	Hugh Jones	21	OTJ
Lewisville	Marcus	5 A	Gary Shafferman	9	INDPD
Lovejoy	Lovejoy	3 A	Dr. Mike Goddard	5	OTJ
Richardson	Pearce	5 A	Beverly Vance	4	ODPD
Shallowater	Shallowater	2 A	Tom Johnson	15	MTR
Wimberley	Wimberley	3 A	Greg Bonewald	3	OTJ

Legend for Principals' Acquisition of Differentiated Instruction (DI) Knowledge

OTJ	On the Job
MTR	Mentor
INDPD	In-District Professional Development
ODPD	Out-of-District Professional Development
GC	Graduate Courses
UC	Undergraduate Courses
IS	Independent Study



Note: This pie chart represents Question 1 on Survey One.



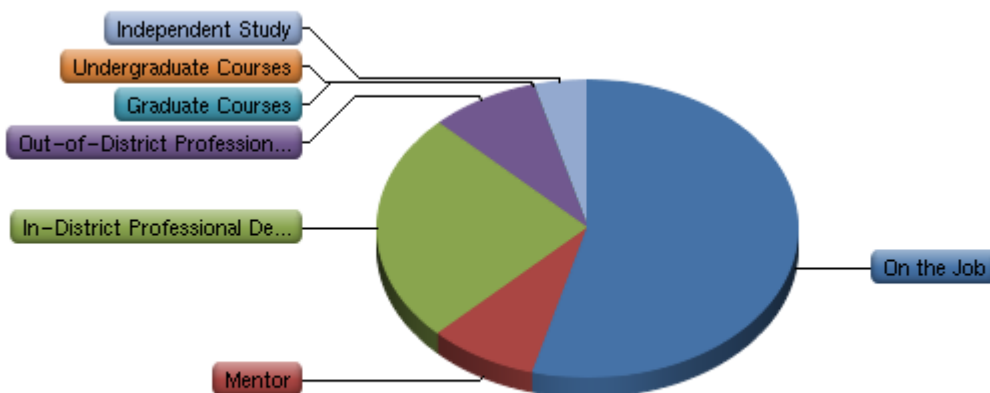
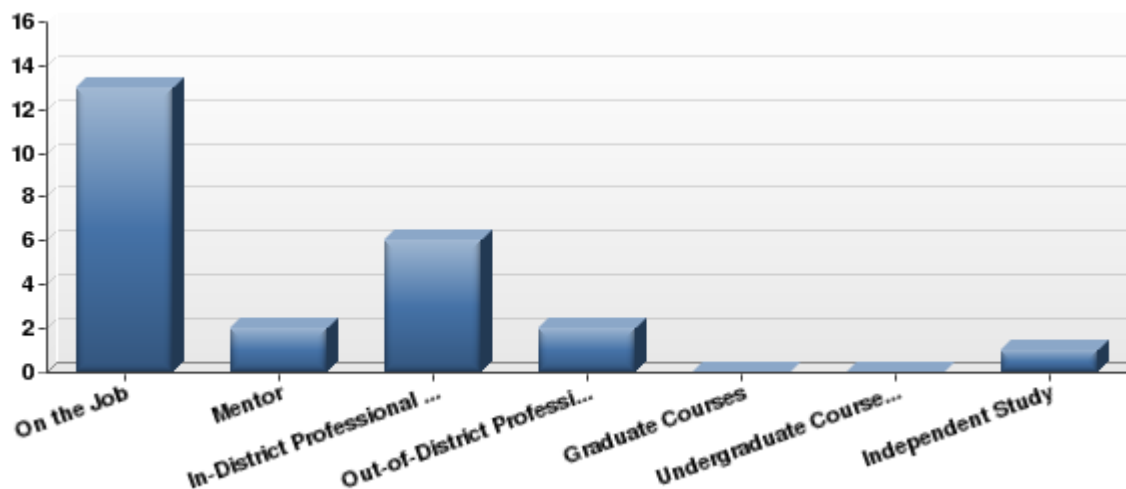
**APPENDIX J**  
**REPORT FOR DELPHI SURVEYS IN ROUNDS ONE, TWO, THREE**

**REPORT FOR DELPHI SURVEYS IN ROUNDS ONE, TWO, THREE**

*Differentiated Instruction's Impact: Texas Principals' Perceptions*

**2. Identify the source from which you have learned the most about Differentiated Instruction?**

This information represents Question 2 in Survey Round One.

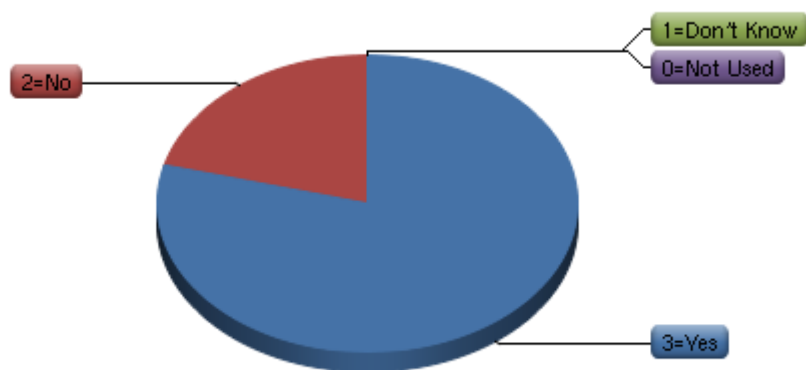
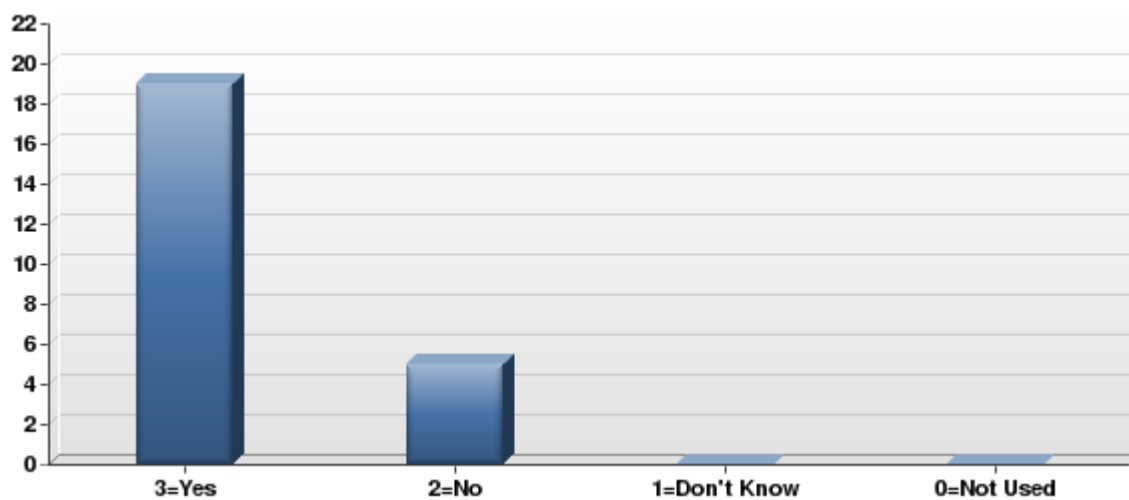


#	Answer		Response	%
1	On the Job		13	55%
2	Mentor		2	8%
3	In-District Professional Development		6	25%
4	Out-of-District Professional Development		2	8%
5	Graduate Courses		0	0%
6	Undergraduate Courses		0	0%
7	Independent Study		1	4%
	Total		24	100%

Statistic	Value
Total Responses	24

**3. According to your perceptions, did the majority of your teachers (those with at least one year's prior teaching experience), as a whole, frequently (weekly) utilize Differentiated Instruction in their classrooms in 2008-2009?**

This information represents Question 3 in Survey Round One.

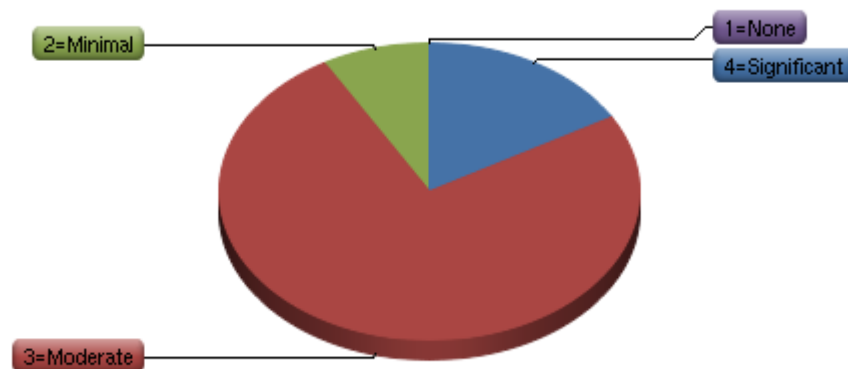
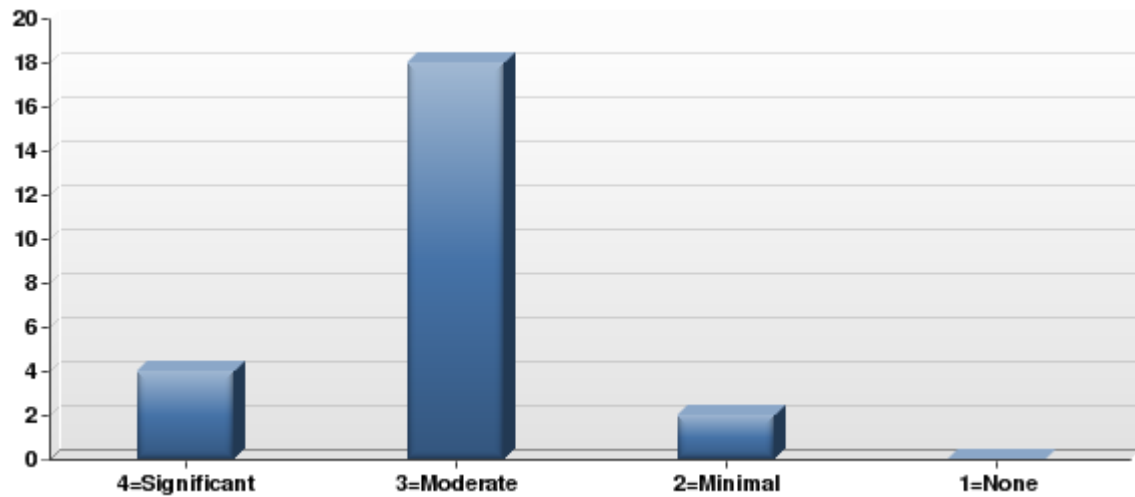


#	Answer		Response	%
1	3=Yes		19	79%
2	2=No		5	21%
3	1=Don't Know		0	0%
4	0=Not Used		0	0%
	Total		24	100%

Statistic	Value
Total Responses	24

**4. According to your perceptions, rate the degree of usage (in terms of frequency) of Differentiated Instruction by your teachers, as a whole, during the 2008-2009 school year.**

This information represents Question 4 in Survey Round One.

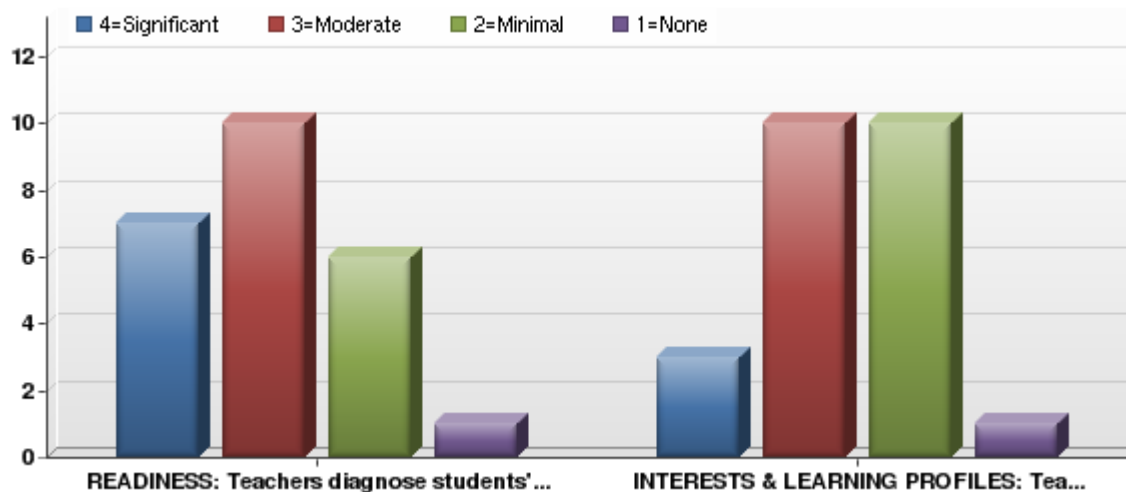


#	Answer		Response	%
1	4=Significant		4	17%
2	3=Moderate		18	75%
3	2=Minimal		2	8%
4	1=None		0	0%
	Total		24	100%

Statistic	Value
Total Responses	24

**5. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified Differentiated Instructional elements.**

This information represents Question 5 in Survey Round One.



Item	Question	4=Significant	3=Moderate	2=Minimal	1=None	#
1	READINESS: Teachers diagnose students' readiness levels prior to specific instruction (Vygotsky, 1962; Csikszentmihalyi, Rathunde, & Whalen, 1993; Tomlinson et al., 2004).	7	10	6	1	24
2	INTERESTS & LEARNING PROFILES: Teachers assess students' interests, multiple	3	10	10	1	24

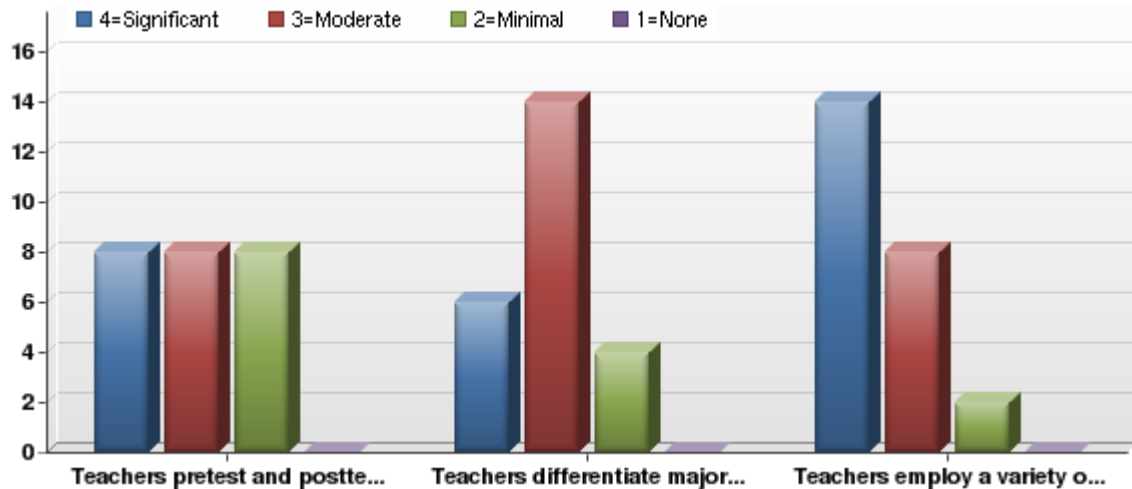


intelligences, and learning styles to inform differentiation (Gardner, 1983; Campbell & Campbell, 1999; Collins & Amabile, 1999; Barrell, 2001; Dunn, Denig, & Lovelace, 2001).							
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Statistic	READINESS: Teachers diagnose students' readiness levels prior to specific instruction (Vygotsky, 1962; Csikszentmihalyi, Rathunde, & Whalen, 1993; Tomlinson et al., 2004).			INTERESTS & LEARNING PROFILES: Teachers assess students' interests, multiple intelligences, and learning styles to inform differentiation (Gardner, 1983; Campbell & Campbell, 1999; Collins & Amabile, 1999; Barrell, 2001; Dunn, Denig, & Lovelace, 2001).		
Variance	.74	.42	.42	.59	.42	.42
Standard Deviation	.86	.65	.65	.77	.65	.65
IQR	2	1	1	1	1	1

**6. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified elements utilized to differentiate CONTENT.**

This information represents Question 6 in Survey Round One.



Item	Question	4=Significant	3=Moderate	2=Minimal	1=None	#
1	Teachers pretest and posttest students to determine mastery levels to decide on approach to student learning [i.e., curriculum compacting is used] (Reis & Renzulli, 1992; Heacox, 2002; Earl, 2003; Tomlinson & McTighe, 2006).	8	8	8	0	24
2	Teachers differentiate major concepts and generalizations for differing student abilities and needs (Tomlinson, 2004).	6	14	4	0	24

3	Teachers employ a variety of instructional resources in addition to standard text (Tomlinson, 2001).	14	8	2	0	24
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Statistic	Teachers pretest and posttest students to determine mastery levels to decide on approach to student learning [i.e., curriculum compacting is used] (Reis & Renzulli, 1992; Heacox, 2002; Earl, 2003; Tomlinson & McTighe, 2006).	Teachers differentiate major concepts and generalizations for differing student abilities and needs (Tomlinson, 2004).	Teachers employ a variety of instructional resources in addition to standard text (Tomlinson, 2001).
Variance	.70 .60 .23	.43 .22 .22	.43 .24 .24
Standard Deviation	.83 .78 .48	.65 .46 .46	.66 .49 .49
IQR	2 1.25 1	.25 0 0	1 1 1

**7. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified elements utilized to differentiate PROCESS.**

This information represents Question 7 in Survey Round One.

Item	Question	4=Significant	3=Moderate	2=Minimal	1=None	#
1	Teachers incorporate flexible grouping opportunities based upon students' readiness, interests, and learning profiles (Lou et al., 1996; Tomlinson, 2003).	6	12	6	0	24
2	Teachers use a variety of instructional strategies to address learner variance (Tomlinson, 1999).	14	8	2	0	24
3	Teachers provide activities at different levels of difficulty, such as tiered assignments, to build upon students' varying degrees of prior knowledge and skills, in order to scaffold their learning (Tomlinson, 2003),	5	14	5	0	24
4	Teachers grant students choices in completing tasks [i.e., learning	3	10	11	0	24

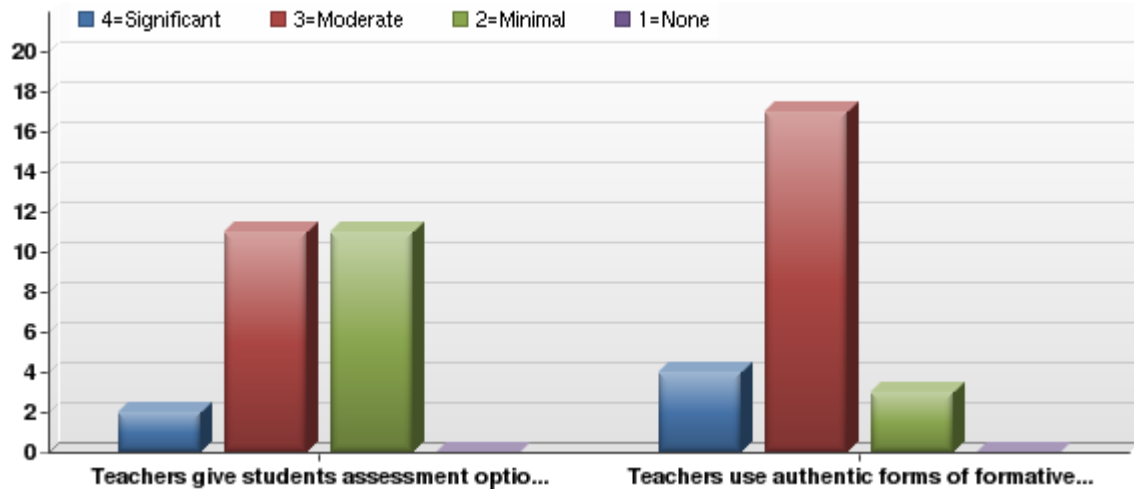
5	contracts] (Tomlinson, 2001). Teachers engage students in varying degrees of higher-order questioning techniques (Rosenshine, Meister, & Chapman, 1996).	7	16	1	0	24
6	Teachers present students with opportunities to solve relevant problems at different levels of complexity [i.e., problem-based learning] (McDaniel & Schlager, 1990).	8	10	6	0	24

Teachers incorporate flexible grouping opportunities based upon students' readiness, interests, and learning profiles (Lou et al., 1996; Tomlinson, 2003).	Teachers use a variety of instructional strategies to address learner variance (Tomlinson, 1999).	Teachers provide activities at different levels of difficulty, such as tiered assignments, to build upon students' varying degrees of prior knowledge and skills, in order to scaffold their learning (Tomlinson, 2003),	Teachers grant students choices in completing tasks [i.e., learning contracts] (Tomlinson, 2001).	Teachers engage students in varying degrees of higher-order question techniques (Rosen-shine, Meister, & Chapman, 1996).	Teachers present students with opportunities to solve relevant problems at different levels of complexity [i.e., problem-based learning] (McDaniel & Schlager, 1990).
.50 .20 .20	.43 .24 .24	.40 .30 .30	.49 .49 .49	.28 .22 .22	.60 .23 .23
.70 .50 .50	.66 .49 .49	.70 .50 .50	.70 .70 .70	.53 .46 .46	.78 .48 .48
.50 0 0	1 1 1	0 0 0	1 1 1	1 1 1	1.25 1 1

Note: Statistics at bottom of columns: First row of numbers = Variance; Second row of numbers = Standard Deviation; Third row of numbers = IQR

**8. According to your perceptions, rate the degree of effectiveness for improving your students' Spring 2009 TAKS performances of your teachers' usage of the following research-identified elements utilized to differentiate PRODUCT.**

This information represents Question 8 in Survey Round One.



Item	Question	4=Significant	3=Moderate	2=Minimal	1=None	#
1	Teachers give students assessment options from a variety of product choices for demonstration of mastery (Tomlinson & McTighe, 2006).	2	11	11	0	24
2	Teachers use authentic forms of formative and summative evaluation to assess student progress (Wiggins, 1993; Black & William, 1998).	4	17	3	0	24

Statistic	Teachers give students assessment options from a variety of product choices for demonstration of mastery (Tomlinson & McTighe, 2006).			Teachers use authentic forms of formative and summative evaluation to assess student progress (Wiggins, 1993; Black & Wiliam, 1998).		
Variance	.42	.34	.34	.30	.17	.17
Standard Deviation	.65	.58	.58	.55	.41	.41
IQR	1	1	1	0	0	0



**9. If your teachers used Differentiated Instructional elements in 2008-2009 not previously identified in research that you perceive were of critical impact in improving your students' Spring 2009 TAKS performances, please list them, beginning with the most effective. If not, enter, "Not Applicable."**

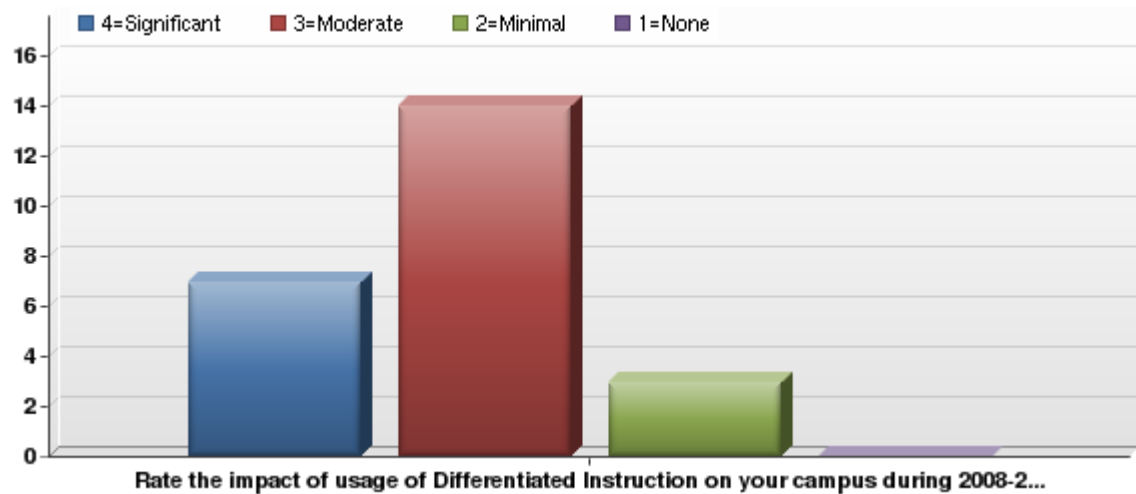
This information represents Question 9 in Survey Round One.

Text Response
tutorial groups, cooperative learning strategies, hands on labs using small groups (science), peer editing, peer tutoring and discussion
intensive tutoring targeting specific skills
Science--lots of lab time--math teachers used tutorials based on individual student weaknesses
Consistent benchmarking each 6 weeks and grouping of students in classes who were on the bubble list from their previous year's TAKS results has been a great help with our overall success in TAKS.
Our teachers keep track daily of each student's progress as they teach beyond what is required on the TAKS

Statistic	Value
Total Responses	5

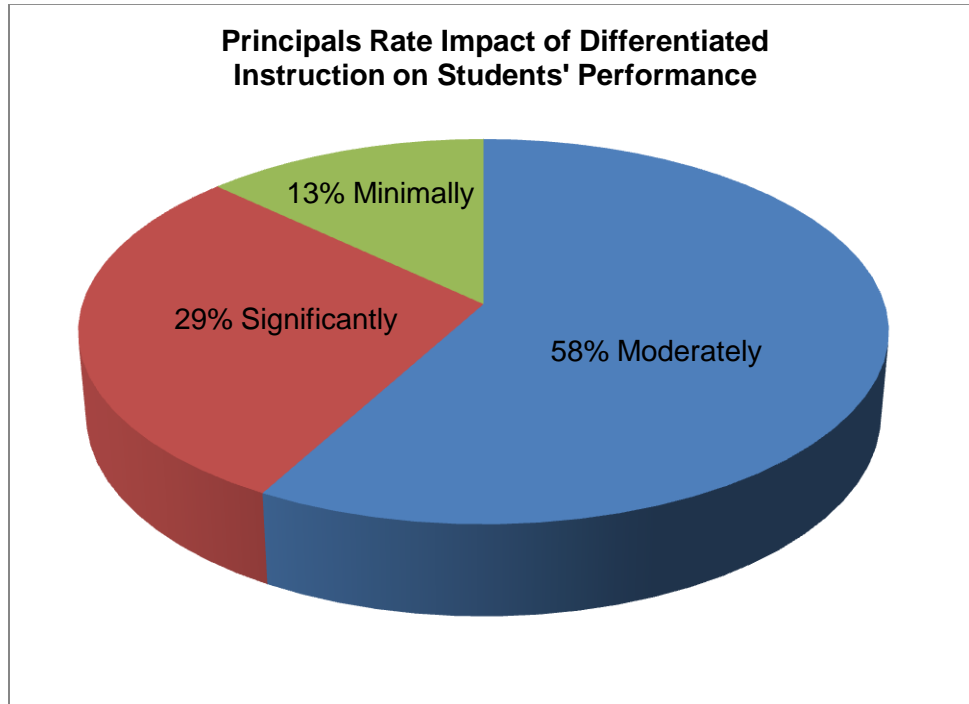
**10. According to your perceptions as a principal of an "Exemplary" high school in Texas for 2008-2009, to what degree did your teachers' usage of Differentiated Instruction, overall, during 2008-2009 positively impact your students' Spring 2009 TAKS performances?**

This information represents Question 10 in Survey Round One.



Item	Question	4=Significant	3=Moderate	2=Minimal	1=None	#
1	Rate the impact of usage of Differentiated Instruction on your campus during 2008-2009 on your students' Spring 2009 TAKS performances.	7	14	3	0	24

Statistic	Rate the impact of usage of Differentiated Instruction on your campus during 2008-2009 on your students' Spring 2009 TAKS performances.
Total Responses	24



## VITA

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Experience	<p>State College Supervisor, 3 Years</p> <p>Public School Administrator, 9 Years</p> <p>Regional Education Service Center Specialist, 4 Years</p> <p>Public School Teacher, 9 Years</p>
Positions	<p>Teacher Intern Supervisor</p> <p>Federal Grant Program Administrator</p> <p>Career and Technical Education Director</p> <p>High School Principal</p> <p>Regional Curriculum and Technology Education Specialist</p> <p>High School English Teacher</p>
Associations	<p>Association of Supervision and Curriculum Development</p> <p>Texas Association of Secondary School Principals</p> <p>Texas Computer Education Association</p>
Honors	<p>Texas Career and Technology Director of the Year</p> <p>ORACLE International Continuing Education Curriculum Award</p> <p>Phi Kappa Phi, Texas A&amp;M Chapter, Texas A&amp;M University</p> <p>Kappa Delta Pi, Mu Chi Chapter, Texas A&amp;M University</p> <p>Chancellor's List Honor Society, Texas A&amp;M University</p>