Exploring preservice teachers' views of intelligence

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EXPLORING PRESERVICE TEACHERS’ VIEWS OF INTELLIGENCE

by

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ABSTRACT

Exploring Preservice Teachers’ View of Intelligence
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This study explored preservice teachers’ views of intelligence. Specifically, I was interested in whether preservice teachers believed that intelligence was changeable (incremental) or fixed (entity). Dweck and colleagues found that people view traits like intelligence as either fixed or incremental (Dweck & Leggett, 1988; Dweck, Chiu, & Hong, 1995; Plaks, Grant & Dweck, 2005). Teachers bring both their beliefs and knowledge into the classroom. Views about intelligence affect beliefs about student ability. Teachers' expectations, instructional decisions, teaching strategies, and educational assessment are affected by these beliefs. In order for change to occur, learners must engage deeply (Dole & Sinatra, 1998, Sinatra & Mason, 2008). Change is more likely to occur when implicit theories are brought to light and examined. Interventions that refute prior knowledge and engender reflection have been shown to be facilitative of change (Mason & Gava, 2007). Change is also more likely when the learner engages deeply with the content (Patrick & Pintrich, 2001; Pintrich, Marx & Boyle, 1993; Sinatra & Mason, 2006). This study employed a mixed methods approach to explore preservice teachers’ personal and implicit beliefs about intelligence. Participants were randomly assigned to four conditions where they read a refutational text, an alternative text, participated in a structured discussion on intelligence or school uniforms using a prediscussion organizer, or did some combination of these activities.
Specifically, Condition 1 participants read a refutational text on intelligence and completed a structured discussion, Condition 2 participants read a refutational text and discussed school uniforms, Condition 3 participants read an alternative text on the brain and had a structured discussion on intelligence, and finally Condition 4 participants read the alternative text and discussed school uniforms.

Refutational texts provide a platform for deep cognitive engagement that may occur when a text directly refutes prior knowledge (Murphy & Mason, 2006). Although refutational texts have been shown to be effective (Hynd, 2003; Guzzetti et al., 1993), only a few studies have tried to increase the effectiveness of refutational texts by combining these texts with other interventions such as discussion (Broughton, Sinatra, & Nussbaum, 2009).

My results did not support my hypothesis that preservice teachers would be primarily fixed in their viewpoints. In fact, participants came to the study with views consistent with an incremental perspective. In this study the most effective educational intervention to increase conceptual change was the combination of refutational text plus structured discussion. The results indicate that preservice teachers’ views of intelligence are centered on personal and emotional beliefs rather than theory or empirical evidence. The condition with the most change read the refutation text and discussed intelligence; however, there was also a main effect of text.

From an educational standpoint, this study suggests that refutational texts combined with a structured organizer may be a more effective aid in learning. In particular, the predisussion organizer may have provided the reflection time and thought organizer necessary to stimulate elaborative processing. Participants in Condition 1 who
read the refutational text about intelligence and completed the prediscussion organizer
used their individual comments from their organizer as elements within their discussion.

Refutational texts and combining structured discussions has promise as an
intervention both in the classroom and online. Strongly held personal views are difficult
to dislodge and by having preservice teachers explore their beliefs, it may have a
beneficial result later on in their future and challenging careers.
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CHAPTER 1

INTRODUCTION

Teachers bring both their beliefs and knowledge into the classroom. Their accumulated knowledge may be primarily experiential and content based produced through professional and personal education. Indeed teachers’ knowledge store may also include beliefs about their knowledge of their content area, their profession and the world around them. Some of this knowledge is explicit, tacit, and concrete in nature while some is implicit (Patrick & Pintrich, 2001). These implicit beliefs may be a help or a hindrance to their pedagogy. Ashton (1990) posits that all teachers hold implicit theories about “students, the participants they teach and their teaching responsibilities, and that these theories influence teachers’ reactions to teacher education and to their teaching practice” (Fang, 1996, p. 51). For the purpose of this study, implicit theories should be examined by preservice teachers during this stage of their education.

Changing or shifting the knowledge of preservice teachers is difficult. They are considered to be preservice since these participants have not yet completed their course of professional study. Thus these participants do not yet have craft knowledge developed in the classroom. In order for change to occur, learners at any level must engage deeply with the new idea (Patrick & Pintrich, 2001; Pintrich, Marx & Boyle, 1993; Sinatra & Mason, 2006). Changing beliefs about knowledge may lead preservice teachers to accept reform, utilize novel as well as standard strategies, and expect more from their students. Gregoire’s (2003) work on teacher change in mathematics suggests that teachers may see reform as a challenge or a threat. Gregoire’s theories are examined in chapter two. Her work about reform messages and conceptual change is valuable in research about
dislodging and understanding closely held beliefs. Reform messages may threaten closely held beliefs among teachers.

The implicit beliefs that preservice teachers bring to the classroom may interfere with their pedagogy and possibly their future as successful teachers. Deemer (2004) suggests that teachers’ beliefs about the effectiveness of certain classroom strategies are related to their perceptions about demonstrations of student ability. For instance, beliefs about the changeability of intelligence might encourage preservice teachers to consider using different strategies as well as class results in combination with standardized testing results when they have their own classrooms. They might rely too heavily on standardized testing or, as an alternative, disregard test scores when determining student achievement. Intelligence is a key belief to examine since it has such potentially negative or positive implications for students. Teachers’ definitions of intelligence can impact their instructional practices. Berg (1992) suggests that traditional definitions rely on testing and other measurements but Sternberg (2004) suggests that lay people have much broader conceptions than researchers. Ultimately, it may be that intelligence is a very personal construct.

**Implicit Theories about Intelligence**

Carol Dweck and colleagues (Dweck & Leggett, 1988; Dweck, Chiu, & Hong, 1995; Plaks, Grant & Dweck, 2005) suggest that one way people make sense of their social world is to assume that traits such as intelligence and personality remain stable throughout one’s life (an entity view) or are dynamic, changing, and malleable (an incremental view). Dweck does not define intelligence per se; however a traditional psychometric view is that there is a general ability factor “g.” It is not the purpose of this
study to go into great detail about psychometric theories of intelligence. Indeed preservice teachers’ definitions of intelligence may not consider “g” at all.

Dweck’s research indicates that these implicit theories guide individuals’ judgments in social interactions. In regards to the classroom, the view that intelligence is fixed versus changeable has social and economic consequences. Dweck’s research indicates that individuals who believe that intelligence is changeable are more likely to have high expectations of student performance. Indeed entity theory has been linked to performance goals, whereas incremental views have been associated with mastery goals.

A performance goal emphasizes grade or ability comparisons versus a mastery goal which emphasizes knowledge and not necessarily a letter grade or performance indicator. Dweck et al. (1995) suggest that the construct of intelligence cannot be measured with great certainty. For instance, intelligence seems to be an objective constructive, related to knowledge as well as performance. In addition it is culturally bound and thus subject to cultural norms and expectations. Another point that Dweck and colleagues make about entity theorists regarding intelligence is that “high effort may imply low ability” (p. 325). A belief that effort involves lack of ability is potentially very detrimental in the classroom. Elliott and Harackiewicz (1996) question whether entity theories might be good especially if you are an extremely bright student. Thus, there appears to be some discussion of the personal value of each view of intelligence among researchers.

Definitions of intelligence. Sternberg argues that conventional definitions of intelligence are incomplete (2002). I previously presented a traditional description of intelligence but other ideas and conceptions about intelligence may be more common among preservice teachers. A lay definition of intelligence might be the ability to learn
about, learn from, understand, and interact with one’s environment. However, Berg (1992) states that the “term intelligence may be synonymous with intelligence testing and how well one scores on an intelligence test” (p. 2). Clearly there is conflict in the definition of the construct. This conflict may in part be due to what Joram and Gabriele (1998) note as preservice teachers’ lack of appreciation about “foundation courses in their professional development, particularly Educational Psychology” (p. 178). This research comes from Book, Byers and Freeman (1983). These researchers indicate that preservice teachers may regard their Educational Psychology courses as less important than their traditional classes. This might be the result of course work that does not rely on Educational Psychology concepts, perhaps due to time constraints. Could this lack of appreciation or understanding affect beliefs that preservice teachers have regarding pedagogy?

Research also indicates that intelligence is culturally bound. When parents’ conceptions of intelligence match their teachers or when they differ, it is predictive of academic success or failure for those students (Okagaki & Sternberg, 1993). In addition to success in the classroom, various cultures and lay people have differing conceptions of academic success and often this is entangled with conceptions of intelligence. Implicit theories can have a great effect on performance, those implicit theories can be wrong or misguided (Sternberg, 2004) for both the parent and the teacher.

**Conceptual Change**

Conceptual change theorists posit that change is difficult and occurs best when students engage deeply with the content (Dole & Sinatra, 1998; Posner, Strike, Hewson & Gertzog, 1982). Change is more likely to occur if implicit theories are brought to light and examined through a structured intervention that refutes previous knowledge and
engenders reflection. The purpose of this study is to examine preservice teachers’ views of intelligence, and to examine whether their views can be changed. Specifically, I examined whether they believe that intelligence is fixed (an entity view) or changeable (an incremental view). I used the Cognitive Reconstruction of Knowledge Model (CRKM) from Dole and Sinatra (1998) as my primary model for conceptual change. I review some other important conceptual change models to illustrate other points of views and specifically one (Gregoire’s CAMCC) which describes teacher change.

**Refutational text in conceptual change.** Refutational texts have been used to facilitate conceptual change because researchers have shown that when texts are written to refute misconceptions or to promote change they can be effective (Guzzetti et al., 1993; Hynd, 2001; Limon, 2003). Reading involves background knowledge. Furthermore, since the act of reading is constructive (Kintsch, 1988), the individual may form a mental model during the process. Kintsch’s Construction Integration Model posits that the reader integrates prior knowledge with the current text. Preservice teachers may have some prior knowledge about intelligence that can be refuted through the use of text. For instance, preservice teachers may have studied intelligence theories in their introductory educational psychology classes and may have implicit beliefs about intelligence developed through experience.

The refutational text written for this study included persuasive information about rising IQs (Intelligence Quotient), No Child Left Behind, and the importance of effort. Persuasive informational articles were used to make the message fruitful and relevant. These themes were added to the refutational text in order to provide strong and repeated messages. In addition they were current topics important to preservice and active teachers. Alexander, Buehl and Sperl (2001) describe persuasion as the act of moving
ones’ beliefs or understanding through argument resulting in deep cognitive processing. Petty and Cacioppo (1986) suggest that the act of reading a text may be persuasive, thus refutational texts may bring about change through engagement.

Change may occur through many venues. Dole and Sinatra (1998) posit in their theory that personal relevance as well as background knowledge are factors in change. Personal relevance can be a catalyst for change. Indeed Chinn and Brewer (1993) suggest that individuals have a number of rejection schemes when confronted with information that contradicts their existing ideas or knowledge. Thus in the current study to counteract these rejection strategies, I added a structured discussion to the intervention. Guzzetti (2000) suggested that refutational texts might need additional intervention to produce change. Learners with lower levels of reading ability have difficulty as well as anyone who strongly rejects the change message. Discussion, on the other hand, may involve cooperative groups. Cooperative groups may be a forum to convince doubters about alternative conceptions. Guzzetti further suggests that if refutational texts are a cognitive conflict strategy, then combining them with discussion would be a powerful intervention. Nussbaum, Winsor, Aqui and Poliquin (2007) used argument vee diagrams to structure online discussions.

**Collaboration and discussion in conceptual change.** Collaborative learning benefits from social interaction. Social interaction may improve individual interest in topics. Individual disinterest results in lower cognitive involvement (Gregoire, 2003). Therefore the act of collaboration and discussion brings individuals closer and through argumentation the question or concepts examined may result in deeper processing. Linn and Slotta (2003) define collaboration as any opportunity students have to learn from each other. This includes face to face as well as online discussions. Employing
argumentation in the classroom (real and virtual) may produce social awareness, collaboration, and understanding of argumentative structures (Kuhn, 1991). In addition structuring the discussion assists students in creating more complex arguments and identifying evidence, weighing arguments, and producing more effective counterarguments (Andreissen, 2002). Andreissen calls this “arguing to learn.”

In this study discussion was conducted online asynchronously. The computer has become a learning tool and environment with its own language, affordances, and constraints. Online collaboration may be enhanced by a structured discussion (Nussbaum, Hartley, Sinatra, Reynolds, & Bendixen, 2003). The online environment has been investigated in the educational context by many researchers anxious to promote learning (Voss & Wiley, 2000; Nussbaum et al., 2007). The online environment may promote greater engagement since individuals who are shy or socially less adept feel empowered by the anonymity of their responses (Larreamendy-Joerns & Leinhardt, 2006). In addition, online collaboration may increase motivation and persistence, especially when a topic is emotionally charged or otherwise distasteful for the students (Linn & Clancy, 1992; Springer, Stanne & Donovan, 1999).

**Research Questions**

Three research questions guided this study. 1. What are preservice teachers' views about intelligence prior to the intervention? This question explores preservice teachers’ definitions of intelligence. Specifically, do preservice teachers' believe that intelligence is fixed or incremental? 2. Do preservice teachers change their views about the changeability of intelligence after intervention involving refutational text and structured discussion? 3. What is the relationship between open-minded thinking and conceptual change?
Method

One hundred and seventeen undergraduate participants enrolled in preservice teacher education courses originally took part in this study. However the final sample was one hundred and three, as participants were dropped for non-completion of measures and as outliers. The participants were drawn from a subject pool from Educational Psychology classes. Students participated in partial fulfillment of their course requirement. The data were collected online via WebCampus, an online learning environment common to all class sections and accessible to all students. The data collection took approximately one hour. Approximately three quarters of the research tasks was completed individually. One task was completed by dyads. The participants were randomly assigned to dyads to complete an asynchronous structured online discussion.

Conditions

The study consisted of four conditions: (a) refutational text and related intelligence discussion, (b) refutational text and school uniform discussion, (c) alternative text, with intelligence discussion, and (d) alternative text, school uniform discussion. All conditions completed a demographics survey, the Actively Open-Minded Survey, a pre intelligence survey, a post intelligence survey and a post essay. The pre and post intelligence surveys asked participants views of intelligence and also contained a brief essay question. All participants also completed a prediscussion organizer to assist in the structure of the discussion. The prediscussion organizer either referred to the intelligence text “Do you agree that intelligence can be changed? Why or why not?” or the school uniform question “Do school uniforms improve grades? Why or why not?”
Analysis

Appropriate quantitative analyses were conducted to examine the three research questions. Measures were piloted first and revised as necessary. This procedure also informed the researcher as to potential methodological analyses recommendations. The essays and discussions were analyzed both quantitatively and qualitatively. Qualitative analysis included content analysis of patterns and themes in the responses of the participants. Illustrative case analysis was selected because initial questions were descriptive. This analysis provided a means for developing a better understanding of participants’ views of intelligence as determined by the quantitative analyses (Yin, Borman, Clarke, Cottner & Lee, 2006). A convenience sampling of the discussions was analyzed qualitatively for rich information and deeper meaning to inform the researcher beyond the quantitative data.

The mixed methods design selected was purposeful and sought first to identify participants’ view of intelligence, identify the strongest intervention(s) and then to explore the conditions that promoted or inhibited change. Cresswell’s (1995) and Greene (1994) provide rationale for the use of complimentary methods that include triangulation, the state of methods or ideas being complementary, initiation, sequential development and expansion. Greene (1994) states that ultimately when using mixed methods, one method confirms the other.

Summary of Results

The majority of preservice teachers had incremental views of intelligence prior to the intervention. Indeed results of all measures were heavily skewed in favor of an incremental view of intelligence. Participants had broad and complex views of intelligence articulated by Sternberg. Indeed this is in line with much wider conceptions
of intelligence among lay people than those psychologists who are “g” supporters (Berry, 1974; Sternberg & Kauffman, 1998). Intelligence is seen as the ability to learn and understand and/or to deal with new or trying situations. Intelligence is also seen as a very simple concept, just how smart one is.

Participants in the refutational text plus structured discussion condition experienced the most change. The refutational text alone condition did have some change but it was not significant. It does however indicate the positive power of text-based interventions. The qualitative analysis of Condition 1 revealed distinctions of beliefs which I placed on a continuum from humanistic world views to ultra fixed biologically determined views of intelligence.
CHAPTER 2

RATIONALE FOR PRESENT STUDY

Overview

Preservice teachers have tacit and implicit knowledge that they bring to teaching situations (Patrick & Pintrich, 2001). Some preservice teachers may have beliefs that intelligence is fixed and unchanging. This type of knowledge may limit their effectiveness in the classroom through reliance on preconceived ideas about intelligence. They might expect unfair results from natural ability or from effort alone. Moreover, preservice teachers may have very different conceptions about intelligence and may vary in their views of its practical application in the classroom. Instructional strategies learned within preservice coursework may not be implemented due to achievement assumptions that preservice teachers have about many of their students. Indeed, given the public notion of failing schools and test driven success from the No Child Left Behind Act, preservice teachers may have limited expectations about their future students opportunities for success.

Preservice teachers’ prior beliefs are well developed and very personal (Joram & Gabriele, 1998). Views of learning and teaching held by preservice teachers may be limiting (Anderson et al., 1995). Kagan’s (1992) research into beginning and preservice teacher beliefs indicates they are stable, hard to change, and aligned with the type of teaching that the teacher provides. Kagan says that preservice teacher beliefs become part of their pedagogy and thus later on are transformed into their own teaching practices. Thus there is the potential for problematic pedagogy to occur. Nespor (1987) states that among the properties of teacher beliefs there is a heavy emphasis on the experiential,
teachers derive much of their beliefs from memories of specific events. Preservice teachers likely also have an experiential component to their implicit beliefs.

Changing or shifting the knowledge of preservice teachers is difficult. In order for change to occur learners must engage deeply with ideas (Patrick & Pintrich, 2001; Pintrich, Marx & Boyle, 1993; Sinatra & Mason, 2008). Automatic change or heuristic processing (an informal method or rule of thumb) probably has less of a role in the change of beliefs or deeply held knowledge. Teacher educators must acknowledge their students’ entering beliefs (Tillema, 1994) in order to facilitate conceptual change. Holt-Reynolds (1994) noted that often educators and students discuss constructs assuming each of them holds the same view, thus never bringing the tacit and implicit knowledge and beliefs to the surface where they can be compared and reflected upon in a collaborative way (Alger, 2006). Patrick and Pintrich (2001) strongly suggest that the belief systems of preservice teachers be identified to ultimately improve instruction and further professional development.

Implicit belief systems for preservice teachers may employ entity or incremental views of intelligence. An entity view supposes that traits cannot be changed whereas an incremental viewpoint allows for change through instruction and or increased effort (Dweck & Leggett, 1988). These views must be made explicit so that misconceptions may be subjected to a conceptual change intervention. This type of intervention requires affective and motivational aspects of change as well as removing misconceptions about factual elements. Indeed stronger background in intelligence concepts and theory may prove helpful in potential instructional practices. Examining preservice teachers’ views about intelligence and its role in the classroom may shift their understanding of this construct. The construct of intelligence might be academically defined or one that has a
broader purpose or as Sternberg (2002) puts it “accounting for the bases of success in all of one’s life” (p. 455).

In this chapter, I will not be addressing teacher change specifically but focus instead on preservice teacher belief change. Richardson and Placier (2001) note that teacher change extends from preservice teacher education students and beyond. Teacher change research is a vast and complex field. Change and/or reform may be seen as distressful and depending on the belief system of the individual as positive or negative. An openness to change thus could be said to facilitate the use of new or novel instructional interventions and a willingness to reflect on the need for change. Promoting or obtaining belief change before students become teachers may be helpful.

Refutational texts use persuasive messages to promote conceptual change (Hynd, 2003). Guzzetti (2000) noted that refutational texts have been successful in promoting change but may need discussion components added to help learners with lower levels of verbal ability. A structured discussion for the purpose of this study used a prediscussion organizer to provide support for the participants (Nussbaum et al., 2007; Nussbaum, 2008). In addition, refutational texts combined with structured discussions may increase cognitive engagement and assist in the promoting of complex processing. Refutational texts and structured discussions may be an instructional intervention that promotes preservice teacher change and also allows for contemplation and reflection. Willingness to change may interact with these cognitive states.

The literature review for this study is divided into three sections. The first section considers the many definitions of intelligence and the most current theories that apply to education including implicit belief systems; intelligence is considered as a construct that is social as well as cognitive. Next, I discuss conceptual change and theories within this
field specifically related to knowledge change. Most of the conceptual change theories to be discussed have focused on science education. The third section presents the intervention methodologies that were used in this study including refutational texts, argumentation, computer-supported collaboration, and online discussion.

**Intelligence Theories**

**Dweck’s View on Implicit Theories of Intelligence**

The work of Dweck and colleagues has investigated implicit theories that people have about personal characteristics, in particular the stability and or changeability of those constructs (e.g., Dweck, 1999; Dweck & Leggett, 1988; Dweck, Chiu, & Hong, 1995). Implicit theories have been described as folk or lay theories. Most people have “basic theories about the fixedness or malleability of human personality” (Plaks, Grant & Dweck, 2005, p. 246). The most famous of these theories and the most applicable to potential preservice teacher belief change, is the entity versus incremental theories about intelligence. The entity theory views intelligence as fixed and thus rigid, unyielding to motivation or affectively motivated change. In contrast the incremental perspective sees traits as malleable, yielding to affective or warm efforts, and changeable.

Dweck and colleagues (Dweck & Leggett, 1988; Hong, Chiu, Dweck, Lin, & Wan, 1999; Levy & Dweck, 1998) proposed that an entity view of knowledge views intelligence to be fixed and stable. The view of intelligence as a trait suggests it is hereditable and cannot be changed by the teacher or the student. In contrast, an incremental view of intelligence allows for improvement and enhancement of intelligence through both effort and pedagogy. Teachers, who hold an entity view, may view students whose initial work is of a high level as being high achievers, whereas incremental advocates reserve judgment until summative assessment (Butler, 2002).
Implicit theories have received much research, because of their predictive association with cognition, affect, and behavior (Spinath, Spinath, Riemann & Angleitner, 2003). Implicit theories about intelligence have been linked to mal-adaptation to challenges. Entity views lead to a helpless reaction to poor performance academically. Incremental theorists, however, see effort as a prime factor in setbacks (Hong, Chiu, Dweck, Lin, & Wan, 1999).

Spinath et al. (2003) examined implicit theories about intelligence and personality and the relationship to actual intelligence and personality. In a study of 592 adult twins using self report personality measures; the researchers found those participants’ implicit theories about the changeability of intelligence and personality had very little relationship to actual performance. In other words, people’s beliefs about themselves and their theories were separate from their actual traits. This study included questions about a wide range of socio-economical and biographical characteristics.

Dweck and colleagues (Dweck, 1999; Dweck et al., 1995; Dweck & Leggett, 1998) in several studies indicate that these perspectives may affect cognition, affect, and motivation as well as other domains of academic performance. Implicit theories become an issue in competency. The impact of implicit theories on potential belief or knowledge change suggests that epistemic factors play a role in protecting or changing these theories (Plaks, Grant & Dweck, 2005). The concern with implicit theories, such as entity and incremental views of knowledge, is whether these beliefs can be changed and whether recognition of one’s implicit theories is sufficient to bring about change. Entity theorists tend to make social judgments that are rigid, long-lasting explanations for behavior while incremental theorists may attribute behavior to temporal conditions or situational consequences (Chiu, Hong & Dweck, 1997; Dweck, 1991; Levy & Dweck, 1998).
Joram and Gabriele (1998) examined preservice teacher beliefs and some of the issues reported by preservice teachers as obstacles to their beliefs. They report the research of Book, Byers and Freeman (1983), that suggests that preservice teachers do not consider their educational psychology courses as important or perhaps do not consider the information as vital. Could a lack of appreciation or disregard about educational psychology constructs lead to misunderstandings about intelligence and learning?

Dweck’s implicit theories are usually assessed by a three-item questionnaire (Dweck et al., 1995). Using a six-point scale, all of the questions reflect either an entity or fixed view. An example from the intelligence-theory scale would be, *You have a certain amount of intelligence and you can’t really do much to change it.* The narrow focus on the perception of malleability in this scale is sufficient according to Spinath et al. (2003). Dweck and colleagues (1995) report high internal consistencies (α > .90) and retest-reliabilities (r about. 80 over two weeks).

Intelligence theory began with Spearman (1904, 1923), Thorndike (1913), and Thurstone (1938), but these theories addressed the structure of intelligence, not whether intelligence was fixed or malleable. This question is addressed, however, by a more contemporary theory of intelligence, Sternberg’s Triarchic Theory of Intelligence. Sternberg views intelligence as composed of identifiable components, and intelligence can be increased by targeting and training these specific components. Sternberg notes that “lay conceptions of intelligence are quite a bit broader that one’s of psychologists who believe in g…Implicit theories provide a starting point, not an ending point” (p. 472-473, 2002).
Sternberg and the Triarchic Theory of Intelligence

Psychologist Robert Sternberg was himself a victim of poor testing practices. Thus his search for understanding in intelligence testing and measurement stems from his personal desire to prevent this stigma or stereotype from happening to others. In 1985 Sternberg conceived of his triarchic framework of intelligence composed of traditional intelligence as well as creative and practical abilities. He defines creative intelligence as the ability to react with intelligence to a new situation. Practical intelligence is more obvious, this also requires transfer but in real world environments. For instance practical intelligence may be easily demonstrated however analytic may not be so easily apparent except in a traditional intelligence test. As is often remarked, some people are “book smart” but unable to perform at the same level of intellect outside of the classroom or on traditional assessments. This seems to suggest that creativity and practical intelligence may be separate from traditional (analytic) intelligence. Perhaps it is that we test these skills differently and/or often not appropriately. Nonetheless, the notion of what intelligence is seems to be connected to what people remember from their schooling as well as their own experiences.

Sternberg’s componential subtheory. Sternberg’s (1979) componential subtheory of intelligence is an information-processing model. This model of cognition posits that intelligence has a shared center of mental processes that are interchangeable and useful to any culture or environment. Indeed, Sternberg suggested three types of components to intelligence. The metacomponents are the monitoring and attention resources. The performance components are those responsible for encoding, retrieval, and mental comparison. The knowledge-acquisition components are those that are concerned with new information and the adjustments of recently added material in long-term
memory. This model would suggest that intelligence increases with age as the knowledge base builds and as knowledge acquisition methods improve. These components work as an integrated system.

Sternberg’s two non-traditional frames are distinct from traditional linguistic and mathematical operations that would appear on intelligence tests, but they still use the same basic sources. It may be that these creative and practical abilities are evident in situations that are either difficult to assess without a performance assessment of some type and/or difficult to conceive of and reliably assess using pen and paper. Sternberg developed a test battery, the Sternberg Triarchic Abilities Test (STAT), for this theory (1993, 2004). Sternberg’s battery measures creative intelligence with novel analogies, computational questions that employ fictitious numbers and the use of transformations (implying linguistic, spatial and computational skills). Practical intelligence as measured in the STAT assesses everyday reasoning which includes practical math and successfully negotiated one’s environment.

Sternberg’s concept of practical knowledge stems from an assumption that some aspects of intelligence are tacit, that is; not explicitly taught and often not verbalized (Sternberg et al., 2000; Sternberg & Wagner, 1993; Sternberg, Wagner, & Okagaki, 1993; Sternberg, Wagner, Williams & Horvath, 1995; Wagner, 1987; Wagner & Sternberg, 1986). Sternberg (2004) and his associates found that practical knowledge increases with experience not unlike fluid intelligence.

**Creative intelligence testing.** Sternberg recognizes the need to test his theory and recognizes the shortcomings of creative intelligence testing in particular. Ackerman and Lohman (2006) suggest that it may be another decade before significant progress is made in that direction. Sternberg and his colleagues continue to refine and test the battery. He
has been outspoken in his declaration that it is time to move on and broaden conventional theories. Indeed Sternberg (2004) points out the lay people have much wider conceptions of intelligence than those psychologists who are “g” supporters (Berry, 1974; Sternberg & Kauffman, 1998).

**Cultural Ideas of Intelligence**

Ethnic groups have different ideas of intelligence; these conceptions can greatly affect test scores. Okagaki and Sternberg (1993) found that when the conception of intelligence that parents have matches closely with their children’s teachers, those children do better in school. In addition to success in the school room, various cultures and lay people have differing conceptions of what success is and often this is entangled with conceptions of intelligence. Implicit theories can have a great effect on performance, those implicit theories can be wrong or misguided (Sternberg, 2004) for both the parent and or the teacher.

Dweck, Chiu and Hong (1995) suggest that implicit theories may account for cultural differences concerning education. Stevenson and Stigler (1992) suggest that malleable beliefs about intelligence and the role of effort may account for the greater educational achievement among Asian cultures. In fact Sternberg (2002) says “that in Western patterns of schooling, children typically study a variety of subject matters from an early age and thus develop skills in a variety of skill areas. This kind of schooling prepares the children to take a test of intelligence…” (p. 451). In contrast Sternberg argues that most measures of practical intelligence have to do with developing expertise, not necessarily academic knowledge (for example apprenticeships).
**Intelligence Quotient or IQ**

Psychometric tests used for measuring intelligence or academic fitness are generally called IQ tests. These assess intellectual abilities and are normed to represent across the board spectrums of the population. They measure verbal, spatial, and quantitative abilities as well as number series, pattern analysis, digit span, etc. The most common tests are the Stanford-Binet and the three tests by Wechsler for preschool, children, and adults. Mental age originally was determined by measuring the number of items passed and the mental age of the child to the chronological age as a quotient; hence the term intelligence quotient. For example, a 10-year old child with a mental age of a 12-years old has an IQ of 120 (12/10 x100). A 10-year old with a mental age of 10 would have an IQ of 100 (10/10 x 100) (Bjorklund, 2005). The number of items passed by a child determines the mental age. This method of determining IQ is no longer used and now a deviation is employed to determine IQ. The children are compared with performance of their own age, not older or younger. However this improvement makes developmental comparisons difficult.

IQ tests do predict educational achievement, occupational success, and other socially related outcomes but only if extended to the population on whom the test was normed. According to Hunter (1983), IQ tests are the best predictor of job success, indicating verbal and mathematical competence is obviously essential to all jobs. Even when IQ is measured before school it is a stable predictor of academic success. IQ scores can change, although generally they remain relatively stable. Of course there are other factors that can influence or explain variance in IQ scores such as environmental factors, health, motivation, and opportunities.
Nettlebeck and Wilson (2005) consider IQ only as a “proxy” for intelligence (p. 613). IQ is merely an average set of scores from speeded tests for educationally relevant ability; it is not a glimpse into the mind or cognitive architecture and as such cannot reveal cognitive structures. It can suggest discrepancies in ability or skill but cannot pinpoint the actual cognitive componential area. IQ scores have risen roughly 30 points across the 20th century (Flynn, 1999). This can be attributed to many factors including educational intervention in problem solving and nutrition. Furthermore IQ may be improved by educational interventions that involve abstract problem solving and other sorts of mental challenges (Ceci & Williams, 1997; Vygotsky, 1978).

**Flynn effect.** The rise of IQ scores studied by Flynn suggests that intelligence may be a malleable construct, responsive to instruction and/or to effort and strategy use. However Flynn states that, “The hypothesis that best fits the results is that IQ tests do not measure intelligence but rather correlate with a weak causal link to intelligence,” (Flynn, 1987). Indeed Flynn posits that intelligence is made up of many factors and that perhaps IQ does not accurately reflect them. There has been an increase in education among the countries that Flynn’s data covered. Flynn’s explanations for the increase include improvement in early childhood education, test development changes, and finally actual intelligence rate increases. Flynn (1999, 1984) favors environmental reasons for the rise in IQ. There is continued discussion as to whether these improvements in IQ really equate to a rise in intelligence. Therefore, improvement based on instruction and possibly nutrition figure largely among researchers rationale for these gains, however there is still much debate about the reason for the gain in IQ scores.

Furthermore, most of the gains in the IQ tests have been attributed to increases in fluid-ability tests rather than crystallized-ability tests. Fluid-ability tests “actually
measure an expertise acquired through interactions with the environment” (Sternberg, p. 452). An example of a fluid-ability test would include abstract reasoning and ongoing development of expertise. This would suggest possible evidence for an incremental view of intelligence.

**Theories of Change**

**Conceptual Change Perspectives**

Originally, conceptual change theorists focused on describing knowledge, memory, and knowledge change. According to Hunt (1993), a preoccupation with the conceptualization of knowledge has shaped psychological and philosophical thinking for centuries. Cognitive psychologists delving into these questions have tried establishing conceptualizations of knowledge. These have been described as schemata, scripts, or frames (Anderson & Pearson, 1984; Rumelhart & Ortony, 1977; Shank & Abelson, 1977). Piaget’s theories about knowledge acquisition have figured heavily in this research.

The process of assimilation includes addition, deletion and generalization (Chi, 1992). Vosniadou and Brewer (1987) described this type of cognitive process that results in mostly assimilation as a “weak restructuring.” Assimilation is considered to be the less desirable of the two Piagetian processes, in that real knowledge change may not occur or it may be temporary or uncertain. Change theorists like Carey (1992), Chi (1992), and Thagard (1992) saw conceptualize change on a continuum from weak to strong.

When change is strong or radical, this results in the reorganization of existing knowledge. Change theorists, Siegler (1996) and Smith, diSessa and Roschelle (1993) see change as more evolving than revolutionary. Thus, change is a more gradual procedure. Recent work into explanatory models of change have delved into issues of background
knowledge and its relationship with conflicting information sources such as classrooms and textbooks (Chi, 1992; Posner, Strike, Hewson, & Gertzog, 1982; Vosniadou & Brewer, 1992).

Posner, Strike, Hewson and Gertzog’s (1982) model of conceptual change was developed in response to questions about why students held on to existing conceptions despite instruction to the contrary, and to define what kind of conditions were necessary for such changes to occur. The Posner et al. (1982) Conceptual Change Model (CCM) describes how it is necessary for students to view the new conception as intelligible, plausible, and fruitful and to experience dissatisfaction with their existing concepts for change to occur.

Radical change occurs when students reorganize preexisting conceptions. Dole and Sinatra (1998) argue that “radical change requires considerable cognitive effort” (p. 113). When students are dissatisfied with existing explanations of data then the process of change may be more likely to occur. If the solution or new data makes sense (intelligible) then the learner is more likely to consider it. The third condition is plausibility. Does the learner consider the data or solution to be believable? If so then the learner has found the solution, believable, understandable and may be ready to make the effort to change. Finally the learner must consider the new data to be fruitful in such that the doors to new inquiry, assumptions, and revelations are now available or visible to the learner.

An important line of research in the change process was the development of research into the two important constructs of beliefs and attitudes. Posner et al. (1982) briefly mention the importance of metaphysical and epistemological commitments but the model does not specifically mention beliefs or attitudes. Dole and Sinatra (1998) define beliefs as “the thoughts that people have about attitude objects” (p. 113). Eagly and
Chaiken (1993) consider beliefs the building blocks of attitudes. Beliefs have a valence for the individual, in that they are either positive or negative. Beliefs can be complex or simple.

Research in persuasion in social psychology developed models of attitude and belief change. Theories are either highly quantitative models of change that have numerical weights on each element of change and their reflective power in the change process. Or the models are process models that have a cognitive orientation; they try to explain the cognitive processes for attitude and belief change (Eagly & Chaiken, 1993).

**The Petty and Cacioppo (1986) Elaboration Likelihood Model (ELM).** The ELM is based on the social psychology theory of persuasion; these processes are proposed to underlie belief change. Models like the ELM are called dual process models because they provide two routes for attitude change. The central route is the thoughtful consideration of the message content which came from Fiske and Taylor (1991) and the peripheral route is the “individual’s quick and cursory judgment based on variables peripheral to the message content” (Dole & Sinatra, 1998, p. 115). The Petty and Cacioppo (1986) model of Elaboration Likelihood is such a model with two routes for attitude change.

The main construct in the ELM model is elaboration. Elaboration concerns the depth of the individual’s consideration of “issue-relevant arguments contained in a message” (Petty & Cacioppo, 1986, p. 128). It exists on a continuum from high to low, obviously determined by the degree of cognitive effort. High elaboration is primarily affected by motivation and ability. Motivation is an overarching construct in this model with several components such as personal relevance. A personal or intrinsically relevant topic will promote the processing of a message more readily than an irrelevant one.
Another construct linked to motivation is “need for cognition” (Cacioppo & Petty, 1982, Cacioppo, Petty, Feinstein, & Jarvis, 1996). This concept is described as the “need to structure relevant situations in meaningful, integrated ways” (Cohen, Stotland & Wolfe, 1955, p. 291). It can be also be described as a continuum; those individuals who have a need for high elaboration or a desire will process a message more readily and with greater cognitive effort (Dole & Sinatra, 1998) than those who simply use heuristics with low elaboration (Chaiken, 1987).

As noted, the two routes to persuasion are central and peripheral. Persuasion through a peripheral cue is still a type of change and worthy of consideration especially in education. A pleasant context (Petty & Cacioppo, 1980) or a simple message that can be easily understood (Eagly & Chaiken, 1993) may result in moderate elaboration. It is unreasonable to expect high elaboration rates for all learners. Consistent with the CCM model of Posner, Strike, Hewson and Gertzog (1982), Petty and Cacioppo agree that change is very difficult.

The Cognitive Reconstruction of Knowledge Model (CRKM). Dole and Sinatra’s (1998) model draws from research in social psychology, cognitive psychology, science education, and various change models. The model emphasizes the importance of the interaction between the learner and the characteristics of the message. For the most part existing research has not considered the prior knowledge or conceptions of the individual in assessing persuasion intervention (Eagly & Chaiken, 1993). So if the learner has contradictory information then prior knowledge may impede the comprehension of new information (Guzzetti et al., 1993; Lipson, 1982).

Dole and Sinatra (1998) posit three important existing qualities of a learner’s existing knowledge that directly influence the possibility of change. They are strength,
coherence, and commitment. Strength is the depth and completeness of an existing conception. Eagly and Chaiken’s (1993) research suggests that the strength of an existing idea has a strong role in the possibility of change. The stronger an idea is held by the individual, the harder it is to change.

Coherence in the Dole and Sinatra’s CRKM model refers to the degree to which learners find the new idea conceptually coherent. Learners are less likely to accept incoherent ideas. Ideas must make sense to the individual. Thagard also describes the coherence of the learner’s idea as important (Thagard, 1992). The individual’s commitment to their existing ideas may be weak or strong and influenced by many different sources. Dole and Sinatra (1998) identified commitment to an existing idea as a need to believe. Knowledge change depends on the existing strength, coherence and commitment of an individual’s conceptions. These factors contribute to the likelihood of conceptual change.

Individuals must be motivated to process the new information. Motivation was an indirect element in the CCM and was reassigned more directly in the reconceptualized CCM of Strike and Posner (1992). Posner et al. (1982) described dissatisfaction as a motivating factor for changing one’s ideas. The CRKM also describes dissatisfaction as one of many motivations for change. Dole and Sinatra’s (1998) model also considers personal relevance in the change process (Chaiken & Stangor, 1987), interest in the topic (Alexander, Kulikowich, & Jetton, 1994; Hidi, 1990; Schiefele, 1991), emotion (Gaskins, 1996), and self-efficacy (Dole, Brown & Trathen, 1996; Parajes, 1997) to be determinative of change. Dole and Sinatra use the term personal relevance from Petty and Cacioppo’s (1986) ELM, to describe motivation elements derived from these personal reasons.
As in the CCM and ELM, high engagement is synonymous with deep cognitive action, reflection, and elaborative strategy use. Dole and Sinatra (1998) consider this state of high engagement to be the highest form of metacognitive engagement. Conceptual change is most likely at this highest level of engagement. Bereiter (1990) offered a description of the situation in which this high engagement could occur. He called it intentional learners in inquiring classrooms. Students in this situation are in control of their learning and are aware of their ideas. Elements such as discussion (Alverman & Hayes, 1989), critical inquiry, or the critical assessment of an author’s message (Beck, McKeown, Hamilton, & Kucan, 1997) could be used in such a classroom to promote engagement.

In conclusion, the CRKM is designed with the interaction of the level of engagement of the learner and the complex relationship of existing knowledge, motivation, and message effects. Research is needed to establish the level of individuals’ existing knowledge and the conceptual and coherent integrity of that knowledge structure. The valence of attitudes and the degree in which motivation is involved or available for intrinsic or extrinsic manipulation is an area of research that could greatly benefit both theoretical and applied research in conceptual change.

The Cognitive and Affective Model of Conceptual Change. Gregoire (2003) proposed a theoretical model, the *Cognitive-Affective Model of Conceptual Change* (CAMCC), which incorporates crucial components of highly cognitive models of belief change with the integration of motivational and affective factors found in social psychology theory and research. Gregoire’s (2003) model is intended to specify mechanisms under which significant and enduring belief change in teachers of mathematics may occur. The CAMCC offers an explanation of why teachers’ beliefs
about mathematics instruction are so resistant to constructivist-oriented reforms and is a conceptual model for relating and implementing reform-oriented messages.

Gregoire (2003) draws on work by Lazarus (1984, 1991) asserting that, “what gets noticed in the environment is influenced not only by attitudes, as Fazio’s model (Fazio, 1986) depicts, but also by an individual’s goals and prior beliefs” (p. 164). The CAMCC incorporates the above ideas in a model intended to explain the process of conceptual change in the subject-matter beliefs of teachers.

The CAMCC begins with the presentation of a reform message, which requires the learner to decide or interpret whether the message implicates self. For those teachers who interpret the message as not challenging nor implicating themselves the message is construed as either benign or positive (benign-positive appraisal). This type of appraisal of a message does not necessarily lead a learner to systematically process the message. This supposition is based on the notion in dual-process models that benign or neutral appraisals promote chiefly heuristic processing. That is, because the message brings about no feelings of discomfort for the person, he/she need not further process the information.

The person’s prior experiences and beliefs are involved in the level to which he/she accepts or gives in to the message. If the recipient’s prior experiences and beliefs are not in concurrence with the presented message, then he/she will not yield to the message and there will be no belief change. For example, if a teacher is directed to change to a method of teaching that is not validated by their experience or professional development, then the teacher may reject the message to change or reform. If, on the other hand, the person’s prior experiences and beliefs are in accord with the message, the teacher will likely yield to the message. The recipient ends up in a state described as
assimilation/superficial belief change. That is, the reform message is not rejected, “but the teacher’s cognitive schema about teaching is not radically altered, and true conceptual change has not occurred” (Gregoire, 2003, p. 166).

If the recipient decides that the message implicates self (negative feelings or discomfort) he/she then engages in a stress appraisal. Gregoire explains that dealing with a stressful situation levies a cost of time, energy, and capacity. However, stress is not always negative—appropriate levels coupled with approaches toward growth and challenge potentially lead to greater learning and adaptation. The coping mechanisms and resources available to, and employed by, recipients to deal with the stress have a direct affect on the appraisals he/she makes about the message. Gregoire (2003) defines resources as characteristics of the person, including efficacy beliefs and knowledge, and of the situation, including available time and support from others. From this stress appraisal, the CAMCC moves the recipient on to an assessment of motivation. The recipients’ level of motivation is largely dependent on their efficacy beliefs.

Gregoire (2003) defines teacher efficacy beliefs as their situation-specific expectations that they can help students to learn. These beliefs are based on four sources of information: (a) enactive mastery experiences, (b) verbal persuasion, (c) vicarious experiences, and (d) physiological and affective states. The researcher proposes that enactive mastery experiences are of the most importance in regards to high efficacy and include prior mastery experiences with helping students learn. The teachers or recipients of the message may be persuaded by others to believe that they have the capability to implement a reform (verbal persuasion). They might also observe other teachers’ successful implementation of the reform (vicarious learning). The recipient’s reaction to the reform, might also affect their self-efficacy.
Gregoire (2003) explains that there is research to suggest that strong self-efficacy can help a recipient or teacher to deal with stress. Those with low self-efficacy might perceive stressful situations as more threatening than those with high self-efficacy (Jerusalem & Schwarzer, 1992). Whether teachers view a message as threatening has a strong bearing on their approach or avoidance intentions and type of information processing in which they engage. The motivation or affective segment of the model is where the recipients or teachers choose how to react to or appraise the message. According to Gregoire (2003) their reaction and motivation is largely dependent on their self-efficacy beliefs regarding the message. This path leads the recipients through shallow processing of the message where at the very best, they might assimilate or superficially change their beliefs, and at worst they would experience no belief change.

Reform messages such as Gregoire refers to impact on teaching practice (Roehrig & Kruse, 2005). The authors found that teachers who had reform based practices also had high belief in reform. Reform-based teaching practices are student centered and indicate an “affective response towards students” (p. 416). The student is considered to have a vital and critical role in instructional practice and the “construction of knowledge” (p. 416).

**Actively Open-Minded Thinking**

Relative to promoting high engagement, Baron (1994) suggests that students’ thinking can be improved. Indeed this involves both students’ metacognition and reflection. Baron defines actively open-minded thinking as the opposite of wishful thinking and bias. Actively open-minded thinking must include a search for information that covers multiple possibilities, fair inference to the possibilities and confidence that the breadth of the search is appropriate. This process also includes consideration of less
obvious explanations and the ability to rebut criticisms or further make sense of them through modification. Thus open-minded thinking skills may be seen as a predictor of willingness or openness to change.

Stanovich and West developed the Actively Open-Minded Thinking Scale (AOT) (2003). This 41 item thinking disposition measure was the result of combining 8 items from the Openness-Values section of the Revised NEO Personality Inventory (Costa & McCrae, 1992); 9 items measuring dogmatism (Paulhus & Reid, 1991; Robinson, Shaver & Wrightsman, 1991; Trodahl & Powell, 1965); 3 items from the categorical thinking subscale of Epstein and Meier’s (1989) constructive thinking inventory; 9 items from the belief identification scale developed from Sa et al. (1999), and 2 items from a counterfactual thinking scale developed by Stanovich and West (1997). The response scale format is a 6 point Likert scale ranging from: Strongly Agree to Strongly Disagree. The measure is treated as a 41 item composite scale and in two examples they report Cronbach’s alpha to be .83 and .84. The score on the scale is obtained by summing the responses. Higher scores represent the tendency for open-mined thinking. The scale has been used extensively with undergraduate populations (see for example, Sa et al. 1999), as well as students enrolled in preservice teacher education courses (Sinatra, Southerland, McConaughy, & Demastes, 2003; Sinatra & Southerland, 2009). In all studies, the instrument has been shown to correlate with other measures of effortful cognition such as Need for Cognition (Cacioppo et al., 1996).

**Intervention Methodologies**

**Refutational Texts**

A refutational text is much more than a compare and contrast text. In a refutational text, the reader receives direct information that refutes or debunks a common
misconception. Glesne (1998) notes that “we are a society that venerates the written word…” (p. 58), thus text-based interventions can be powerful. The refutational text has to be designed with the understanding of what is and is not persuasive for that particular message and audience. Of course the misconception must be acknowledged otherwise the text will not be effective. Research has shown that this intervention is effective and simpler to use than others (Palmer, 2003; Gregoire, Ashton & Gill, 2004; Hynd, 2001; Buehl, Alexander, Murphy & Sperl, 2001; Guzzetti, Snyder, Glass & Gamas, 1993). Hynd (2001) suggests that refutational texts may be used to induce conceptual change in a specific direction as a successful means for intervention. Indeed sometimes refutational texts that are designed to be neutral still induce change, this indicates how potentially powerful the written word can be for learners. Texts with a constructivist nature suggest that learning through specially formulated texts can be a type of conceptual change (Posner et al., 1982).

Hynd states that refutational texts involve persuasion and indeed states “in order to change one’s ideas, one must be persuaded to make that change” (2001, p. 699). The crafting of refutational texts is probably the most intricate step in this type of intervention. Both Palmer (2004) and Hynd (2001) suggest that refutational texts can be successful in achieving assimilation or accommodation which indicates that conceptual change induced through this method can be either weak or strong. Thus refutational texts can be applied in cases of weak or strong conceptual learning challenges, which make this an excellent and practical pedagogical intervention. Hynd (2001) also discusses some of the less than attractive issues about using refutational texts such as the issue about employing persuasion. Hynd (2001) describes a refutational text as a text designed to advance a “common theory, belief, or idea” (p. 700). This tenet is then juxtaposed against
an alternate conception which is suggested to the reader to be better for a number of reasons. The reasons are also provided for the reader.

The most difficult component of a refutation based conceptual change intervention is the crafting of the text. In order to be effective, the writer must know the belief system that they have to combat. A successful refutational text must include a strong message (Petty & Cacioppo, 1986), a repeated message (Cacioppo & Petty, 1979) and employ Chinn and Brewer’s three conditions for change; multiple examples of evidence, credibility, and unambiguous of the information. For instance, students may view a written argument as having greater plausibility than an oral one and that a longer argument carries more weight than a shorter one. In this study, the message that two conditions received repeated the idea that intelligence can be changed and thus there was an implication that having a fixed view of intelligence could be harmful for students.

**Motivational and epistemological impact in the refutational text.** Palmer (2004) investigated views about high school biology conceptions; he mentions that motivational (Pintrich, Marx & Boyle, 1993) and epistemological factors should not be ignored in the text or the research planning. He looked at learners’ views about the term “ecological niche” that had been shown to be frequently misunderstood. Palmer used a target misconception and attempted to induce accommodation through refutational texts. Palmer found that students who were motivated appeared to engage in conceptual change, as well as students who were interested in the subject and did not have a robust misconception. Those who indicated metacognitive engagement with the process, and had background knowledge in science also experienced change. These were all factors in conceptual change. Murphy and Alexander (2004) also found high interested students were less likely to result in change.
Palmer’s control text also caused change but he argued that the “warm” factors such as motivational, epistemological and cognitive factors were important predictive conceptual change elements. The warm factors may have had a greater role in the change than the text itself. In other words, the students were ready or in Gregoire’s terminology yielding and accepting toward change and thus learning was intentional (Pintrich & Sinatra, 2003). Palmer’s intervention was extremely short (2 minutes). He argued that accommodation is not always difficult and may be accomplished with less effort than previously thought, however the existing cognitive factors play a large role and must be utilized, to provide the atmosphere for intentional learning and thus the opportunity to change. The “warm” factor in the text for this study are the mention of No Child Left Behind, the personal responsibility for harm, and the suggestion that teachers who believe intelligence is fixed may not be as effective as a teacher.

**Collaborative and Argumentation-Based Learning**

A branch of collaborative argumentation-based learning has developed recently specifically employing the computer as a facilitator for instruction. This field is called Computer-Supported Collaborative Learning, or CSCL (Andriessen, 2003). Most students struggle when asked to form a cogent and rational argument. Despite the existence of strategies to assist students (Baker, 2003), students still need assistance in combining their thoughts, evidence and competing arguments (Walton, 1996). Indeed as Nussbaum and Schraw (2007) and Nussbaum (2008) indicate students need assistance integrating a solution, weighing both sides, and evaluating and recognizing compromises.

**Refutational texts and discussion.** Guzzetti (2000) acknowledged the need for discussion in her evaluation of the role of refutational texts in producing a powerful impact for change. She recognized that refutational texts alone are not capable of
producing change especially in learners with lower level reading. Discussion, on the other hand, can produce cooperative groups that may convince other students about alternative conceptions. Guzzetti suggested that refutational texts may produce cognitive conflict; and when combined with the instructional power of collaborative discussion they may be more likely to produce change. Depending on the quality of the discussion, collaborative discussions may also increase the likelihood that learners become highly engaged with the refutational text. Collaborative discussions also provide learners with an opportunity to voice doubts and reservations with the arguments being advanced by the refutational text, and to have these doubts and reservations addressed.

**Discussion and collaboration.** Learners have to have an active interaction with their environment, for instance they must have structured tasks and rationale for what they are supposed to accomplish. Otherwise learners become distracted and unfocused. For example when online students are disengaged, they tend to drop out or fail to complete tasks. Chen and Zhang (2003) suggest that collaborative learning in science discovery may be beneficial. Research by Gorman and colleagues (Gorman, 1986; Gorman, Gorman, Latta & Cunningham, 1984) studied confirmation bias as a group task. They found that groups out preformed individuals in their choice of a confirmatory strategy, disconfirmatory strategy, or a combination of the two. Teasley (1995) examined fourth grade students’ collaborations in verbal behavior. The students had to work together to complete a task which included the production of hypotheses and experiments to test the hypotheses. Out of four conditions, the talk dyads condition was most successful in the collaborative task, followed by individual talk alone, then individual, and no talk. Finally, the no talk dyads had the worst performance. This nature of learning it also provides evidence of the increased learning potential of collaboration.
Wiley and Bailey (2006) note that it is important for groups to discuss the task(s) and thus planning gets done faster with less misunderstanding. The prediscussion argument worksheet for this discussion activity was designed to answer questions about goals and to structure the interaction to eliminate questions. Discussing the tasks ahead may provide structure for the students and allow students to anticipate the actual task.

**Argumentation and collaboration.** Argumentation in a collaborative setting appears to enhance learning (Andriessen, Baker, & Suthers, 2003; Bell & Linn, 2000, Chinn, O’Donnell, & Jinks, 2000; Driver, Newton & Osborne, 2000). Collaborative argumentation is a newly evolving field existing both in the classroom and also entirely online. Nussbaum (2002, 2008) defines collaborative argumentation as “students working together to construct and critique arguments” (p. 479). The construction of arguments requires students to collaborate and to separate the elements of the argument and to identify counterarguments. Engaging in this process may or may not be successful as students, particularly in the online environment, may choose the easy way out and simply agree with each other (Koschmann, 2003).

Successful argumentation produces the opportunity for students to recognize and resolve inconsistencies even if agreement is not reached (Andriessen, Baker, & Suthers, 2003; Chinn, 2006). Argumentation does have a social component as learners bring their own point of view and cultural expectations to the process. Social norms may guide the argument construction and the discourse between the learners as they determine what evidence is (Toulmin, 1958). Knowledge building (Bereiter & Scardamalia, 2006) in this process may be transparent and become explicit as the arguments are constructed.

Argumentation has been scrutinized and examined from many fields. However the perspective of education is new. Andriessen (2002) points out that there may be great
benefits in arguing to learn for teachers, students and researchers. Examining how arguments assist in learning may impact learning environments as well as strategies and expectations.

Argumentation is an instructional strategy used to produce and hone critical thinking skills. Chinn (2007) suggests that the rising use of argumentation in classrooms raises questions about its benefits, instructional goals, and appropriate instructional methods. Argumentation is not the typical debate that students might have with each other. Instead it is a deliberate process involving a stance with reason and evidence resulting in counterarguments and eventually agreement, compromise, or even disagreement. The key is the deep processing involved and the use of rationality instead of purely opinion or affect.

Voss and Wiley (2000) suggest that argumentation may also cause students to build their own theory or rationale for an argument, perhaps leading to what Dole and Sinatra (1998) refer to as personal relevance as well as deep engagement. Developing and identifying the reasons for an argument may force the learner to truly acknowledge their own beliefs as well as making the beliefs and knowledge of others explicit. Preservice teachers (Richardson & Placier 2001; Patrick & Pintrich, 2001) need to have their beliefs brought to the surface in order to remove misconceptions and to provide an opportunity for change.

**Online collaborative learning with texts.** Andriessen (2002) further suggests that when students employ cooperative argumentation, “they are often arguing to learn” (p. 443). This collaboration strategy involves deeper conceptual learning, one of the key concepts of conceptual change. According to Posner et al. (1992), key conditions for conceptual change activate cognitive conflict which requires engagement and generally
includes strong, repeated messages. Collaborative learning benefits from social interaction which can improve typical individual disinterest in topics of little interest. In situations where individuals are not interested there is usually less cognitive involvement (Gregoire, 2003). However as Andriessen (2002) states that the nature of science argumentation requires the give and take as well as the acknowledgment of shared goals. Extending the expectations of argumentation in the classroom may produce social awareness, collaboration, understanding of argumentative structures as well as more personal and relevant learning (Dole & Sinatra, 1998).

Kuhn, Shaw and Felton (1997) conducted research involving student essays about capital punishment. Then the students discussed this for several weeks resulting in another culminating essay. The results of this research showed a significant increase in the number of two sided and functional arguments. Researchers in the Learning Sciences have begun to examine the power and potential of small groups using computers. Previously collaborative classroom interactions have been positive and indicative of significant improvements in individual learning (Asterhan & Schwartz, 2007; Greeno, 2002; Kuhn & Udell, 2003).

Keefer, Zeitz, and Resnick (2000), when investigating oral use of argumentation, found that there was also a distinct starting point, goal, and commitment to each argument. This appears to be consistent with written argumentation as well. This indicates that there may be a shift in discussions both orally and in the written format. Andriessen (2003) also studied argumentation in collaborative writing. Dyads were used to write argumentative letters about government contracts either for or against a position. Electronic communications and a text editor were used. Each participant was sent a
“given argument” before the discussion. This contained three arguments which were to be used as a starting point for the argumentative letters.

The researchers closely examined the participants’ debates looking at the actual discussion, the phase, the extent of the discussion and if and when the given arguments were included in the actual discussion. The researchers divided the arguments into content generation, text generation and text completion. The researchers further divided the discussions into negotiations as to whether they were informative or argumentative and how elaborate they were. They found that negotiations were different in all three phases, suggesting that argumentation changes during learning tasks. In addition, elaboration was an important factor, usually involved in defining the preferred position which would indicate shallow processing.

Negotiation however was indicative of the degree of argumentation and elaboration. Only 10.2% of the discussion analyses were considered to be elaborate. This low figure again supports the need for structured discussions and directed tasks in argumentation.

**Purpose of the Study**

The purpose of the study was to explore preservice teachers’ views of intelligence, (in particular whether they believe that intelligence is fixed or changeable) and whether these views can be changed. Using the CRKM (Dole & Sinatra, 1998) framework and their expectations of the environment for change, I designed a study that employed a refutational text alone and then compared it with a structured discussion to see which intervention was the most effective.

This study also examined the effect of a refutational text alone versus a intervention where a structured discussion was combined with a refutational text to
produce a possibly stronger and more effective change. According to the CRKM (Dole & Sinatra, 1998) higher levels of engagement are more likely to produce change.

Research Questions and Hypotheses

Three Research Questions Guided this Study

1. What are preservice teachers' views about intelligence prior to the intervention? This question explored preservice teachers’ definitions of intelligence. Specifically, do preservice teachers' believe that intelligence is fixed or incremental? I hypothesized that the majority of preservice teachers would consider intelligence to be fixed, because they may not understand the true nature and complexity of the concept of intelligence.

2. Do preservice teachers change their views about the changeability of intelligence after intervention? The study design entailed four intervention conditions. Specifically, I hypothesized that Condition 1, refutational text plus structured discussion would cause the most amount of change, due to the combined influence of both the refutational text and the collaborative discussion. I hypothesized that Condition 2, refutational text only, would also promote change, but less change than expected in Condition 1. Refutational text has supported effectiveness in previous research; therefore, I expected an effect of text alone. Finally, I hypothesized that participants in Condition 3, structured discussion alone, would experience the least amount of change, because without the background knowledge provided by the refutational text the discussion may be weak and provide little opportunity for change, or change might occur in the “wrong direction,” or naïve beliefs might persist. Condition 4 was the control group, using the alternative text and the non-related discussion.

3. What is the relationship between open-minded thinking and conceptual change? I hypothesized that open-minded thinking would be related to conceptual
change. Open-minded thinking reflects a tendency to be more highly engaged with ideas, which is the type of engagement that results in conceptual change.

Summary

Research into the impact of implicit theories and their role in influencing preservice teachers’ beliefs is very important. The attitudes and expectations that preservice teachers bring to the classroom are often hidden and implicit. If preservice teachers knew that their un-examined belief structures might cause them to be unfair and biased, then teacher educators would attempt to have these problematic theories brought to attention and examined in a thoughtful but supportive way.

Views about intelligence may be incremental or fixed. Dweck and her colleagues argue that fixed views are associated with performance and incremental with mastery. People may even hold more than one view at a time. Entity views hold a poor view of effort and link it with low ability. Beliefs about intelligence that preservice teachers bring into the classroom might have a big impact on student success and perhaps lead to low or overly high expectations.

Conceptual change theories attempt to explain the interaction between learner characteristics, beliefs and knowledge structures and incompatibilities with implicit and explicit theories about knowledge, beliefs and implicit theories that may impact classroom practice. A study that employs qualitative methods to explore the rich rationale behind and supporting preservice teachers’ personal and implicit and perhaps inconsistent (Smith, diSessa, & Roschelle, 1993) beliefs plus quantitative data about preservice teacher beliefs will be an important contribution in the ongoing process of helping preservice teachers deal with situations and provide preservice educators information about preexisting beliefs that preservice teachers bring into the classroom.
CHAPTER 3

METHOD

Design of the Study

The design of this study was a mixed methods approach. Specifically, in the first phase of the study, quantitative data about students’ views about intelligence were assessed in the form of Likert scale items. In addition, qualitative data in the form of open-ended questions were collected about preservice students’ views about intelligence to further illuminate the research questions. In the second phase of the study, dyadic discussions were analyzed qualitatively, and individual open-ended posttests and essay questions were examined both quantitatively and qualitatively to explore students’ views of intelligence after intervention. A 2 x 2 factorial design was used, crossing structured discussions with use of refutational text in phase one and two before the qualitative analyses.

The intervention consisted of four conditions. Participants in Condition 1 (text plus discussion) read the refutational text and then completed an asynchronous discussion about intelligence. Condition 2 (refutational text only) participants read the refutational text but completed a discussion about school uniforms. Condition 3 (discussion only) participants read an alternative text and completed a discussion about intelligence. Finally, participants in Condition 4 (control) read the alternative text and discussed school uniforms.

Participants

Participants in this study were 103 members of the educational psychology subject pool from a large southwestern university located in a metropolitan area. The participants in the subject pool completed research as a course requirement for
introductory educational psychology and educational assessment methodology. Of those that completed all portions of the study, 77.3% of the participants were female and 11.8% were male. Students’ ages ranged from 17 years to over 50, with 14.2% of participants in the 30 to 39 year age. Participants were Caucasian (66 %), African American (11.3%), Hispanic (9.4%), and Asian (10.4%).

Participants were primarily juniors (55.2 %), seniors (24.8%) with some sophomores (19%) and freshman (1.0%). Participants reported their education teaching focus areas as follows: 38.7% elementary education, 29.2% secondary or high school, 23.6% other, 3.8% undergraduate, 2.8% middle or junior school, and 1.9% preschool or early education majors. Areas of concentrations were reported by participants as 6.8% in mathematics, 11.7% in English/language, 1.9% in Spanish, 1.9% in Music, 4.9% in Art, 7.8% in Special Education and 65% in other. Eighteen percent of the participants did not select education or a related area as a major. Participants reported receiving special education benefits in elementary school (3.8%), middle or junior school (0.9%), in all schools (0.9%).

Participants’ grade point average or G.P.A. was 3.23. The majority of students (61%) were directly out of high school. Participants indicated that they had some prior experience teaching, primarily in preschool (77.7%). The demographics did not specifically ask for length of time teaching, however, given that most were directly out of high school, it is likely that their preschool teaching experience was mostly assisting teachers or observing. This indicates that the majority of the participants had little teaching experience. A total of 117 students completed the research assignment but 10 were removed from the final statistical analysis due to non-completion of specific
measures in the study. This included lack of pre and post measures and non-completion of discussion. Another four were removed as outliers (please see pg. 57 for a complete reporting of this procedure). The final number of participants was 103.

**Measures and Materials**

**Demographics.** Demographics were collected for the purposes of describing the research participants and examining individual differences (Appendix A). Items included gender, age, ethnicity, major, expected teaching area, prior teaching experience and G.P.A.

**Actively open-minded thinking.** The Actively Open-Minded Thinking (AOT) scale measures willingness to change beliefs and the ability to cognitively reassess and ultimately accept new and challenging beliefs (Stanovich & West, 1997). Sample items from the AOT include “I think there are many wrong ways, but only one right way to almost anything” and ”Beliefs should always be revised in response to new information or evidence.” Developed through the work of Stanovich and West (1997) and further elaborated on by Sá, West, and Stanovich (1999), this 41 item scale was drawn from a number of pre-existing inventories in social and cognitive psychology (Costa & McCrae, 1992; Paulhus & Reid, 1991; Robinson, Shaver & Wrightsman, 1991; Trodahl & Powell, 1965). The final score of this survey was calculated by summing of the items, which are treated as one scale. Stanovich and West (2003) report a Cronbach’s alpha of .83, indicating good reliability in previous research. High scores in the inventory indicate the ability to accept and grapple with belief change and low scores indicate what Sá, Kelley, Ho and Stanovich (2005) call “cognitive rigidity.” (See Appendix B for complete survey.)
Intelligence belief survey. Participants answered one open-ended short answer question about their definition of intelligence, along with four Likert scale questions measuring their beliefs about the nature of intelligence as fixed or changeable (see Appendix C). The questions specifically addressed contrasting views of intelligence as fixed or changing; particularly in response to classroom instruction. This survey was developed based on the work by Dweck and her colleagues on the theory of entity (fixed) versus incremental (changeable) intelligence (Dweck, 1999b; Dweck, Chiu, & Hong, 1995; Dweck & Leggett, 1988). Participants were asked about their current view of intelligence (fixed or changeable) and asked to indicate the certainty of their belief, using a Likert type scale of 1-5, where 1 = strongly disagree and 5 = strongly agree. The open ended definition question was scored qualitatively using a taxonomic approach and examination of common themes. Participants completed the intelligence survey both pre and post intervention.

Refutational text. Participants in two conditions (Conditions 1 and 2) read a refutational text about intelligence written as a commentary about the changeability of intelligence. The text emphasized the importance of this idea given the demands and expectations of the No Child Left Behind Act (see Appendix D). In addition, the text cautioned against teachers accepting only standardized tests as legitimate indicators of intelligence. The goal of the refutational text was to expose misconceptions about intelligence and advocate teaching with appropriate strategies and expectations to support achievement. The text used popular teaching issues to promote strong and engaging messages. The text was designed to promote conceptual change by suggesting that
incorrect information about student intelligence may result in poor outcomes for their prospective teachers.

The text was written to elicit interest by emphasizing issues preservice teachers may have and possible classroom outcomes. Sparking emotions may lead to concern and thus greater attention to the message about the malleability of intelligence. Information articles about No Child Left Behind leading to intense pressure on standardized testing in the classroom were used as a basis for the text (Fuller, Wright, Gesicki & King, 2007, Wallis & Steptoe, 2007; Zuckerbrod, 2007; Zakaria, 2006). The text was 8 paragraphs and 755 words.

Alternative text. Participants in Conditions 3 and 4 read a comparable expository text about the brain (Appendix E). This text described left and right brain features in a general way. The text was 766 words and 9 paragraphs. This text was used to eliminate concerns about time on task issues within the study.

Prediscussion organizer for online discussions. The structured discussions were structured by a prediscussion organizer (see Appendices F and G) which was designed to scaffold collaborative learning in an online environment. The prediscussion organizer specifically asked students to answer the question, give arguments for and against and also to state their opinion. They were also asked whether they agreed with or had arguments with the text that they had just read. This graphic organizer attempted to provide a visible framework for the argumentation process. Researchers suggest that support is often necessary for most students during collaboration exercises and in particular during argumentation interventions (Cho & Jonassen, 2002).
All participants completed the organizer individually prior to any discussion. Participants in Condition 1 and 3 were instructed to discuss and come to a conclusion about this question: “Do you agree that intelligence can be changed? Give an argument as to why or why not?” (see Appendix F). In contrast, participants in Condition 2 and 4 were instructed to discuss and come to a conclusion about this question: “Do school uniforms improve grades? Why or why not?” (see Appendix G). Prediscussion organizers asked participants to construct arguments for, arguments against, and conclusions.

Post essay. All participants completed an essay question post intervention that examined their views of intelligence in an academic situation. The essay item was the second open-ended question for the study. Participants were presented a classroom scenario and asked to write an essay reacting to the situation based on their views of intelligence. Specifically the preservice teachers were asked how they would approach two students, one of whom was academically successful and who viewed his success as a consequence of his study habits. The other student was not academically successful and seemed fatalistic about his chances to do well on a test. The preservice teachers also were asked to describe the two students’ views of intelligence (see Appendix I for the essay prompt).

Procedure

Pilot testing of instruments. All instruments were piloted and examined for potential revision prior to the administration of the study. Total time for participants to complete the study was one hour to allow for potential computer issues with the online discussion. Demographics for the pilot were similar to those of the final study as the participants were drawn from the same subject pool. Data from the pilot testing was used
to examine the instruments or for possible problem items. Edits in all measures with the exception of the AOT were completed based on the pilot data information and analysis.

**Approved research data collection.** Participants were randomly assigned to one of four conditions. All measures were delivered via WebCampus, an online learning environment commonly used in educational settings. Data collection took place over a three semesters. All students completed all measures on line, the informed consent was read by the students but signature collection was waived by the IRB review. (See appendix M for original IRB document). The total time to complete all instruments was approximately 1 hour.

**Phase 1.** Participants first received an informed consent displaying the authentic stamp of the Institutional Review Board. Participants consented via a mouse click. Participants were randomly assigned to one of the four conditions. The number of dyads in each condition varied as some participants were missing partners and they did not complete the discussion portion. In Condition 1 there were thirteen dyads, in Condition 2 there were seven, Condition 3 had nine, and Condition 4 had twelve.

Participants logged into a predetermined location through WebCampus. Participants in all conditions completed a demographics survey first after reading their informed consent online. Next all participants completed the AOT, then the Intelligence Pretest. Next participants in conditions 1 and 2 read the refutational text. Participants in Conditions 3 and 4 read the alternative text.

**Phase 2.** The second phase of the study was done in dyads, with the exception of the prediscussion organizer and the Intelligence Posttest. Participants received their condition assignment through WebCampus email and were instructed to log in to their
condition after completion of the demographics, AOT, Intelligence Pretest and the Refutational text/Alternative text reading assignment. Dyads were randomly assigned to condition. The researcher provided reminders to the participants about their condition assignment and research timing.

**Prediscussion organizer and discussion instructions.** In Condition 1 and 3 participants received a prediscussion organizer. They completed the worksheet individually prior to engaging in discussion. Within the discussion they were instructed to answer the question: “*Do you agree that intelligence can be changed? Give an argument as to why or why not.*” Participants were instructed to discuss and to come to a conclusion about the previous question. Then participants individually completed the intelligence post test.

Condition 2 and 4 participants were randomly assigned to dyads and provided a prediscussion organizer. This was completed individually before the group discussion. The prediscussion worksheet structured the discussion and provided directions for the group roles and task assignments. The participants received the instruction to answer the question: “*Do school uniforms improve grades? Why or why not?*” Participants were instructed to discuss and come to a conclusion about the previous question. After the discussion all conditions individually completed the Intelligence posttest and essay.
I begin this chapter by explaining the preliminary analyses and the organization of the quantitative and qualitative analyses for each research question. I describe the quantitative results in section one. In section two, I describe the qualitative results and how they explain and illustrate the quantitative results. This study required a two-phase analysis. The first portion of the study is based on quantitative analysis of the survey measures and essays. The second portion of the study involved a qualitative analysis of five case studies extracted from the open ended questions, discussion organizers, discussions and post essay. In addition, I explored why specific instances of change occurred in the quantitative analysis. To begin the results section I first review the study research questions and how they relate to the analyses performed.

**Research Questions**

Recall that three research questions guided this study. 1. What are preservice teachers' views about intelligence prior to the intervention? Specifically, do preservice teachers' believe that intelligence is fixed or incremental? 2. Do preservice teachers change their views about the changeability of intelligence after intervention? 3. What is the relationship between open-minded thinking and conceptual change?

**Section One: Quantitative Results**

**Preliminary Analyses**

In order to address the research questions of interest, I first determined which participants had complete data sets. Specifically, participants were excluded from further analysis if they had missing data on multiple measures or incomplete submission of post
outcome measures. Based on these criteria nine participants were excluded. In addition I compared the results of the preservice teachers (82% of participants) with those who did not identify an education major. I ran a median test between both groups and there were no significant differences between these groups on any outcome variables. Therefore, for the purposes of this study, the term preservice teachers is used to refer to this entire sample, which is comprised of students enrolled in preservice teacher education coursework at this university.

Next, I developed rubrics and scoring procedures for all of the open-ended questions. The procedures for scoring are described below (see Appendix J for rubric). Correlational analysis was conducted among the instruments at pretest and posttest. Correlational analysis was employed to examine whether there is a relationship between attitudes about intelligence, and actively open-minded thinking. Correlations indicate a relationship and not causality however they do provide evidence of the direction of the relationships. The basic assumptions of ANOVA were also tested during the preliminary analysis (normality, equality of variances). Alternative techniques were employed such as nonparametric statistics.

**Rubric development and open-ended question scoring procedures.** The participants were asked two open-ended questions pre and post. The first of these two questions was: *How would you define intelligence?* Recall that participants were asked to write two or three sentences below. This was the first item in the intelligence survey which was administered pre and post. A rubric was developed guided by research Question 1 - What are preservice teachers’ views about intelligence? Specifically, this
question asked whether they thought intelligence was incremental or fixed. (See Appendices K-L for rubrics).

**Open-ended scoring categories.** In line with research Question 1 (What are preservice teachers views’ of intelligence), this open-ended question was scored using the following categories (1 = Incremental, 2 = Fixed, 3 = Both, 4 = Not sure). Recall that research Question 1 specifically also asked whether preservice teachers viewed intelligence as incremental (changeable) or fixed. *Incremental* indicated a belief in the changeability of intelligence, *Fixed* indicated a biological and/or non-dynamic view of intelligence, *Both* indicated a combination view of intelligence as both changeable and fixed, and finally *Not Sure* or unclear was used to score those views that were unclear.

Two independent raters scored all of the pre and post responses. Two categories, *Both* and *Not Sure*, proved difficult to assure a high level of inter-rater agreement. Therefore, responses categorized as *Both* were collapsed into the *Incremental* category because the participants clearly expressed a view of intelligence as changeable. The category *Not Sure* was dropped from further quantitative analysis. All responses were then rescored. Final inter-rater agreement for the responses was 85% at pre-test and 84% at post-test. Crosstabs analysis showed the kappa for pre-test items was $\kappa = .77$, and for post was $\kappa = .74$. The final scores for this question were entered into all further analyses as a dichotomous variable, with 1 = *Incremental*, and 0 = *Fixed*. Table 2 reports the means and standard deviations for open-ended question 1 pre and post.

**Essay scoring rubrics.** An analytical and a holistic rubric were developed to examine both the content and the quality of the essays. Essay questions were analyzed to look for beliefs about the changeability of intelligence. The essays were scored
holistically for overall cohesion and analytically for the analysis of themes within the
essay. Essays were coded through examination of the strength of argument, point of view,
sophistication of argument, use of evidence and references to the refutational text based
on a similar scoring strategy used by Nussbaum (2008) and Nussbaum and Schraw
(2007) (see Appendices K and L for the rubrics). Means and standard deviations were
calculated for the essays and additional statistical tests as necessary.

The analytical rubric was developed based on the same categories used in scoring
intelligence survey question 1, that is Incremental, Fixed, Both and Not Sure (indicating
one or the other but not definite). As with the scoring of the intelligence survey question
#1, the Both category was collapsed into the Incremental category. Not Sure was
dropped from further quantitative analysis. As with intelligence survey question 1, the
analytical scores were entered into all further analyses as a dichotomous variable, with 1
= Incremental, and 0 = Fixed. Tables 3 and 4 report the means and standard deviations
for analytical scores for the essay. Note that the holistic scores for the essay as shown in
Table 4 are normally distributed, the skew and kurtosis is below 1.0. The holistic essay
used a three-point scale. The holistic essay rated essays for quality from 1 as poor to 3 as
good. Please see Appendices K - L for more information. Table 3 shows the means and
standard deviations of the analytic and holistic essay scores; Table 4 shows the skew and
kurtosis of the holistic score (those for the analytic score are not shown because these
were dichotomous).

The holistic rubric was developed to score the essays for quality of response. The
prompt queried teachers’ views of intelligence, students’ views of intelligence and
pedagogical solutions to students’ problems. The essays were scored for the respondents’
beliefs about intelligence and whether they addressed all aspects of the prompt. In addition they were scored for length.

*Inter-rated reliability.* Two independent raters scored all of the essays using both the holistic and analytic rubrics. The second rater was trained to score holistically using three anchor essays. After initially scoring a subset of the essays, the rubric was adjusted and the three anchor essays were changed to reflect the changes in the rubric. This resulted in three scores, 1 for poor, 2 for fair, and 3 for good. (See Appendices K - L for the description of the three rubric scores.) Final agreement for the holistic essays was 80%. The analytic essay agreement was 91%. Crosstabs analysis revealed that the kappa for post-test was $\kappa = .74$.

*Scoring of Likert scale items.* The four Likert scale items were administered pre and post. Question 4 was reverse scored so that high scores on all four questions reflected a view consistent with intelligence as incremental. Table 5 and 6 reports the means, standard deviations, skewness and kurtosis for the four Likert scale item both pre and post. As can been seen in Figures 1- 4, all four Likert scale items were negatively skewed, with the modal response in the direction of acceptance of incremental views of intelligence. The skew was more severe for the posttest items than the pretest items. Also, the skew was more severe for Item 4, “pre-determined at birth.”

*Factor analysis.* Factor analysis was conducted to see if all four items loaded on the same factor. The results are shown in Table 7. The four Likert scale items were factor analyzed using Promax rotation and produced one factor (explaining 51.0% of the variance). Factor scores were then computed; this produced weights for computing a weighted average of the individual item scores. A high factor score represented an
incremental view of intelligence. I determined a pre and post factor score for all four items and then derived a change score from their differences. This score represented a shift towards an incremental view of intelligence (see Table 8).

After running the factor analysis on the four Likert Scale questions, I wanted to establish whether outliers appeared among the responses (see Table 7). I conducted an ANOVA using treatment condition and computed studentized residuals and predicted scores pre and post. ANOVA is an accepted method of analysis to identify outliers. Norusis (2005) states that the process of using studentized residuals allows violations to be visually apparent, and I have provided the results for the reader to examine. In particular, I have outlined the units that were outliers (see Figures 5 and 6). Four participants were excluded from further analysis based on this analysis. In the qualitative section I have examined one of the participant outliers. This provided an additional rationale for removing outliers.

**Actively Open-Minded Thinking Scale.** The next preliminary analysis was completed to score the AOT and determine reliability. First, items were reverse coded as indicated by the original authors’ instruction. Next, a composite score, the sum of all items, was determined for each participant. The scale was subjected to a Cronbach’s alpha reliability analysis. The alpha was .85. This was consistent with alpha levels reported in previous research. The \( N \) was 99, \( M = 171.22 \) and the \( SD = 19.57 \).

**Data pertaining to each research question.** Research question 1 asked, What are preservice teachers' views about intelligence prior to the intervention? Specifically, do preservice teachers' believe that intelligence is fixed or incremental? In order to address this question, data from the open-ended intelligence survey question #1, the essay
(analytic and holistic scores), and the four Likert scale items were subjected to separate analyses using the factor scores described previously.

Research question 2 asked: Do preservice teachers change their views about the changeability of intelligence after intervention? To answer this question, I examined the four Likert scale questions from the pre and post intelligence surveys as well as the post essay. Tables 2 - 6 show the descriptive statistics for these variables. The post essay had two scores, analytic and holistic. All four items as well as the essay were sufficiently skewed such that non-parametric statistics were employed (see Figures 1 through 4). Non-parametric statistics are used when data does not meet expected parametric assumptions for normality and homogeneity of variance (Hinke, Wiersma & Jurs, 1998).

Correlations among the relevant constructs reported above were used to address research question 3, What is the relationship between open-minded thinking and conceptual change?

**Results of Interest for Research Question 1**

Recall that the first question in the intelligence survey asked participants to define intelligence. Rubrics previously described were scored as incremental or fixed. As noted, results for the intelligence survey were skewed. Initial responses for open-ended question 1 indicated that 69.9% of the participants were categorized as indicating an incremental view before any intervention. Eighty-nine percent of participants agreed or strongly agreed with Likert scale question 2 (is intelligence changeable?). For question 3 (Can you be made smarter through instruction), 98% of the participants answered in agreement (agree or strongly agree). For question 4 (Is your intelligence determined at birth?), 86% answered disagree or strongly disagree (this item was ultimately reverse scored), and in
response to question 5 (Can instruction raise your intelligence?), 83% answered in
agreement (agree or strongly agree).

Recall that the factor analysis conducted on the four Likert scale items described
above indicated that a high factor score represented an incremental view of intelligence.
All four Likert scale questions in this analysis showed that participants had incremental
views. To answer question 1, I also looked at the results of the post essay. The analytic
rubric scoring indicated that 92.8% of the participants had an incremental view of
intelligence. Extended descriptions of essay analysis are listed under results of interest for
question 2. In-depth analysis of participants’ views is elaborated within the qualitative
section.

Results of Interest for Research Question 2

A 2 x 2 factorial design was used, crossing structured discussions with use of
refutational text. Recall that the dependent variable was the factor change score. I used a
median test (which compares whether the changes in each condition tended to be above
or below the common median). The overall median test was significant $\chi^2(3, N = 103) =
8.99, p \leq .03$. Pairwise comparisons were then conducted, (see Figure 7) showing that
Condition 1 (combining text and discussion) was significantly different from Condition 3
(discussion only) and 4 (control). The comparison between Condition 1 (combining text
and discussion) and Condition 2 (refutational text only) approached significance ($p \leq
.08$). However for text there was a significant difference in the change score towards an
incremental view of intelligence between the experimental condition and the control
condition $\chi^2 (1, 51) = 4.46, p \leq 0.05$. Recall the skew of the Likert questions pre and post
was primarily in favor of a incremental viewpoint of intelligence (see Figure 1-4).
There was change from pre to post in both text conditions, but it was substantially greater in the text plus discussion condition ($M = 0.22$) than in the text only condition ($M = 0.05$). The difference, however was not quite significant ($p \leq 0.08$). Cohen’s $d$ for Condition 1 was 0.71. See Table 8 and Figures 7 and 8 for complete data reporting.

As shown in Figure 8, the posttest factor scores were different from the pretest scores. The text plus discussion groups showed growth and the text alone group showed the greatest growth although it was not significant. However, the overall main effect of text was significant. It is unclear whether there was an interaction effect.

**Open-ended survey results.** The rubric scores for the open-ended intelligence survey question #1 (1 = Incremental, 0 = Fixed) were included in an analysis of variance using condition (text and discussion) as a grouping variable and rubric scores as the dependent measure. The results showed that there were no significant differences among the four conditions in regards to participants’ views of intelligence as either incremental or fixed.

**Holistic essay analysis.** Next, the holistic essays were also subjected to a univariate analysis of variance, using condition as the between subject factor (refutational text group or discussion group) and using the holistic essay scores as the dependent variable. These scores were normally distributed thus allowing an ANOVA to be run (skew was -0.40 and kurtosis was -0.73). No significant differences were revealed.

**Analytic essay scores.** The analytic essay scores were examined using the Fisher’s Exact Test due to the severe skew (making a Chi-square test invalid) and the inappropriateness of using ANOVA on a nominal variable. The Fisher test is the exact probability of obtaining the table under the null hypothesis that the independent and
dependent variable are statistically independent. The analytic essay scores were insignificant with a \( p = .37 \) for refutational text conditions and a \( p = .16 \) for discussion groups. Thus there were no significant differences among the conditions.

Research Question 3

Research question 3 asked, What is the relationship between open-minded thinking and conceptual change? Recall that the AOT was used to address this question. High scores on the combined results were predicted to indicate propensity toward change. AOT scores were correlated with the incremental view of intelligence factor change scores. This correlation proved to be non-significant \( (p = .95) \).

Section Two: Qualitative Analysis, Archetype Example of Illustrative Cases

Preliminary Coding

From the background of qualitative research as a grounded theory approach (Glaser & Strauss, 1967; Merriam, 2001; Creswell & Plano-Clark, 2007), coding is an analytical process that allows for categorizing qualitative data. The coding also describes and details the data categories. I conducted the first level of coding to establish initial patterns and distinctions. I later moved to a second level of coding which entailed changes in the categories and revisions of my coding rubric(s) and development of a taxonomy. In addition integrative diagrams were produced from the data (the participants’ words as well) to illustrate patterns and relationships. Qualitative content analysis was performed on the discussions and essay question as well to identify patterns and themes (Merriam, 2001). This part of the analysis addressed preservice teachers’ various beliefs about intelligence.
Discussions among the four conditions were selected for further analysis. In particular selective sampling was employed to distinguish dyads that provided rich description and answered questions that illuminated the study through qualitative analysis. I selected dyads on the basis of their pre and post definition of intelligence and the scores of their post essays. Then I examined their discussion responses for length and quality of responses. Convenience sampling initially also included whether a participant was incremental or fixed. Illustrative case studies (Merriam, 2001) were developed after the five categories were established (as described below) and further sampling was employed to distinguish participants place on the continuum. Open-ended answers to the post-test intelligence survey provided the researcher with rich qualitative data. Analysis provided the means to understand both the quantitative and quantitative analysis and prompt future studies about conceptual change and intelligence.

I began by examining the pre and post open-ended answers for the definition of intelligence in the condition that experienced the most change, this was the refutation text plus structured discussion group. The open-ended answers to the post-test intelligence survey provided the researcher with rich data and detail about the units of meaning (Putney, 1996). I used the taxonomic analysis approach outlined by Spradley (1980). Primarily used in ethnographic research, a taxonomic analysis provides a process to create patterns and relationships within categories or domains. Spradley (1980) states that a taxonomy is built with all “the relationships among all the included terms in a domain,” (p. 112). Recall that the rubrics used to score the open ended questions included a list of terms (see Appendices J & K). These terms were developed from repeated vocabulary pulled from the responses of the participants. The taxonomy first allowed identification
of the significant and common themes and then allowed for the development of relationships among the themes.

A taxonomy of the themes was further analyzed including repeated vocabulary, possible references to personal experiences, educational terms, and references to the refutational text. This analysis of the words and phrases of the participants provided the elemental units for the thematic matrix that I built. For instance, participants who used the word or phrases containing or referencing intelligence and its use for “the world” while also discussing knowledge resulted in a different taxonomy than those students who did not reference “the world” but also discussed knowledge (see Figures 10 & 11 for examples of completed individual analyses). Inductive analysis provided the means to understand both the quantitative and quantitative analysis and prompt future studies about conceptual change and intelligence. I developed five illustrative cases to demonstrate the wide range of beliefs the participants had about intelligence and whether it was changeable.

**Building a continuum of cases.** I built a taxonomy and matrix of relationships based on Condition 1 participants’ open-ended answers to the definition of intelligence. I selected Condition 1 participants because the refutational text plus discussion condition showed the greatest change. Based on the taxonomies, I selected five distinct, rich cases showing varied views of intelligence from incremental to fixed. I then examined all of the remaining open-ended responses that these five cases produced including: the prediscussion organizer, their discussion posts, and their final post essay (see Appendices A -I) for these measures. Additional elements were added to the taxonomies based on the additional material. Then I developed the five cases more fully, including demographic
information. I examined each response including their discourse with their discussion partners. Finally, I created a separate and distinct diagram depicting the relationships among the elements in the taxonomy. Based on the final taxonomy, I then created labels for each case that described their views of intelligence. I placed the five cases on a continuum from left to right. On the extreme left was the belief in change and the four remaining cases fell to the right, ending on the most belief in fixed intelligence (see Figure 9). However I extended both tails of the continuum to include cases beyond and/or past the traditional views that I expected.

**Analysis of cases of change.** I chose responses that changed pre to post in the Likert Scale questions in the intelligence survey (see Appendix C for description of these questions). I examined the patterns within the participants’ discussions to see if indications of persuasion existed within their responses to each other. In particular, I was looking for evidence of their use of the refutation text in their responses to these measures. I then wrote up separate cases for three discussion dyads, examining individual change and dialogue between the participants. These three groups were selected on the basis of change in more than two questions, especially change in Question 2 (the participants rated the changeability of intelligence on a Likert scale). I also compared their discussion comments with their individual measures (the prediscussion organizer and the post essay) to look for commonalities and discrepancies.

The first research question in this study was whether preservice teachers viewed intelligence as incremental or fixed. Thus when I began the qualitative portion of the study I first wanted to establish a continuum of views from incremental to fixed to best illustrate where preservice teachers’ ideas lay (see Figure 9 for the placement of cases on
the continuum). In addition the illustration of a continuum of views might help in
designing professional development for teachers when dealing with the construct of
intelligence and the resulting consequences in the classroom. I initially expected to
uncover a much heavier valence towards fixed views of intelligence.

**Five illustrative cases.** The five illustrative cases were developed through the
taxonomic process described previously. I examined all participant responses both
quantitative and open ended to develop the archetypes (please see Appendix N for sample
scoring sheets). After building taxonomies, I then created a prototype or archetype
indicating the views of intelligence for five participants. The five illustrative cases were
provided distinct labels and were placed on the continuum from left to right: Humanistic,
Incremental, Both or Composite, Soft Fixed, and Ultra Fixed (see Figures 10-14 for
examples of each archetype). In what follows, I constructed a narrative to exemplify the
positions related to views of preservice teachers on intelligence. The archetype describes
a model or prototype for each set of stated beliefs. I placed the remaining participants in
each category based on the archetypes however there were distinctions case by case.

**Case #1, Humanistic–Anna**

I begin by describing the archetype for Anna, who exemplifies the Humanistic
view of intelligence. The Humanistic taxonomy, as can be seen in Figure 10, includes the
relationship between knowledge and the world, problem solving, and the importance of
nurturing students and a supportive educational environment. I define humanism
consistent with the dictionary definition, “concern with the interests, needs, and welfare
of humans” (The American Heritage® Dictionary of the English Language, 2000), and
for purposes of this study a humanistic approach positions the self in relation to others.
Anna was approximately 40 years old and was a returning adult Hispanic student. She had junior standing and is majoring in Elementary Education. She has no predefined area of interest. She had never had special education services and had prior experience teaching in elementary school.

Examining Anna’s Likert scale answers showed a consistent agreement on all pre and post items and no change pre to post. Her definitions of intelligence pre and post were very rich and were both scored as incremental. For instance in her predefinition she said “Intelligence to me means knowledge of many things, not just academics. It also includes knowledge about the world around us, how to relate to people, how to handle problems that one encounters.” Anna said that one can have intelligence about art or even “survival.” Anna stated that a “true intelligent person has knowledge about many, many things and is not just book smart.” This answer was written before the refutation text was read.

Recall that the refutation text discussed problem solving; Anna’s response included problem solving as well:

Intelligence is really about one’s ability to solve a problem. If one has difficulty solving a problem, an intelligent person will persist at trying to solve it, trying different strategies until one works. We often don’t see all the effort an intelligent person has put into solving a problem, so it seems that they can figure out answers quickly and that effort is not part of intelligence. But this is an illusion. Effort is a big part of intelligence, and for this reason, students can be made more intelligent if they are encouraged to persist in trying to solve problems and to use different strategies, rather than letting students give up prematurely and saying to themselves, “I don’t have what it takes.” Teachers can also help students acquire content knowledge, which in turn makes it easier for students to solve problems and become more intelligent.

In her post intelligence survey Anna mentioned the role of problem solving in addition to her previous themes of “having knowledge about many things and many
aspects of life.” She said again that intelligence is not just being “book smart” but “having the skills necessary to solve problems.” This is a slightly different reference to problem solving but she clearly considered problem solving prior to the refutation text.

Anna also made another humanistic statement, “Intelligence is being aware of the world around you and society, as well as being academically successful.” It appears that her view of intelligence is not just centered on knowledge but has aspects of humanism as well as altruism.

In Anna’s organizer she reiterated her themes about intelligence. In her arguments for intelligence as changeable, Anna said that “intelligence can be changed because children are always acquiring new knowledge and the mind is forever being stimulated. Unless their education or the brain is hindered children have the capacity of acquiring so much information and as they grow experience new things.” She said that in “a nurturing, creative, and stimulating environment, the intelligence of children can change.” I noticed that she did not refer to humans or adult learning but primarily to children but this could be due to the refutation text’s discussion of IQ scores and the assumption that these tests would be measuring the growth of children’s scores.

In her arguments against she merely wondered:

… if the only argument, or question I have about the reading is whether the students who were mentioned in this article (whose test scores were said to have increased) were students who in fact had been observed for a sufficient length of time, and if so, was the increase in test scores the result of an educator working extensively with them and using a variety of methods to do so? Could the result in test scores be the result of some other factors? The text does say a documented fact that IQ scores have risen throughout the world over the last fifty years, indicated that instruction and education has a profound effect on the typical standardized test.
Anna ended her organizer by saying that she believed intelligence can change in children. She did not believe that IQ tests or standardized testing is “a good measure of intelligence.” Rather she suggested that test anxiety or other factors could impact the testing. She recognized the importance of instruction and says “Teachers should utilize a variety of methods to captivate, motivate and educate children, but they should also use several methods to measure their success.” In providing a humanistic archetype it should be pointed out that Anna used words like nurture, creative, caring, captivate and motivate. These are dynamic, action verbs that indicate her belief in altruism and a supportive educational environment. She also appeared to have a multiple intelligence view as she said, “I define intelligence as having knowledge about many things and many aspects of life.”

Her discussion was with a partner who weighed in as considering intelligence as incremental. They had the minimum amount of exchanges (two) including the conclusion. Both participants used their organizers. They agreed that intelligence could be changed; however both recognized that it takes a lot of effort. Anna stressed that it is easier for children to change especially when they have limitations “whether mental or due to outside influences.” The effort has to come from the child and “from the teacher as well.” Anna asked her partner “Do you believe it is harder to change in older children than in younger? Is it really hard to change? I think it is harder to learn new things, you need a highly functional and supportive academic environment.” Her partner responded that “I do not think it is hard to change in older children than in younger, but as getting older people have their own self concepts which are very strong to change. Intelligence can be changed whether people are old or not.”
When Anna responded to the classroom scenario she discussed their views of intelligence. She noted that Oscar believed that if “you study hard, you can definitely gain the intelligence to be able to pass a test.” On the contrary, Lionel is not confident because “he has never done well.” Anna said that “Lionel has given up on himself and does not have the confidence to succeed.” Lionel may believe that his low scores are “due to lack of intelligence rather than because he did not study hard enough or found productive ways to acquire the information he needed to pass.” Here Anna showed that strategy use as well as confidence is important for success in the classroom and that lack of either could result in feeling less intelligence and or performing at a lower level.

Anna’s approach to helping Lionel included getting feedback from Oscar his successful peer, as well as peer tutoring. In addition she would look at how Lionel studies and trying to make the learning meaningful. Once again she promoted world knowledge and connecting the material to the real world. She ended her essay with a positive affirmation for Lionel.

In sum, Anna epitomized the preservice teacher view of intelligence as being changeable but it is contained within and guided by real world applications and the importance of acquiring necessary information, creativity, nurturing and caring. She was comfortable in her assertions and clearly incremental in viewpoint; however, her responses also carried with them the notion that intelligence encompasses the greater good for self as part of humanity, thus the classification of Humanistic. Anna’s responses were among the richest of all participants.
Case # 2, Incremental – Lisa

Lisa represents the incremental archetype on the continuum that sits to the right of the humanistic archetype. As can be seen in the taxonomy depicted in Figure 11, Lisa’s incremental view focuses on the relationship between intelligence and improvement, particularly the importance of strategy use. Unlike her Humanistic counterparts she did not focus on concern for the world. She was approximately 20 years old, Asian, and has junior standing. She was majoring in Elementary Education and had no specific emphasis. Her G.P.A. was 3.25 and she had come straight through from high school. She had no special education services and had no prior teaching experience.

In the Likert scale questions she made one change that I question as being valid. It was on Question 4 which was reverse scored. According to her answer she first strongly agreed and then on her post response just agreed that all of your intelligence is determined at birth, however she refutes this in her first survey answer, “No one is necessarily born with their intelligence for life.” This discrepancy could be attributed to student error and the latter question was just misread. Recall that answering this question in an incremental way was the opposite of all other questions.

Lisa considered intelligence, “the amount of information they hold and how much they are willing to learn.” She then gave an example, noting that:

. . . a person could be excelling in mathematics and struggling in English. To many, this student may seem intelligent in math, but if he/she is not willing to commit themselves to broadening their knowledge in other areas such as English, then I feel that they fall short of being considered intelligent. This definition features change, effort and “broadening” knowledge.

Lisa’s post answer reflected the importance of life experiences. She also said that intelligence “can be intertwined with the word knowledge.” She saw people has “having
strengths and weaknesses.” Lisa also said that “It is those people who know they are not the best at everything that are the ones who are intelligent in that they are open-minded and are willing to seek new information and ideas.”

Lisa’s prediscussion organizer began with:

I strongly feel that a person’s intelligence can be changed, or for lack of a better word it can be improved. We are born with natural talents and can excel in certain areas, but a person’s intelligence is much more than just how much they know; it also includes how much they are willing to seek to improve in areas where they lack.

This is an approach to learning that utilizes modification and also indicates a view of opportunity for all. Although she mentions natural talents this does not make her fixed as she answered the entire Likert scale questions as agreeing the intelligence was changeable or incremental.

She mentioned the refutation text in the organizer. For instance:

The author of the article, Can Intelligence Be Changed, mentions Albert Einstein and how he would most likely do poorly on a Standardized IQ test and that he even did poorly in school. This is a perfect example of how a person’s intelligence is not necessarily measured by how well they perform in school or how good they are at a particular subject. Also, the paragraph about effort playing a large role in a person’s intelligence is evident throughout the world. People who are persistent and try to figure out problems using different resources and strategies are building their intelligence.

She did not say that she had any arguments with the text at all, and appeared to be just indicating areas in the text with which she agreed.

I found Lisa’s opinion very interesting because she linked some of student success to their teachers (and perhaps their intelligence). She discussed her Elementary Education major and said that:

. . . teachers play a huge role in the success of their students. I feel that a part of their intelligence is fixed and that they excel in certain areas because of biological reasons. But, on the other hand, I also know that with inspiration and a drive to
succeed, a student is completely capable of learning much more than one would expect.

This answer suggested that perhaps she was trying to answer the question about intelligence being determined at birth but missed the qualifier “all” of your intelligence. Lisa did acknowledge some role in biology.

Based on this opinion, her archetype would be closer to the center in allowing for some predetermined ability. However she continued to tell about her poor test taking experiences in school and how she overcame them. She did very well in her classes and pushed herself, “to learn and understand content in calculus, trigonometry, and AP classes in high school, I was able to grasp a lot more knowledge than I knew before.” I would expect this experience led her to disregard IQ and other standardized scores based on her own experiences in school. Perhaps her view of intelligence was equated with learning.

Lisa’s partner was determined to show incremental views. Throughout their discussion they both agreed that intelligence can be changed. Lisa quoted the text again, this time about the importance of problem solving. For example she says:

In the intelligence article that was posted, it stated that ‘Intelligence, is really about one’s ability to solve a problem. If one has difficulty solving a problem, an intelligent person will persist at trying to solve it, trying different strategies until one works.’ I could not agree with this statement more since I can relate it to myself and my efforts when I don't understand a problem. People can either say they are not smart enough to figure it out, or do the best that they can to find an answer using any available resources. Many people may call geniuses like Albert Einstein intelligent, but I feel that real intelligence comes from the knowledge that a person can gain and what they do to acquire that knowledge.

Their discussion was longer than most. Lisa wrote two posts and the conclusion; all were dense, multiple sentences. Her partner wrote three fairly long posts. Her partner also discussed problem solving for instance:
I do believe intelligence can be changed because it is not a merely a rating of how smart you are, but, it is an indicator of your ability to learn, and problem solve which, can become stronger with time and or practice.

Her partner also referred to the article’s mention of perseverance and “that we can help students build and practice that skill-making them more intelligent.”

These two students engaged in a more original discussion even though their ideas were complimentary. Their responses to each other were not just echoes of their organizer and seemed more spontaneous.

In Lisa’s post essay discussion about the scenario she found that the Lionel and Oscar have a “different outlook about their performance on the upcoming physics test.”

The role of the teacher was very important to Lisa and she stated:

As a teacher, I would always want to encourage students to put as much effort forth and to study for a test with confidence…In order for students to become more intelligent, I believe they need to have an optimistic mind set and be surrounded with the right kind of motivation and environment.

That appears to be an incremental statement.

In Lionel’s (this was the stronger, more successful student) case, she said that:

As his teacher, I would want to encourage him to use his available resources like myself and other things like his textbook and his peers. I believe a student that seeks help is one who is intelligent and is yearning to learn much more.

Lisa writes an incremental statement and focused around effort from the student.

Lisa’s incremental position represented the most common point of view among the participants of the study. However she differs from the Humanistic archetype in that she talked more about academics than the world.

Case # 3, Composite Incremental and Fixed – Claire

Claire is the composite archetype just to the right of the center on the archetype continuum. As can be seen in the taxonomy depicted in Figure 12, Claire had a mastery
view of intelligence. She viewed intelligence as something acquired, but something that is also influenced by life experiences and personal attributes. She linked experience, association and time as part of life’s lessons and saw experience as a result of lessons learned from trial and error. Personal attributes such as hard work, drive to succeed, perseverance and confidence all are part of the ability to acquire knowledge. She did not see intelligence as necessarily changeable. Instead she saw intelligence as a fixed trait that could be adjusted through experience and personal hard work. Claire also stated that quick learning is not necessarily intelligence (see Figure 12).

She was approximately 25 years old, Caucasian and has senior standing. She was majoring in middle school and had an emphasis in English. Her G.P.A. was 3.2 and she came straight through from high school and had never received special education services nor had any teaching experience.

In her Likert scale answers she only changed on one question. She went from agree to strongly agree on Question 2, which was the rate your views on intelligence question. As I describe throughout this section, question 2 received the most change of any measure, approximately ten participants in Condition 1 increased their support for the changeability of intelligence. Claire’s definition of intelligence pre was “Intelligence is not something that you’re necessarily born with; it is something that’s established over time with how much you’re willing to learn.” Her post definition was much richer but still incremental and fixed. Claire indicated that:

. . . intelligence is something that is acquired through experience, association and time. Life can make us more intelligent through its lessons and trial and error. Also, intelligence can be acquired through hard work and perseverance. Anyone who has a drive to learn will accomplish their goal eventually.
Her themes were effort, perseverance, life lessons and experience. In addition she referred to how an existing base of knowledge can change.

Her prediscussion organizer started off with the statement that intelligence can be changed. Claire said:

Although past researchers have said you’re either born smart, or you’re not, there’s nothing that says you can’t develop more knowledge over time. Knowledge is something that is acquired through time and energy. No one is born with all the information in their head.

Claire stated that although some people may learn quickly than others that did not mean that those that learn less quickly cannot learn the information. Indeed persistence is important and if ones sticks to and/or is motivated to learn they can be successful. She did mention that there are “exceptions to this rule such as people who are mentally retarded or have a serious disorder, but the majority of people who want to learn, can do it with the right tools and dedication.” She had no disagreements with the text and her opinion was that “intelligence can be changed with hard work and perseverance.”

Claire’s partner was identified as incremental. Their discussion was the minimum two posts each and a conclusion and was complimentary rather than dynamic. However, Claire did expand on her organizer comments by elaborating on the role of knowledge after her partner said that “Knowledge is the fact or condition of knowing something with familiarity gained through experience or association.” Her partner began with a definition of intelligence from Wikipedia. The definition of intelligence is the capacity to acquire and apply knowledge (http://en.wikipedia.org/wiki/Intelligence). Claire reacted with a comment that “Knowledge is a tool that comes from wanting to learn. In conclusion, anyone who wants to learn can become more intellectual throughout time.” Both of these students talked about birth and existing knowledge as well as limitations to your intellect.
due to lack of effort, developmental issues or lack of experience. Therefore I placed Claire in the center as a composite between incremental and fixed views of intelligence.

Both partners agreed that “intelligence is gained through experience and association.” Her partner said that “Even the so called ‘smartest’ person in the world can’t just sit on their butt, and expect to acquire knowledge; they have to get out there and learn the material.” Claire’s post essay did not reply to the student’s views of intelligence although she did reiterate that:

... when it comes to intelligence, anything can be learned if you are motivated enough. Taking the time and effort to learn the material for the test is very smart, because Oscar knew that the only way to improve his intelligence on the material was to study for it.

She posited that Lionel’s problem is his attitude, for instance, “anyone with that type of attitude, and non willingness to try, is going to fail at their efforts.” She said, “Anyone can improve a situation by reprogramming their mind. After all, intelligence is all in the brain!”

I placed Claire on the composite viewpoint, highly active but determined by experience, and personal attributes such as perseverance, drive, hard work and confidence. Unlike the previous two archetypes for incremental and humanistic Claire clearly believes in beginning knowledge and possible limitations to changing intelligence. Claire’s answer also suggested beliefs in multiple intelligences, or that some students are better in different areas. She asserted “anyone who wants to learn can become more intellectual throughout time.” She was neither completely incremental nor fixed. Claire appeared to have a pragmatic, mastery view of intelligence.
Case # 4, Soft Fixed or Quasi Fixed- Felicia

The archetype for the fixed view of intelligence has two examples. The first is a soft fixed and is placed on the continuum closer to the composite archetype and distinctly different from the hard fixed archetype on the right edge. As can be seen in the taxonomy depicted in Figure 13, Felicia had a complex view of intelligence. She viewed intelligence as an ability, and therefore somewhat fixed, but she also recognized the influence of instruction on intelligence. However, the influence of instruction is indirect, and can only result in improvement, not significant change. I consider this view important because it is represents a willingness to accept improvement but it is pragmatic to accept that significant change may not be practical or realistic in a classroom. Felicia was approximately 30 years old, African American and was not an education major. She did not specify her emphasis and had a G.P.A. of 3.7. She was an adult returning student and had no special education services. However she had prior teaching experience in preschool. Felicia had a lot of change in her quantitative measures. Her scores according to my rubric changed from an incremental score to a fixed score in her open ended intelligence answers, for instance: “I would tend to agree with the Webster Dictionary’s definition in that it is the ability to learn and understand and/or to deal with new or trying situations.” However her post answer was more fixed, no mention of learning or adaptation. Instead her answer was “The ability to apply and process knowledge.” Recall that ability and processing of knowledge was considered by the raters to be a fixed or biological response.

Her Likert responses changed on all four measures. She first rated the changeability of intelligence as agree and then she changed on her post response to
strongly agree. Her answer for Question 3, *Can you be made smarter through instruction?* was originally strongly agree, she then reversed herself and changed to strongly disagree on the post survey. Question 4 was, *Is all of your intelligence determined at birth?* Question 4 was reverse scored. Felicia’s answer was originally not sure and then she changed to agree. On Question 5, *Can instruction raise your intelligence?* she went from agree to strongly agree on the post survey. Her response to Question 3 was contradicted by her previous comments. I feel uncertain about suggesting that she really did change except in the three cases where she maintained agreement and just increased the strength. These were in Questions 2, 4, and Question 5.

In her prediscussion organizer she stated that intelligence can be changed and praised the text for illustrating how this could happen. She posed a question:

> For example what would teachers do if intelligence were predestined at birth? There would be no reason to teach nor would there be an act called No Child Left Behind. I do agree that our educational system relies too heavily upon standardized tests. I would even go as far as to say that those tests can be gender bias and equally discriminatory.

However incremental this answer may seem, she was contradictory. For instance her discussion postings were more incremental but when she replied individually she viewed intelligence as fixed.

Felicia argued that effort and intelligence do not have a direct correlation. Felicia “would have to acknowledge that (some have) strength or intelligence in that particular area is better.” I think she was trying to say that effort does not make up for intelligence. She did say that “intelligence is directly linked to instruction and experience.” She may be an example of having slight incremental ideas but deep down believed in fixed
intelligence. When she talked about instruction and change in the classroom, it was improvement not an actual intelligence change.

In her discussion Felicia agreed with her partner that intelligence can be changed and continues to give conflicting ideas. On the one hand she said that a “child will learn through effort or through aptitude.” But she also said “I do believe we may be born with or without the capacity to learn but I don’t think that weighs heavily on our ability to learn.” She believed that standardized tests also assess your experience and even status. She had a good example of this as follows:

For example if a standardized test asks a question about football in relation to mathematics and you are not that familiar with football then how do you answer that question and if you get the question wrong does that mean you aren't intelligent?

Her partner was incremental and also quoted the refutation text, in particular Albert Einstein.

Felicia’s partner changed her rating of the changeability of intelligence from a strongly agree to agree and she changed her answer to whether instruction can raise intelligence from agree to strongly agree. They both mentioned the role of instruction, in their conclusion they agreed that “intelligence can be learned.” This statement reflects the overall message of Felicia’s views on intelligence.

It appeared as if Felicia’s answers were more incremental in the discussion however she was all over the place, more so than any other participant. Felicia in her post essay did not discuss views of intelligence and really only concentrated on two factors, the student’s confidence versus effort. In her view it was confidence not effort that makes the difference. Her post essay placed her more firmly as a fixed believer however she was contradicted herself but remaining firmly fixed in all of her definitions of intelligence,
therefore I placed her very close to the middle composite view. Felicia had a strong belief in instruction and performance. Performance has been noted by Dweck, Chiu and Hong (1995) as closely linked to entity views. Her case is important because her case illustrates how unsure preservice teachers’ may be about the construct of intelligence. Bredo (1992) has stated that if psychologists are unsure of what intelligence is then educators might be similarly confused. In addition the underlying strength of biological or fixed intelligence views may trump optimistic or academically learned views. Thus preservice teachers may vacillate between these types of beliefs depending on the situation.

Felicia’s answers although contradictory appeared to indicate that she felt that intelligence was predetermined. She differentiated between ability and improvement. She mentioned being born with intelligence but does indicate a willingness to accept that students can learn and improve. She did not equate that with changing intelligence but merely improving through instruction. Felicia might be an example of what Dweck et al. (1992) posit as the ability to have two opposing views of intelligence. Perhaps she viewed her own ability as one or the other, but maintained a separate view for the classroom. Unlike the majority of incremental believers, Felicia did discuss existing ability rather than everyone’s ability to become intelligent. I interpreted her viewpoint as seeing change as the addition of knowledge and better academics but not an increase in intelligence. After reading all of Felicia’s comments I therefore placed her as a soft or quasi fixed. I found her confusion when answering questions to generally fall back to the fixed viewpoint however it could be that the term intelligence for her has many meanings. She clearly focused more than any of the other illustrative cases on the role of
instruction, the role of the teacher and she was the only case to talk about performance (see Figure 13).

**Case # 5, Ultra Fixed or Strong Fixed- Susan**

Finally, I present the strong or ultra fixed view of intelligence. As can be seen in the diagram depicted in Figure 14, this participant considers intelligence as determined at birth. Intelligence is viewed as an ability used for the processing of information, storage of data and IQ is merely a predictor for this ability. Susan noted that study effort for some students will have to be greater and that strategies can make up for some lost ground. A teacher’s main role is how to use intelligence. Susan’s view is in contrast to Felicia’s views that included belief in instruction and the indirect influence intelligence has on teachers, the students, instruction and experience. That is why Susan is considered the most fixed and was placed at the far right on the continuum (see Figure 9). Susan was actually dropped from the quantitative analysis as an outlier (see Figures 5-6). I believe that looking at her open-ended answer helps to explain why she was an outlier. Susan was a Caucasian junior approximately 35 years old. She did not specify her degree area but was majoring in Special Education. Her G.P.A. was a 3.28, she was a returning student and received special education throughout her schooling experience. She had elementary teaching experience.

Her predefinition of intelligence was fixed, for example: “How a person takes in (process) information and stores the information for later use.” Her post answer is more fixed, however she strongly believes in instruction’s role to harness intelligence. Susan said that “Intelligence is a predetermined ability that cannot be increased. Your ability to
access your full potential is increased through teaching.” Susan believed instruction helps but she did not equate academic improvement as being equal to intelligence change.

In her organizer one can see what her views were:

I do not think your intelligence can be changed. I think when you are born you have a predetermined (hereditary) amount of intelligence that you will eventually have access to, as your body matures and you go through school. I view your intelligence or IQ test, to be your potential ability. How you access it or how good you are at using it, is where I think education has an impact.

After this statement she refuted all the evidence in the refutation text. “1st) – I don’t believe that IQ scores have “risen throughout the world.” 2nd) I don’t think if a person “persist in trying” they are more intelligent. 3rd) I don’t think “Intelligence can be changed!” Recall that this is the section of the organizer where students were instructed to put down arguments against and whether or not they agreed with the text.

In the opinion section she continued and enumerated her disagreements with the text. In the interest of letting her words speak for themselves I am placing the whole quote here.

#1 I would want to see the proof that IQ scores have risen. In order to prove that statement you would have to have the same testing scenarios, across the world -impossible, and have access to that information – impossible.
#2 If a student has learned different problem solving strategies, than that student would be more apt to use those strategies to try and find the answer. He would be more inclined to keep going, instead of returning to the teacher. You could have a more intelligent student, who has not had access to different problem solving strategies or has not been rewarded for taking risks in class, who cannot keep looking for the right solution because of his classroom experiences.
#3 If you take an IQ test when you are three, nine, fifteen, and then twenty one it will not vary by more than 5-10 points. Even if they are different tests. If you fall into the average range on one test, then you will fall into the average range on the next one too. I know there are people who are exceptions to this, but for the majority this is true. We learned this in Psychology 101. In my family, including myself, the IQ’s that we had as kids are not more than 5-10 points different than what we have now - This is true of my children as well.
Since the refutation text did not have cites or specific data she may have seen the article as unsubstantiated commentary. However I think that her continued *impossible* comment after some of her points (such as IQ have risen, intelligence is changeable) indicates her firm belief in the fixed view of intelligence. In her discussion she was paired with a strong incremental student who was not swayed by the fixed tone of the discussion. Susan used her organizer and pasted the whole into her response. She did add that “it is the teacher’s ability to teach students how to use their intelligence is what changes through the school years, and beyond.”

Susan’s partner agreed with that statement but disagreed with her other statements. Her partner said:

But I do not think that people cannot move beyond what they are born with. Sure people naturally possess a higher level of thinking. There are always people who are better in some subjects and those who struggle. But people who struggle shouldn’t give up because they will never get any wiser. They need help seeing new ways to understand things. Teachers can help open the doors to all types of people by being responsive to students’ strengths and weaknesses. But I firmly believe the people all have the ability to improve. No one is predestined to be stuck in a certain bracket because of their IQ test results.

Susan wanted to make sure she understood her partner’s point and wrote “so you think teachers can improve their students IQ?” Her partner said:

No that is not what I am saying. I just don’t think IQ scores are the most relevant measurement. I am saying that people have the ability to improve and learn. Look at students with autism, for example. Years ago those children were cast off as worthless, and now we have learned that these children can learn and improve! It’s a matter of finding ways to reach everyone.

Susan disagreed:

I think your IQ, even the Autistic children you referred to, will not change. I believe the Autistic children you are talking about did not increase their intelligence, but did improve in their ability to process their environment through behavior modification. I think you and I agree about this issue.
Notice that she then claimed that the two agree on this issue. Nowhere was agreement mentioned and these two students did not post a conclusion. Susan was not ready to accept any other opinion and saw agreement when there was none.

Examining Susan’s post essay purely focuses on study habits and emotional or clinical issues. For instance as far as Lionel is concerned she said:

As Lionel’s teacher, I would want to talk with Lionel individually to see if anything was going on at home that might be interfering with his school work. Then I would check his school files to see if this had been a concern in any of the previous school years.

Not another of the one hundred and three participants brought up this issue.

Susan also mentioned that one student had a higher natural ability than the other. However she still said that with twice as much work Lionel could get the same grade. She did encourage peer tutoring and seemed very concerned about the student’s progress. She did not discuss intelligence at all. Her answer was mainly pedagogical and perhaps similar to school psychologists. Susan was very comfortable with her position on the subject yet I think she was unwilling or able to consider the possibility of an incremental view of intelligence.

**Final Relationship Summary**

All participants in Condition 1 were assigned to a category based on my initial illustrative case studies. The humanistic and incremental categories both had 8 participants, 6 participants were categorized as both/composite, 5 were categorized as soft fixed, and only 1 participant was included in the category ultra fixed. I created a relationship Venn diagram (Figure 15) to summarize the five illustrative cases. The humanistic category featured statements caring for the world and others, and how intelligence is used in that capacity. This category also featured knowledge, the role of
personal attributes, the influence of others and multiple intelligences. A typical intelligence definition was “Intelligence is not only book smarts. It is also how you relate to the world around you.”

Incremental participants wrote about a willingness to learn, the broadening of knowledge and saw natural ability plus the role of personal attributes. An example of an incremental definition describes intelligence as “being able to use your knowledge to learn more information and make connections from what you have already learned and believe in, as well as, using your life experiences to discover new things/situations etc.”

Both or composite participants described the role of experience, association and time. They mentioned one’s capacity to learn, limitations due to biology, mastery of learning, and the role of personal attributes like effort. One participant described intelligence as “a person’s aptitude in mental knowledge such as problem solving and IQ together with cognitive and inter/intra personal knowledge.”

In the soft fixed category participants were actually closer to the composite category than to the ultra fixed. They described intelligence as more of a processing and storage function. They also highlighted their belief in instruction and talked about performance rather than mastery. Personal attributes also were important. This category saw intelligence as “how smart one is” or as simply an ability.

Finally in the ultra fixed category, intelligence was seen as a predetermined entity but that its use is taught. Education or instruction therefore is how you reach your potential. This participant wrote that you were born with intelligence. It could be argued that the five categories have much in common as far as how the participants saw the role
of personal attributes such as effort and motivation. Their differences appeared to have more to do with the role of intelligence and the type of words that they used to define it.

**Illustrative Cases from Dyads Showing Conceptual Change**

**The case of Irene and Jerome.** Participant Irene was a female in her thirties. She was African American and a sophomore. She was majoring in an unspecified subject and was not an education major. Her GPA is a 2.5 and she was a returning adult student. She never received special education services and had prior teaching experience in preschool. Her answers for the pre and post open ended intelligence question demonstrate a clear acceptance of the ability of intelligence to change. She said that “intelligence goes beyond a person’s mental capabilities…” For example she stated that “intelligence is physical, emotional and mental. It’s being able to use your own mind to reason what is true to not and being able to back up your opinion.” She also referred to the role of effort in learning in her post intelligence definition.

Irene’s scores for three of the four Likert scale questions were changed in her post test. Recall that the four Likert scale questions asked participants 1) to rate the changeability of intelligence, 2) if you could be made smarter through intelligence, 3) if all of your intelligence was determined at birth and 4) if instruction could raise people’s intelligence. Irene went from not sure to strongly agree for Question 2 about the possibility of intelligence to change. In her response to Question 3 she changed from agree to strongly agree. On Question 4 she changed from agree to not sure. On Question 5 she changed from not sure to strongly agree. The score for Question 4 could have been a mistake as her comments in all post measures were strongly in favor of intelligence not being determined by birth. Recall that Question 4 was reverse scored so this could have
confused Irene. In other words the expected Likert scale answer for all the other questions in favor of incremental views would have been a 4 or a 5 (agree or strongly agree). For instance Irene said that when discussing Lionel’s view of intelligence (the less successful student) that “he is what most critics would say fall under their argument that people are born with their intelligence but this is not so.”

Irene’s organizer was dense and well thought out. Recall that the organizer was to be completed individually in preparation for the coming discussion. She completed all three parts (arguments for, arguments against, and your opinions). She clearly stated her belief in change. She mentioned Albert Einstein’s trouble in school and other themes from the refutation text such as the importance of problem solving and effort. For example, “How do we explain why some students who don’t do well during the school year can do so great on SAT’s.” She also recognized the role of student interest in learning and retaining information. She described intelligence as “one’s knowledge and the more they put an effort into learning, the more knowledgeable they will be.”

Irene also provided a thoughtful rationale for the argument that we are born with our intelligence and it might be said to be unchangeable; for example, “This can be true if a person is locked away from birth and has no outside social contact and cannot be influenced by anything.” She did not believe that there is enough evidence to support the fact that intelligence cannot be changed. In her opinion heredity alone does not explain how people improve and learn things. It is “not just test scores.” Irene felt that the “environment is continuously changing and animals and humans are continuously evolving and adapting.”
In Irene’s discussion she was randomly paired with a participant with incremental views. Although she was not the first respondent, their discussion was positive, however brief. She used her organizer in particular elaborating on the role of the “brain as a powerful muscle.” She mentions the theme from the refutation text’s assertion that problem solving is really intelligence. She posited that then “anyone who puts effort into solving a problem is intelligent.” The conclusion that both members agreed on indicated that intelligence was changeable if “the individual puts the effort into challenging themselves in learning new things which in turn will increase their knowledge.”

Irene’s post essay received an incremental score and a 3 for holistic quality. Recall that the quality of the post essay involved answering all parts of the prompt discussing the student’s views of intelligence and providing a solution for the teaching scenario. Scores ranged from a 1 (poor) to a 3 (good). She reiterated some of her comments from the discussion organizer and her discussions such as the role of effort, problem solving and that test scores can be raised through work and goals. She discussed that the student may associate previous work with failure and that he needed to use positive reinforces as well as her (the teacher’s) help to improve. Lionel, the struggling student in this scenario she saw as what critics call an example of a person born with low intelligence. She said that this is not so and that Lionel just felt like he has no control over his results. She wrote a perceptive and thoughtful post essay using her knowledge of intelligence, motivation and pedagogy. For instance Irene said that “I would suggest he study and review to see if he understands what is being taught…He might not be able to process the information since every student learns differently. I would encourage him to put more effort into his work and set a goal.”
Irene began the study as a believer in the incremental view of intelligence. However she indicated strengthened beliefs at the end of the study. She also referred to the text in her organizer, discussion, and in the post essay. She had an active and dynamic view of intelligence. She fits within the incremental illustrative case example highlighting knowledge and perseverance for improvement. Recall that this case focused on the elements of willingness to learn, broadening of knowledge, the teacher’s role, and effort and optimism (see Figure 11). Irene’s directions to her students in the post essay reflected the use of these five characteristics.

Her partner was Jerome. He also changed in three areas during his post intelligence survey. He was an African American male student over 50 years of age. He was a senior and majoring in undergraduate education, his area of interest was not specified. Jerome was also an adult returning student, had never received special education services and has taught in secondary school. In the four Likert scale questions this participant also changed his score on Question 2 and rated his view of intelligence being changeable from agree to strongly agree. He also changed in the same direction on the question about whether you could be made smarter through education and also changed to strongly disagree that all of your intelligence was determined at birth.

Jerome’s answers for the pre and post intelligence survey Question 1 did change from completely incremental to a more composite answer involving birth and the acquisition of knowledge. This participant did refer to existing knowledge in both answers and was less incremental than Irene. His organizer was shorter and less complete. Jerome found no argument with the refutation text. His arguments for were merely an affirmation statement that intelligence can be changed. He stated that
intelligence could be changed “if the person challenges their mind to learn new things.” Like Irene, he ended with the importance of problem solving (another indication that the text was useful for both of these participants in their discussion). For example he said that “I believe that intelligence can be increased if a person challenges their mind to learn new things and then uses the knowledge acquired along with the current knowledge to solve problems.”

Jerome also pasted parts of his brief organizer in his first discussion message. There was no prolonged discussion between the two participants; the discussion was simply two messages from each and then a conclusion. It should be said though that there was no dissension so they may have felt that prolonged answers were not necessary.

Surprisingly enough, the post essay answer by Jerome was quite long and very thoughtful. He may have felt more comfortable with this case study rather than writing just about intelligence. Jerome also received an incremental score and a good score for the holistic quality. He wrote about study habits and effort. This participant saw Oscar (the more successful student) as having a view of intelligence based on effort and the resulting increase in intelligence. His view of Lionel reflected his understanding of strategy use, peer review, time reviewing test items, and the role of the teacher. For instance Jerome said “…I would advise him to read all of the questions thoroughly… would recommend that he ask Oscar what study methods he employs…would ask Oscar if the test scores reflected the amount of study effort he did.” Here he seemed to point out that there are many facets of successful study and he brought the more successful student Oscar in to the picture. Jerome agreed with Irene, his partner that Lionel’s view of intelligence was that he was born with a certain amount and cannot improve. He said that
“Lionel, on the other hand appears to believe that his level of intelligence is based on what he was born with and that no matter what he does he cannot improve on this level of intelligence.”

Jerome’s model would also be the incremental model. He agreed with most of the elements; however he may have been more likely to shift towards a view that is both fixed and incremental, as he mentioned birth and innate knowledge more often than his partner. His first definition of intelligence was “the amount of knowledge that you have obtained in your life combined with your innate knowledge.” Later in his post answer he said “intelligence as the knowledge an individual is born with and the knowledge they acquire throughout life.”

Irene and Jerome changed the most while still maintaining an incremental view. The discussion did not show any kind of indication towards greater change, however it appears evident in both of their Likert answers, although not as obvious in their open-ended questions. Their post essays however did reflect the organizers as well as the refutation text as being influential.

**The case of Leslie and Gina.** The other two complete discussion pairs that I will be discussing are partners Leslie and Gina and partners Emily and Shannon. Leslie was female, approximately 25 years old. She was a Caucasian Junior studying English for Secondary Education. Her GPA was 2.5; she had come straight from high school and had never received special education services or had prior teaching experience. In the Likert scale questions she changed on Question 2 from agree to strongly agree. On Question 4 she downgraded her answer from strongly agree to agree. Recall that this question was reverse scored and this may have been the reason for the change in score, compared to
her answers on all other questions this response appears to be an anomaly. Question 5 however mirrored her response to Question 2, moving from agree to strongly agree.

In Leslie’s first open ended intelligence question, she stated that “intelligence is measured by tests.” Then she refuted this statement by giving examples of people who are stronger in one domain than another such as math or reading. For instance she also referenced “that there are those that may be intelligent in ‘real world’ situations such as changing a tire or balancing people’s money.” Her summation about intelligence was that “intelligence is a measure of many different aspects of life.” In her post response there was little difference except for a claim that intelligence can be changed: “I feel that intelligence can be changed and also learned by one’s self.”

Leslie had an interesting concept in her discussion organizer. I found it interesting because she described growth as synonymous with change. She said, “When I say grow I mean that people change and develop their own sense of beliefs.” Indeed she also claimed that “people are responsible for their own intelligence because they are the ones that have to pursue the act to learn.” She credited both education and personal will as agents of change. She had no arguments against intelligence changing. Leslie refuted this statement by saying, “I am against the fact that people would believe only one sided, and that intelligence may not be able to be changed.” Again she brought up the concept that intelligence should be measured in other ways. Leslie mentioned that intelligence is learned over time and that there is “not one right answer.”

Curiously Leslie’s partner in the discussion referenced the refutation text quite frequently including the claim that IQ scores have risen throughout the world, the importance of problem solving, and effort. Leslie mentioned only effort from these
refutational facts; however, these statements from the refutational text may have been influential in her shift on the two answers. Leslie’s discussion comments derived from her organizer responses. In particular she reiterated that standardized tests should not be the only measure and that people’s experiences and growth impact their intelligence. For example she said “You are always growing, learning new things, having new experiences, and so much more that your intelligence is constantly being altered to these, to adapt to all of these ongoing changes. Intelligence isn’t only what standardized tests measure.”

Leslie said that “with effort toward intelligence, it can be changed from birth all the way up even though adulthood.” Leslie saw no evidence that change did not occur, “collectively we feel that there seems to be substantial evidence toward intelligence changing over time in a person.” Paired with a partner who had an incremental view, there was little give and take, mostly assertions and agreement. There was the minimum of posting although the responses were several sentences long.

Leslie’s post essay was scored as incremental and received a holistic score of 2 for fair quality. She considered Oscar’s view of intelligence to be linked with studying and a personal view of expanding his intelligence. She said that Lionel did not have a view of intelligence. She recognized the effect that low test scores have on a person’s self esteem as he felt that he cannot improve. She mentioned strategies and the use of personal stories to motivate the student. For instance, Leslie said that “Lionel seems discouraged and that whatever he does will not matter because his test scores are always low. If Lionel was my student I would encourage him and try to relate a personal story about myself to him.” Her pedagogical solution was also to boost his self esteem and
increase his confidence. Leslie also falls under the incremental model. Leslie’s partner Gina was approximately 20 years old. She was Caucasian, a junior in standing and was majoring in Elementary education. She did not specify an area of interest, had a 3.7 G.P.A., came straight from high school, had special education services throughout her K-12 years and had no prior teaching experience. She only changed on question 2, moving from agree to strongly agree.

Gina’s answer for the open-ended question 1 involved using knowledge to learn. For example she defined intelligence as “being able to use your knowledge to learn more information and make connections from what you have already learned and believe.” Gina also cited the role of experience and the discovery of new things. Neither of her pre or post answers specifically referred to changing intelligence but she did say that knowledge changes as you learn new information and “put it to use.”

In Gina’s organizer there is an indication of the effect of the refutational text. She cited the text’s comment on the rise of IQ scores due to increased educational opportunities. She also referred to the text’s assertion that the ability to problem solve is real intelligence, writing “We often don’t see all the effort an intelligence person has put into solving a problem, so it seems that they can figure out answers quickly and that effort is not part of intelligence.” Gina said “it would be very damaging to only consider formal tests and not to consider other indicators of student abilities such as: class assessments, portfolios, classroom discussions . . .” She was one of the few students who referred to multiple forms of assessment. Like her partner she asserted that intelligence is much more than standardized tests and that it grows and alters with new things and experiences.
Gina’s discussed the ability to grasp information faster than others. She said that “it can be a natural way of grasping information much faster than others such as having a natural talent, but it still requires learning techniques and going through trial and error.” Gina elaborated on this thought by referring to the fact that the issue in learning that is not predetermined is how some learn faster or slower depending on the complexity of the material. She referred to the blank slate and how the child was raised (this is in reference to Leslie’s comments about experiences assisting growth and the presence of others, she did not explicitly mention the blank slate).

As previously mentioned, Gina’s part in the discussion with participant Leslie was not dynamic, merely complementary; however, she also used portions of her discussion organizer to relate her thoughts about the question. In examining her post essay response to the teaching scenario, Gina saw both students as different and that this difference was also reflected in how they learn. The positive experiences that Oscar has have reinforced his strong study habits where as Lionel may have lost confidence and or had test anxiety. Gina mentioned that “some students are just great test takers and others struggle to retain information” even if they use the same study methods. The difference between the two students in her opinion was that “Oscar is able to retain and use his prior knowledge to be confident in taking his test.”

Gina saw intelligence as being affected by confidence, person’s thoughts, or feelings, and that these elements can get in the way of how a person’s learns. She also fell under the incremental model. Gina’s time with special education may have influenced her answers and certainly could be influential in her descriptions of Oscar and Lionel’s classroom testing scenario. Leslie changed the strength of two of her four answers. She
changed her view of intelligence as being changeable from agree to strongly agree. Leslie changed her answer to Question 5 whether instruction could raise people’s intelligence from agree to strongly agree. Gina changed only on Question 2, she changed from agree to strongly agree.

The case of Emily and Shannon. The final complete discussion pair I examined was Emily and Shannon. Emily was approximately 20 years old, a Caucasian female or junior standing. She was also an elementary school major with no specific area of concentration. She had a 3.1 G.P.A., entered college straight from high school, never had special education and had no prior teaching experience. In the Likert scale questions she changed on Question 2 relating to the changeability of intelligence from disagree to a strongly agree. She changed from agree to strongly agree on Question 3 whether one could be made smarter through instruction. She answered Question 5 against her opinions both for pre and post. Recall that Question 5 was whether instruction could raise people’s intelligence. I suppose that she may have misread it and therefore I do not consider it a valid change indicator. For instance she says that “I know from experience that one can learn and grow through teaching, I have done it. Every class I have every day, every year I learn more and gain more knowledge.” She may also have been confused by the reverse polarity of Question 4.

Emily’s pre intelligence definition said that “intelligence is not necessarily how smart someone is or is not or even how much they know.” She saw it as a combination of capability and willingness to learn more. Her post intelligence answer was similar but she adds that one can. . . “gain knowledge through instruction and encountering new things.” Her prediscussion organizer started out with her agreement that “Intelligence CAN be
changed.” Note her capitalization and emphasis on the word *can*. Emily said that there may be a mental capacity for “only so much information,” which I see as a storage issue or working memory capacity, however, she said that people are not born with a set amount of intelligence. She mentioned her own experiences and said that “one can learn and grow through teaching.” Emily had no disagreement with the text and found that it backed up her previous answers in the surveys. Emily also commented that willingness to learn may be more important that a lot of people think when measuring intelligence.

She used her prediscussion organizer to start off in the discussion but unlike the other participants that I am focusing on, she responded to her partner Shannon in a novel way and elaborated on her comments. For instance she liked the fact that her partner said that there was no gene for intelligence. Emily also discussed her current course of study, in particular a class for students with special needs. She speculated that students with special needs may have some other influence that “stunted their intelligence.” Emily was sure that students can learn and become more intelligent but that they “may only mature to a certain intelligence. That is why as teachers we can aide them to be successful and expand their intelligence.” When Emily refers to maturing to a certain intelligence I believe she is referring to IQ, perhaps because she has had experience with special needs children. Emily said in her discussion conclusion, “There is not a certain gene that people are born with that says, how much or what level of intelligence they will have. Intelligence is improved though everyday challenges and experiences that students, and people, are willing to take on.”

Emily and Shannon had six total posts for discussion. They agreed on the changeability of intelligence and also on the importance of the teacher’s response to their
students. Both had strong altruistic feelings associated with teaching. A typical exchange was this example where Shannon states “Children with special needs need attention and more help so as teachers it is important to be passionate about what we do. Intelligence is gained and learned through experience so as teachers we need to help everyone as much as we can. I think it is great that you work with children and helping them, it must be a good feeling knowing that you are helping others.” Emily replied, “I also agree and know as teachers that it is our responsibility to model this for all of our students so they believe in themselves and are willing to learn and improve their level of intelligence.” Shannon did not change in any of her scores pre to post and remained steady in her convictions in all other measures, however, the strength of her answers in the discussions may have influenced Emily’s responses.

Emily’s post essay received an incremental and good score for quality. She gave a positive but fair message to both students about preparation combined with real knowledge. She also reassured Lionel that he can still do well despite past low scores. Then she said:

As a teacher I would make sure that all my students were aware that intelligence is not a fixed level or number. They are ALL capable of getting passing scores on every test, in every subject. I would remind them all the time that just because they feel like they always fail or their parents or other students may tell them that they are not as intelligent as everyone else that they are just as intelligent as they want to be. A student can learn as much as they are willing to learn.

Emily directly passed the task of intelligence back to the student; she provided them an active component as well as an emotional one. Both students fall under the incremental model although they would be closer to the humanistic one as they mention feeling good about what you do and being passionate about teaching. But she believes that all students are capable of passing every subject. This belief is probably not
pragmatic considering the vast differences between students enrolled in public education. Her views about intelligence may change when she becomes active practicing teacher. Emily changed the strength of her agreement on Question 2 and Question 3. However she answered Question 5, which asked if instruction could raise people’s intelligence, as a “disagree,” in contrast to her pre and post definitions of intelligence; therefore I do not consider her response to Question 5 valid. Shannon did not change at all; she remained firmly incremental.
CHAPTER 5

DISCUSSION

Introduction

I begin this chapter by summarizing the findings of this study in the context of the research questions. The discussion describes and explains the significance of the results about preservice teachers’ views about the changeability of intelligence and whether shifts in conceptual understanding could occur through a structured intervention. Change is more likely when the learner engages deeply with the content (Patrick & Pintrich, 2001; Pintrich, Marx & Boyle, 1993; Sinatra & Mason, 2006). Recall that conceptual change theorists suggest that change is difficult and occurs best when cognitive conflict is promoted or deep processing is engaged (Dole & Sinatra, 1998; Posner, Strike, Hewson & Gertzog, 1982). I also discuss the educational implications of the results in regards to the use of refutational texts plus structured discussions. I conclude with a discussion of the limitations of this research study and suggestions for future investigations.

Summary of the Findings

The examination of participants’ views of intelligence indicates that the majority considered intelligence incremental (or changeable). In addition the most effective educational intervention to increase conceptual change toward an incremental view was the combination of refutational text plus structured discussion. The refutational text and structured discussion group changed the most perhaps due to the combined effect of the persuasive text and the organizer’s role in allowing students to reflect and prepare their responses before they engaged in the actual discussion. The refutational text may also have provided additional background knowledge for the participants which could have
helped the participants engage in a manner more likely to promote change, though there was less direct evidence of this.

**Interpretation of the Findings**

Recall that Dweck and colleagues found that people view traits like intelligence as either fixed or incremental (Dweck & Leggett, 1988; Dweck, Chiu, & Hong, 1995; Plaks, Grant & Dweck, 2005). My results did not support my hypothesis that preservice teachers would be primarily fixed in their viewpoints. However I did find a wide variety of views about intelligence and perhaps examples of individuals who hold both theories at once as posited by Dweck, Chiu and Hong (1995). In particular this emerged in the qualitative analysis. Recall that Dweck et al. (1995) suggested that an entity view and an incremental view are mutually exclusive. However, Dweck and colleagues state that even though these beliefs might be opposite, it does not mean that people do not have them at the same time. For instance the researchers suggest that an individual who is very gifted—perhaps a genius—may hold an entity view about themselves but an incremental view for others. Alternatively, they may believe some components are fixed and some are malleable. Finally, they may be undecided or may not recognize that they hold inconsistent beliefs.

Preservice teachers, in this study, generally viewed intelligence as incremental. However I did see that there was some confusion in their views and indeed a few of the preservice teachers contradicted themselves. For instance, one participant marked disagree when asked to rate the changeability of intelligence yet said she agreed that intelligence was changeable during her discussion. That leads me to suggest that some of their views are not necessarily consistent. Perhaps they do not have a well developed
mental model of intelligence. It might also be due to confusion about the term “intelligence.” It is also possible that the contradiction I saw was actually changed due to the refutation text and the interaction with their partner. This may in turn be related to a lack of appreciation or respect for educational psychology foundation courses among preservice teachers (Joram & Gabriele, 1998).

**Views about intelligence.** Research Question 1 asked, What are preservice teachers’ views of intelligence? Specifically do they believe intelligence is fixed or changeable? Although some participants’ views were inconsistent, the majority held incremental views. The exploration of participants’ views about intelligence suggests that they held certain prior beliefs about the changeability of intelligence. Participants saw intelligence as primarily related to academic success effort, knowledge, and usefulness to mankind, book smarts, and teaching. However the teaching or influences of teachers was a common theme in their definitions. In other words, preservice teachers saw intelligence as not being static but directly influenced by teaching. The participants in this study appear to believe in teaching and the power of instruction, therefore they were overwhelming incremental in their theoretical viewpoint. In addition I would suggest that preservice teachers have aspirations to make a difference. Indeed they may have heavily identified with the academic process or felt left out of the academic process, thus their choice to be teachers. In particular these attitudes are present in the post essay responses which were overwhelmingly positive and comfortable indicative of solid pedagogical instruction.

Their views of intelligence were diverse, however; some included biological foundations and others participants were convinced that all are intelligent and all can
learn (see Figure 15 for an overview of their views). Some consider all intelligence to be more about what you do with your ability and whether it has positive overtones for society at large. This perspective I framed as humanistic. As I mentioned previously among the participants in my study, altruism or concern about the world appears to be a primary component in preservice teachers’ views about intelligence. For instance in this answer, “Intelligence is not so much how book smart someone is but how they view the world and what they do with that view,” the emphasis is on the use of intelligence.

Preservice teachers in this study relied more on personal experience and had a high degree of respect for motivation and effort. An experiential example of intelligence was: “Something that can be learned through experience and taught in school; knowledge of many facts and ability to think through and work out problems.” This definition may illustrate the reliance these preservice teachers had developed through their own academic lives.

My data suggest that there is misunderstanding of the term intelligence. For instance: “Intelligence is not something that you’re necessarily born with, it is something that’s established over time with how much you’re willing to learn.” The expectation that all students have the same potential to learn may be a burden which could lead to burn out in well meaning and conscientious teachers. A more realistic attitude about the wide spectrum of human achievement capabilities could be advantageous to teacher development and retention. Incremental views of intelligence do not invalidate existing cognitive or developmental impediments. Indeed an incremental view of intelligence allows preservice teachers to keep encouraging and expecting change which is the best
pedagogical option, however it does not mean that they can necessarily enact change of the same degree in all their students.

The participants rarely referred to knowledge of educational psychology concepts and in particular human development. It could be that preservice teachers might need more time with developmental topics in their Educational Psychology courses. It may also be helpful if Educational Psychology Courses stress the importance of biological constraints for preservice teachers. A reason to stress biological constraints is because I observed that many of the preservice teachers in my sample had unrealistic expectations about how much change they could effect.

I created Figure 16 primarily to show the relationship between the concepts brought up in the preservice teachers’ definitions and discussions about intelligence and potential educational psychology concepts that could be helpful in changing or altering conceptions about intelligence. The diagram contains two circles with pie shaped wedges. The larger of the two circles has three sections. This circle represents preservice teacher views extracted from my analysis. The largest part of the preservice teacher views of intelligence (approximately 60%) contains their implicit beliefs and personal experience. The role of strategy use, motivation and effort comprise about 30% of preservice teacher views and the remaining 20% includes world use, knowledge and the belief that intelligence is more than just “smarts.” The circle represents the three major categories and influences on preservice teachers’ views about intelligence. Directly across, I have presented a slightly smaller circle almost even divided. In this circle I have placed what I described as projected assistance from Educational Psychology. I have included areas that I found to be misunderstood or inconsistently represented such as: IQ, standardized
testing, Educational Psychology concepts, and Development. On the other half I have
included the conceptual change role (CRKM) and included the reform models (CAMCC),
these models may serve as a framework to improve knowledge of Educational
Psychology concepts that in turn could be beneficial to preservice teachers’
understanding of intelligence and provide a means to examine the role of implicit beliefs.

My interpretation is that preservice teachers in this study viewed intelligence as a
concept that included and embodied academic success and improvement. Perhaps that is
why they considered the accumulation of knowledge to be a part of their definition of
intelligence. Either way the term was generally interpreted by the participants as in more
humanistic terms, for example as whether intelligence was useful beyond the classroom. I
would suggest that this is a good practice in so far as teachers need to look beyond tests
to assess their learners’ true capabilities. But preservice teachers should also be aware of
the high and low milestone markers of cognitive ability. Educational Psychology’s role in
preparing preservice teachers to understand how we learn integrates the lay and the
scientific. The key interpretation of learning may rely more heavily on experience.

**Educational Interventions**

**Refutational text main effect.** Although the results indicated that preservice
teachers entered the study with incremental views, the interventions were able to create
some change. Among the three interventions, the use of a refutational text was effective
in promoting conceptual change about the changeability of intelligence. Recall that the
text described increases in overall IQ scores throughout the world and suggested that
these increases were due to instruction as well as improved nutrition, etc. The text also
discussed the importance of strategy use and problem solving. The increase in accepting
an incremental view in this study supports the literature on refutational text as facilitating conceptual change (Guzzetti et al., 1993). The results suggest that participants may have increased their acceptance about the changeability of intelligence through the pertinent information and persuasive details in the refutational text.

The refutational text was used in discussions to support, as well as to dispute, the possibility that intelligence is changeable. Recall that I examined the discussions in Condition 1. The refutational text was mentioned in the following ways:

I do agree that intelligence is changeable. The article does an excellent job in illustrating this. For example what would teachers do if intelligence were predestined at birth? There would be no reason to teach nor would there be an act called No Child Left Behind.

Here is a contrary example: “I don’t believe that IQ scores have risen throughout the world.” However this student’s rationale for disputing the statement in the refutational text was experiential in nature. “In my family, including myself, the IQ’s that we had as kids are not more than 5-10 points different than what we have now - This is true of my children as well.”

However, it was much more common for the text to be used for support, and strengthen, incremental views. It is possible that Gregoire’s CAMCC could explain the resistance to change in the one case observed, but for the most part this model was less applicable to the results than I originally anticipated. However, my results do show that refutational texts with reform messages can be useful in strengthening beliefs when teachers are already receptive to the message. Dole and Sinatra’s CRKM is more applicable to these results because it holds that, in addition to cognitive conflict, personal relevance and self-efficacy also predict change. My participants discussed their past experiences in the classroom when they showed a “change” in intelligence, they were
also highly personal about their beliefs and mentioned the refutational text arguments as being convincing. Recall that the strength and coherence of the message are key components of the CRKM.

**Refutational text plus structured discussion.** The second intervention examined whether a refutational text plus a structured discussion would be effective in promoting conceptual change about the changeability of intelligence. I had hypothesized that this condition would be the most likely to increase acceptance of the incremental nature of intelligence, even more than a refutational text alone. This study shows that it may be possible to increase engagement with refutation texts through structured discussion. However, it is difficult to tease apart the role of the prediscussion organizer from the discussion itself. Both should be considered part of the intervention.

Below is an example of how many participants cut text from their prediscussion organizer and pasted the text into a discussion note:

**Prediscussion Organizer Argument For:** I agree that intelligence can be changed because children are always acquiring new knowledge and the mind is forever being stimulated. Unless their education or brain, is hindered children have the capacity of acquiring so much information and as they grow experience new things. Given the opportunity, and being in a nurturing, creative, and stimulating environment, the intelligence of children can change.

**Discussion Posting Response:** I agree with you that intelligence can be changed. I think however, it is harder when children have limitations, whether mental or due to outside influences. I do agree however that it takes effort, not only from the student, but the teacher as well. Children are constantly acquiring new knowledge and experiencing new things about the world around them which I believe can aide in the development of their intelligence given a nurturing and supporting environment.

I plan to use organizers like this in my own teaching practice. I felt that the participants completed more reflective discussions when they completed the organizer. As mentioned earlier, the refutation text was integrated in the prediscussion organizers and in the
discussions. Lund, Molinari, Séjourné and Baker (2007) indicate that argumentation diagrams assist in the framework of producing and justifying knowledge. Indeed Nussbaum et al. (2007) demonstrated the potential for structuring discussions with prediscussion organizers and this study strengthens this finding.

Participants who completed the prediscussion organizer and then engaged in dyadic discussions may have had a significant advantage over those who did not discuss the refutational text. My explanation is that these students had to establish their view points. It makes sense that students will use what they already have written or prepared in digital format. The preparation and digital access may enable students to save time and thus provide a faster and more economical means of completing an assignment. Discussion alone does not necessarily require students to take a stand or provide specific arguments. The term *discussion* may imply that students should cooperate and thus not prompt students to prepare to argue their position or state claims or warrants. Participants may be more prepared in a structured discussion; they can just paste their previously composed arguments into their discussions and can rely on any assigned text for detail and evidence more effectively than in an impromptu or extemporaneous exchange with a “stranger” in an educational setting.

Adding a prediscussion organizer to the refutational text may have also allowed students the extra time to reflect on the topic. The prediscussion organizer was completed before the dyadic discussion. Participants were asked to state their arguments for, arguments against, and their opinion. In addition they were asked if they had any disagreements with the text. Using a text to fortify and reinforce arguments is a long
standing educational practice. Students expect to use a text to quote or reference to respond to an educational question.

Finally, Voss and Wiley, (2000) research suggests that building arguments may provide students the tools to produce their own rationales and reasons behind events; this might lead to what Dole and Sinatra (1998) refer to as personal relevance as well as deep engagement. Students may be more likely to excel when roles are differentiated and also may be more likely to perform at a higher level when they care.

Andriessen’s (2003) argumentation studies in collaborative writing involved dyads that were given an argument before the discussion. The structure of the arguments and the phases of the argument within the collaborative writing process appeared to indicate that argumentation changes within the discussion cycle. In this study most participants were already inclined to accept and support the incremental view of intelligence; however the discussions responses appeared to be influential in further increasing acceptance, possibly by being exposed to others who reiterated aspects of the refutational texts or elaborated on it.

A mismatch in Condition 3. In Condition 3 there was a mismatch between what some students read and what they discussed. Participants in the conditions that had the expository text (not the refutation text) expressed confusion when asked to discuss intelligence. Recall that all participants were instructed to complete an organizer before they discussed in dyads. The organizer was either about the changeability of intelligence or whether school uniforms improved grades. The resulting confusion had an effect on the results.
Structured discussion alone. The final intervention in research question 2 was whether a structured discussion alone facilitated conceptual change about the changeability of intelligence? Participants who did not have the same text as their prediscussion organizer and discussion did not demonstrate change. Recall that two groups read an alternative expository text. As stated before there may have been confusion or a disconnect between what they expected and what was then delivered to them during the course of the research. It could be that these problems stemmed from the informed consent and the instructions given to them in the study measures. For instance the prediscussion organizer could have said that although you did not read about this topic, please complete the following organizer. The condition that only received a structured discussion had no text based reference to refer to when answering the prediscussion organizer or preparing and completing the discussions.

Importance of clear instructions. Providing enough clarity in a research study is parallel to providing enough clarity in a class, and is particularly online. I had not predicted that this condition would be effective, because students would lack sufficient background knowledge however, the concerns that students had about the organization may be valuable to educators. Indeed students wanted to know why they were discussing a subject that they had not read about; it could be that reassurance is important even when instructions have already been given. Perhaps reassurance acts as a sort of affirmation that students need to go on and finish an assignment particularly in an online environment.
Actively Open-Minded Thinking Measure

Research question 3. This question asked whether there would be a connection between Actively Open-Minded Thinking and the prediction of change about the changeability of intelligence. The quantitative analyses failed to show a relationship between the AOT and the prediction of change. In addition there was no evidence that this measure predicted change. It is not clear why this measure did not show the usual association with change. It could be that there was insufficient change in the study since the views of the participants were already generally incremental.

Summary of Educational Implications

From an educational standpoint, this study suggests that refutational texts combined with a structured organizer may be a more effective aid in learning. In particular the prediscussion organizer may have provided the reflection time necessary to discuss creatively with an anonymous partner and, more importantly, to engage in elaborate processing. Participants in Condition 1 who read the refutational text about intelligence and completed the prediscussion organizer used their individual comments from their organizer as elements within their discussion. The prediscussion organizer may have been more important than the actual discussion, although more research is needed to confirm this.

Recall that the prediscussion organizer was completed individually before the participants were placed in dyads. They were asked to state their arguments for, arguments against and their opinion about the changeability of intelligence. In addition they were asked if they had disagreements with the text. As an educational intervention this condition may have been the most effective both in the quantitative and qualitative
analysis. However more research is needed to determine if this is so. The post hoc comparisons between the text only and text plus structured discussion was not quite significant, it was however promising.

It may be that providing a means of thought organization including argumentation format assisted students in discussing a topic. In addition even though most participants already agreed with the assumption that intelligence was changeable, when confronted with an informed partner who also agreed; agreement changed in intensity during the post intelligence survey. In Condition 1 \((n = 27)\) 10 participants changed from agree to strongly agree in particular on question 2, which asked participants to rate the changeability of intelligence on a five point Likert scale. More research will be needed to demonstrate if their change was due to the discussion alone, the refutation text, or the structured discussion or the combination.

**Preservice Teacher Change**

Among preservice teachers, personal relevance may prevent or trump change (Dole & Sinatra, 1998). In this study, preservice teachers entered the study with the strongly held beliefs that intelligence was changeable. Preservice teachers appear to see intelligence as something they can reform and not a static concept. Is their conception of intelligence different from that of traditionally inclined educational psychology experts? Preservice teachers have a definition of intelligence that is socially and culturally broader than what educational psychology “experts” might expect. In contrast, Sternberg (2002) states “The notion of intelligence as adaption to the environment and as operationalized in narrowly based intelligence tests is incomplete. Instead, I argue for a concept of successful intelligence, according to which intelligence is the ability to achieve success in
life, given one’s personal standards, within one’s sociocultural context,” (p. 448). Notice that Sternberg’s definition is incremental and thus perhaps in line with the general beliefs of the preservice teachers in this study.

**Positive signs for teacher education in the post essay.** The preservice teachers were very positive in their approach to the classroom teaching scenario. I considered it positive because they were generally upbeat about the students’ issues and resolved to assist them to succeed. Recall that the post essay asked for views of intelligence but also asked the participants to respond to a teaching scenario. Studying, strategy use, and effort were commonly referred to for example:

Oscar believes that because of the amount of effort he has put in, he will do well on the test. This demonstrates the idea that intelligence can be improved upon by putting in effort. I would agree with Oscar and encourage him to keep trying hard…

**Post essay prompt construction.** This essay also was problematic due to the way I wrote the prompt. It might have been more effective if I had not used testing as the determination for intelligence. In addition I should not have used Physics as the subject matter. I may have been better to select a subject matter like history rather than a more complex subject. It could be that their own views of intelligence were not important when asked about a pragmatic situation involving specific students. Thus their focus was on the task at hand and thus the participants ignored some of the questions in the prompt such as what are the students’ views of intelligence. In all, the prompt could have been written with more deliberate attention around the research questions.

**Sternbergs’ theory and potential for preservice teachers.** Sternberg describes three parts or types of intelligence: analytical, creative, and practical. This theory of intelligence may fit with preservice teachers’ views expressed in this study. His theory
acknowledges that intelligence is not always obvious in every area. I would suggest that Sternberg’s personal background as an educational misfit helped to make his views what they are (http://www.yale.edu/rjsternberg/about.html). Indeed Sternberg dedicated the book *Successful Intelligence* (1996) to the teacher that recognized that he could do better.

The ability to get something done effectively appeared to be a connected theme with intelligence with some of these participants. The participants did not mention Gardner. There were no claims about Gardner’s theory of multiple intelligences. The term multiple intelligences were used twice in Condition1, and types of intelligence was referred to by a few participants. The trend was towards recognition that students might be better in one area than another and that you could not generalize from student to student. Students who were better in one area than another did not mean that they were not intelligent but had a limitation in one area or a greater strength in another.

**Additional Limitations of the Study**

Participants were mainly white, female, education majors and participants from other majors might have different and less incremental points of view. However, I am making generalizations in this study only to the preservice teacher population. My sample was from only one university and students in other programs and at other universities might have different views.

**Time and participant assignment.** A second external validity limitation of this study is that the intervention was constrained by time. I designed the study to take one hour; however, due to logistical online constraints I probably would have been better served to make it a two-hour study. The reason for this was the lag time between discussion partners. Participants were randomly assigned to a partner; however, the
participants proceeded on their own pace in the first individual session. Therefore some
participants were ready to discuss but their partners had not yet logged on. I did try to
contact the students and let them know that their partner was waiting. Participants who
were waiting for their partner might have been less inclined to elaborate on their
responses unless they got a partner who was very engaging.

**Other limitations.** Online instruction sometimes presents impediments to
learning for the researcher and the participants. There were questions about start and stop
time and issues that were out of the control of the researcher such as confusions about
sign up times. In addition I should have had another mechanism in place to prompt
students to complete the organizer; however more research needs to be done to determine
which mechanism or mechanism would be most effective for students. All conditions
could have benefitted from clearer instructions. In retrospect there could have been a
wrap up after each section with perhaps a set of frequently asked questions for
participants to make sure their concerns were addressed. The refutational text and the
time on task expository text could have been vetted by more random students and/or
preservice instructors. In particular perhaps the point of view of those who know nothing
professionally about teaching might have been useful for the instructor.

**Future Research**

From an educational standpoint, this study highlights the need for preservice
teachers to anticipate a need to change or moderate their implicit beliefs if necessary
towards a more balanced view of intelligence and learning. Understanding Educational
Psychology concepts may be helpful. Overall one might predict from this study that
preservice teachers would be amenable to studying Sternberg’s theory because of its
incremental nature. I think it is also important, however, to teach preservice teachers about biological constraints. An expectation that all of one’s students are able to learn at the same rate or level is impractical given the nature of human variability. Students do have varying degrees of ability and some have learning disabilities, often undocumented. Part of this is having preservice teachers acknowledge what they believe. Are these beliefs changeable within their preservice course of study or are they deeply held personal beliefs, thus more difficult to alter? Preservice teacher programs may need to establish if these beliefs are grounded in personal experiences and if so can they be shifted or changed. In addition it would be interesting to conduct the same research on in-service teachers to see if their views are any different. Does experienced craft knowledge trump implicit beliefs with experienced teachers? Are their views more fixed and less incremental? Does their length of time teaching account for a viewpoint towards fixed or incremental?

Understanding of educational psychology concepts may have been less strong among the preservice teachers in this study. Could strengthening these concepts have an effect on their views about intelligence? Certainly understanding the human learning process is essential. Preservice teachers decide on their vocation perhaps due to an overwhelming desire to help others or to continue their humanistic viewpoint. If, as Gregoire (2003) research indicates, teachers resist reform messages (such as the need to change techniques or instructional professional development), then it is essential to work with preservice teachers to identify their implicit beliefs and to identify their core beliefs. Professional development may only be effective when implicit beliefs are discussed during these interventions.
Combining refutational texts and structured discussions has promise as an intervention both in the classroom and online. The prediscussion organizer did not take long to create nor did it take the participants a long time to complete. The benefits appear to be promising. Examining prediscussion organizers with both abstract and concrete questions may provide data useful for classroom applications. A study that teased apart the prediscussion organizers’ effects versus the refutational text would also be important educationally. A refutational text study that used a reform message with which most of the participants initially disagreed might be a more stringent test of the interventions explored in this study. This might produce results more favorable to Gregoire’s (2003) model versus the Dole and Sinatra (1998) CRKM. Strongly held personal views are difficult to dislodge and by having preservice teachers explore their beliefs, it may have a beneficial result later on in the future and in the challenging careers of these preservice teachers.
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“*Pluto Has Been a Planet My Whole Life!*” Emotions, Attitudes, and Conceptual Change in Elementary Students Learning about Pluto’s Reclassification.


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Linn, M.C., & Slotta, J. D. (2003). Enabling participants in online forums to learn from each other. In J. Andriessen, M. Baker, & D. Suthers (Eds.), *Arguing to learn: Confronting cognitions in computer-supported collaborative learning environments* (pp. 61-97). Boston: Kluwer.


TABLES
Table 1

**Summary Table of Measures**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Individual/Dyad</th>
<th>Scoring</th>
<th>Research Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Individual</td>
<td>Frequencies</td>
<td>All questions</td>
</tr>
<tr>
<td>AOT</td>
<td>Individual</td>
<td>41 item total sum</td>
<td>Q3</td>
</tr>
<tr>
<td>Pre Intelligence Survey</td>
<td>Individual</td>
<td>5 items, question 1 was open ended, questions 2-5 were Likert questions. Open ended questions were scored by two independent scorers. Question 1 was dichotomously scored.</td>
<td>Q1 and 2</td>
</tr>
<tr>
<td>Organizer</td>
<td>Individual</td>
<td>Participants were asked their opinion about the changeability of intelligence or do school uniforms improve grades? Participants had to state their opinions for and against and finally their opinion. Participants were expected to use this organizer before they discuss.</td>
<td>Q1 and 2</td>
</tr>
<tr>
<td>Discussion</td>
<td>Dyad</td>
<td>Participants discussed whether intelligence is changeable or do school uniforms improve grades?</td>
<td>Q1 and 2</td>
</tr>
<tr>
<td>Post Intelligence Survey</td>
<td>Individual</td>
<td>5 items, question 1 is open ended, questions 2-5 were Likert. Open ended questions were scored by two independent scorers. Question 1 was dichotomously scored.</td>
<td>Q1 and 2</td>
</tr>
<tr>
<td>Post Essay</td>
<td>Individual</td>
<td>Open ended questions were scored by two independent scorers. Essays were scored analytically with dichotomous scoring and holistically with a scale of 1-3. Quality, completion of all prompt questions and length were included.</td>
<td>Q1 and 2</td>
</tr>
</tbody>
</table>
Table 2

Definition of Intelligence:
Pretest and Posttest Open-Ended Questions: Means, Standard Deviations

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Question (n = 83)</td>
<td>0.70</td>
<td>0.46</td>
</tr>
<tr>
<td>Posttest Question (n = 83)</td>
<td>0.71</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Note: Questions coded 1 = Incremental or Both, 0 = Fixed.
Table 3

*Essay Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Type of Rubric</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical(^a) (n = 69)</td>
<td>0.93</td>
<td>0.26</td>
</tr>
<tr>
<td>Holistic(^b) (n = 98)</td>
<td>2.30</td>
<td>0.66</td>
</tr>
</tbody>
</table>

\(^a\)Converted into a dichotomous variable, 1 = *Incremental or Both*, 0 = *Fixed. Not Sure* dropped from analysis.

\(^b\)Scored from 1 – 3. 1 = *Poor*, 2 = *Fair* and 3 = *Good*. Good essays answered question about intelligence.
Table 4

*Essay Skew and Kurtosis for Holistic Essay*

<table>
<thead>
<tr>
<th>Type of Rubric</th>
<th>Skew</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holistic ((n = 98))</td>
<td>-0.40</td>
<td>-0.73</td>
</tr>
</tbody>
</table>
Table 5

*Likert Questions 2-5, Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Question</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate your views ($n = 27$)</td>
<td>4.24</td>
<td>0.83</td>
</tr>
<tr>
<td>Made smarter ($n = 21$)</td>
<td>4.59</td>
<td>0.50</td>
</tr>
<tr>
<td>Determined at birth ($n = 25$)</td>
<td>3.96</td>
<td>0.94</td>
</tr>
<tr>
<td>Instruction raise ($n = 24$)</td>
<td>4.00</td>
<td>0.89</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate your views ($n = 27$)</td>
<td>4.62</td>
<td>0.49</td>
</tr>
<tr>
<td>Made smarter ($n = 21$)</td>
<td>4.54</td>
<td>0.90</td>
</tr>
<tr>
<td>Determined at birth ($n = 25$)</td>
<td>4.06</td>
<td>0.91</td>
</tr>
<tr>
<td>Instruction raise ($n = 24$)</td>
<td>4.08</td>
<td>1.30</td>
</tr>
</tbody>
</table>

*Note:* Items coded on Likert Scale 1-5 (1 = *Strongly Disagree*; 5 = *Strongly Agree*).
Table 6

*Likert Questions 2-5, Skew and Kurtosis (n = 103)*

<table>
<thead>
<tr>
<th>Question</th>
<th>Skew</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pretest</strong></td>
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<td></td>
</tr>
<tr>
<td>Rate your views (n = 27)</td>
<td>-0.94</td>
<td>1.36</td>
</tr>
<tr>
<td>Made smarter (n = 21)</td>
<td>-0.69</td>
<td>-0.72</td>
</tr>
<tr>
<td>Determined at birth (n = 25)</td>
<td>-1.71</td>
<td>1.71</td>
</tr>
<tr>
<td>Instruction raise (n = 24)</td>
<td>-0.79</td>
<td>0.51</td>
</tr>
<tr>
<td><strong>Posttest</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate your views (n = 27)</td>
<td>-1.40</td>
<td>2.35</td>
</tr>
<tr>
<td>Made smarter (n = 21)</td>
<td>-2.84</td>
<td>11.44</td>
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<tr>
<td>Determined at birth (n = 25)</td>
<td>-1.27</td>
<td>1.89</td>
</tr>
<tr>
<td>Instruction raise (n = 24)</td>
<td>-1.91</td>
<td>2.82</td>
</tr>
</tbody>
</table>
Table 7

*Factor Analysis Total Variance Explained (n = 107)*

<table>
<thead>
<tr>
<th>Component</th>
<th>% of Variance</th>
<th>Cumulative %</th>
<th>% of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate Your Views about the Changeability of Intelligence</td>
<td>51.02</td>
<td>51.02</td>
<td>51.02</td>
</tr>
<tr>
<td>Made Smarter</td>
<td>19.47</td>
<td>70.50</td>
<td></td>
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<tr>
<td>Intelligence Determined at Birth</td>
<td>15.01</td>
<td>85.51</td>
<td></td>
</tr>
<tr>
<td>Can Instruction Raise</td>
<td>14.49</td>
<td>100.00</td>
<td></td>
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</table>

**Component Matrixa**

<table>
<thead>
<tr>
<th></th>
<th>Rate Your Views about the Changeability of Intelligence</th>
<th>Made Smarter</th>
<th>Intelligence Determined at Birth</th>
<th>Can Instruction Raise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate Your Views about the Changeability of Intelligence</td>
<td>.747</td>
<td>.762</td>
<td>.601</td>
<td>.580</td>
</tr>
</tbody>
</table>

*aOne component extracted. Note factor analysis was completed before ANOVA outlier process.*
Table 8

Analysis of Variance for Definition of Intelligence Question

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>$\eta^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ref Text (RT)</td>
<td>1</td>
<td>0.23</td>
<td>0.00</td>
<td>0.63</td>
</tr>
<tr>
<td>Disc Intel(DI)</td>
<td>1</td>
<td>0.36</td>
<td>0.01</td>
<td>0.55</td>
</tr>
<tr>
<td>RT x DI</td>
<td>1</td>
<td>2.38</td>
<td>0.03</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Within-group error</strong></td>
<td></td>
<td></td>
<td></td>
<td>72</td>
</tr>
<tr>
<td><strong>Within subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (T)</td>
<td>1</td>
<td>0.04</td>
<td>0.00</td>
<td>0.85</td>
</tr>
<tr>
<td>T x RF</td>
<td>1</td>
<td>3.04</td>
<td>0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>T x DI</td>
<td>1</td>
<td>0.05</td>
<td>0.00</td>
<td>0.82</td>
</tr>
<tr>
<td>T x RF x DI</td>
<td>1</td>
<td>0.39</td>
<td>0.01</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Time (T) within-group error</strong></td>
<td></td>
<td></td>
<td></td>
<td>72</td>
</tr>
</tbody>
</table>
Table 9

*Incremental View Factor Difference Scores: Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Pre Change Factor Score</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
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<tr>
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<tr>
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FIGURES
Figure 1. Frequencies for Questions 2 and 3 Pretest Intelligence Survey
Figure 2. Frequencies for Questions 4 and 5 Pretest Intelligence Survey
Figure 3. Frequencies for Questions 2 and 3 Posttest Intelligence Survey
Figure 4. Frequencies for Questions 4 and 5 Posttest Intelligence Survey
Figure 5. Analysis of Variance using (Studentized Residuals) to Determine Outliers for Pre Likert Questions.

Note: Outliers are framed.
Figure 6. Analysis of Variance using (Studentized Residuals) to Determine Outliers for Post Likert Questions.

Note: Outliers are framed.
### Discussion

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**Pairwise Comparisons (Median Test):**

- **Conditions 1 and 3** \( \chi^2 (1,52) = 3.87, p \leq 0.05 \)
- **Conditions 1 and 2** \( \chi^2 (1,48) = 3.05, p \leq 0.08 \)
- **Conditions 1 and 4** \( \chi^2 (1,51) = 4.46, p \leq 0.05 \)
- **Conditions 2 and 3** \( \chi^2 (1,46) = 0.95, p \geq 0.05 \)
- **Conditions 2 and 4** \( \chi^2 (1,45) = 0.00, p \geq 0.05 \)

*Figure 7. Incremental View Factor Difference Mean Scores for All Conditions (n = 103)*
Figure 8. Incremental View Factor Change Scores for All Conditions, Pre and Post
Figure 9. Continuum of five illustrative cases, incremental views on the left and fixed on the right.
Figure 10. Humanistic View, Anna’s case
Figure 11. Incremental View, Lisa’s Case.
COMPOSITE VIEW, CLAIRE’S CASE

INCREMENTAL AND FIXED

MASTERY: SELF IN RELATION TO PROBLEM –

- Intelligence
- Acquire
- Life
  - Experience
  - Association
  - Time

- Lessons
  - Trial and Error

- Personal Attributes
  - Perseverance
  - Drive
  - Hard Work
  - Confidence

- Multiple Intelligence

Figure 12. Composite View, Claire’s Case
Figure 13. Soft Fixed View, Felicia’s Case
Figure 14. Ultra Fixed View, Susan’s Case
Figure 15. Overview of Illustrative Cases
Figure 16. Final Relationship Diagram
APPENDIX A

Demographics

Please complete the following demographic questions. Recall that all instruments are identified by number only and your complete confidentiality is assured.

1. What is your age? ______________________

2. What is your gender? Please circle: Male  Female

3. Please circle the ethnicity listed below which best represents how you identify yourself:
   American Indian/Alaskan Native   African American/Black   Caucasian/White
   Hispanic/Latino/Chicano          Asian                Other

4. Please circle your year in college:
   Freshman  Sophomore  Junior  Senior

5. What is your college major? Please circle:
   Preschool or early education
   Elementary education
   Middle or junior school
   Secondary or high school
   Undergraduate education
   Other:_____________________________

   Do you have a content major such as music or math? Please circle
   Math
   English/Language
   Physical Education
   Spanish
   Other Languages
   Music
   Art
   Special Education

6. What is your current G.P.A.? ______________________

7. Which of the following best describes your educational background?
   □ Straight through from high school
Adult returning student
GED then college

8. Did you ever receive special education services? Please circle Yes  No
   If so what school age? (please circle) Preschool
   Elementary
   Middle school
   Secondary school

9. Do you have prior teaching experience? Please circle Yes  No
   If so what school age: (please circle) Preschool
   Elementary
   Middle school
   Secondary school
APPENDIX B

Actively Open-Minded Thinking Scale

Composite Actively Open-Minded Thinking Scale -- 11/6/03
Directions: The items are preceded with the following instructions:

This questionnaire lists a series of statements about various topics. Read each statement and decide whether you agree or disagree with each statement as follows:

1 - Disagree Strongly 2 - Disagree Moderately 3 - Disagree Slightly
4 - Agree Slightly 5 - Agree Moderately 6 - Agree Strongly

Mark the alternative that best describes your opinion. There are no right or wrong answers so do not spend too much time deciding on an answer. The first thing that comes to mind is probably the best response. Be sure the number on the answer sheet corresponds to the number of the statement to which you are responding. There is no time limit, but work as quickly as possible.

1. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.

2. What beliefs you hold have more to do with your own personal character than the experiences that may have given rise to them.

3. I tend to classify people as either for me or against me.

4. A person should always consider new possibilities.

5. There are two kinds of people in this world: those who are for the truth and those who are against the truth.

6. Changing your mind is a sign of weakness.

7. I believe we should look to our religious authorities for decisions on moral issues.

8. I think there are many wrong ways, but only one right way, to almost anything.

9. It makes me happy and proud when someone famous holds the same beliefs that I do.

10. Difficulties can usually be overcome by thinking about the problem, rather than through waiting for good fortune.

11. There are a number of people I have come to hate because of the things they stand for.
12. Abandoning a previous belief is a sign of strong character.

13. No one can talk me out of something I know is right.

14. Basically, I know everything I need to know about the important things in life.

15. It is important to persevere in your beliefs even when evidence is brought to bear against them.

16. Considering too many different opinions often leads to bad decisions.

17. There are basically two kinds of people in this world, good and bad.

18. I consider myself broad-minded and tolerant of other people's lifestyles.

19. Certain beliefs are just too important to abandon no matter how good a case can be made against them.

20. Most people just don't know what's good for them.

21. It is a noble thing when someone holds the same beliefs as their parents.

22. Coming to decisions quickly is a sign of wisdom.

23. I believe that loyalty to one's ideals and principles is more important than "open-mindedness."

24. Of all the different philosophies which exist in the world there is probably only one which is correct.

25. My beliefs would not have been very different if I had been raised by a different set of parents.

26. If I think longer about a problem I will be more likely to solve it.

27. I believe that the different ideas of right and wrong that people in other societies have may be valid for them.

28. Even if my environment (family, neighborhood, schools) had been different, I probably would have the same religious views.

29. There is nothing wrong with being undecided about many issues.

30. I believe that laws and social policies should change to reflect the needs of a changing world.
31. My blood boils over whenever a person stubbornly refuses to admit he's wrong.

32. I believe that the "new morality" of permissiveness is no morality at all.

33. One should disregard evidence that conflicts with your established beliefs.

34. Someone who attacks my beliefs is not insulting me personally.

35. A group which tolerates too much difference of opinion among its members cannot exist for long.

36. Often, when people criticize me, they don't have their facts straight.

37. Beliefs should always be revised in response to new information or evidence.

38. I think that if people don't know what they believe in by the time they're 25, there's something wrong with them.

39. I believe letting students hear controversial speakers can only confuse and mislead them.

40. Intuition is the best guide in making decisions.

41. People should always take into consideration evidence that goes against their beliefs.
APPENDIX C

Intelligence Survey Pre

1. How would you define intelligence? Write two or three sentences below.

2. Rate your views about the changeability of intelligence. If you feel that intelligence can be changed, please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

3. Can you be made smarter through education? Do you agree or disagree? Please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
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</tbody>
</table>

4. Is all of your intelligence determined at birth? Do you agree or disagree? Please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
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<th>Disagree</th>
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<td>5</td>
<td>4</td>
<td>3</td>
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</table>

5. Can instruction raise peoples’ intelligence? Do you agree or disagree? Please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
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APPENDIX D
Intelligence Refutational Text
Can Intelligence Be Changed?

Some people say that grades in school, standardized test scores, or IQ test results
tell you all you need to know about a person’s intelligence. That is, these people believe
that the intelligence people are born with is the intelligence they will have for their
lifetime. These people believe that intelligence is fixed and unchanging. This suggests
that while everyone can learn new content in school, nothing can be done to improve a
student’s intelligence. According to this view, how intelligent you are is determined at
birth and cannot be changed.

This may have been your view of intelligence as well. But, research suggest that
intelligence can be changed! It is a documented fact that IQ scores have risen throughout
the world throughout the world over the last fifty years, indicated that instruction and
education has a profound effect on the typical standardized test. Intelligence is really
about one’s ability to solve a problem. If one has difficulty solving a problem, an
intelligent person will persist at trying to solve it, trying different strategies until one
works. We often don’t see all the effort an intelligent person has put into solving a
problem, so it seems that they can figure out answers quickly and that effort is not part of
intelligence. But this is an illusion. Effort is a big part of intelligence, and for this reason,
students can be made more intelligent if they are encouraged to persist in trying to solve
problems and to use different strategies, rather than letting students give up prematurely
and saying to themselves. “I don’t have what it takes.” Teachers’ can also help students
acquire content knowledge, which in turn makes it easier for students to solve problems
and become more intelligent.
In these days of No Child Left Behind, teachers are worried about their own success in the classroom and the implications if their students do not perform up to expected standards. Imagine the pressure on teachers to bring up students’ test scores to meet the minimum standards. If it is true that intelligence is fixed and unchanging, what can teachers do?

Teachers can improve students’ intellectual abilities to perform better in the classroom and on standardized test scores. Even IQ test scores can change with the right experiences. Standardized tests and IQ scores don’t tell the whole story of a student’s intellectual abilities. Most people do not know that most standardized tests are not meant to be indicators of intelligence. Many of these tests were designed to indicate where and when a student could be reasonably assisted. We all know about the genius of Albert Einstein. But, did you know that even Albert Einstein did poorly in school? It is possible that even he may not have performed well on today’s tests given what we know about his classroom performance.

Many of us hold conflicting ideas about intelligence. Our ideas from our experience may tell us one thing, whereas test scores may tell us another. It is well documented that IQ scores have risen throughout the world over the last fifty years indicating that instruction and education has a profound effect on the typical standardized test. Often intelligence it thought to be determined only by our genes and heredity, but rising test scores show us that it is not only heredity which contributes to intelligence; instruction can play an important role. Intelligence is not simply a biological factor that students cannot change, indeed research shows that although humans may be born with
greater strengths in one area than another, they still have the capacity to improve and grow.

Given this new information about the possibilities of changing students’ intelligence, imagine the damage that can be done if teachers only consider standardized test scores when they assess a student’s capabilities. It could be very damaging to only consider formal tests and not to consider other indicators of student abilities such as: class assignments, portfolios, classroom discussions and other types of assessments when forming judgments about student intelligence.

Students may have the capability to do well and yet their performance is not up to where it could be. Teachers can improve students’ chances for intellectual growth and achievement by providing a supportive environment and tasks designed to promote intellectual development. Teachers must recognize this or else they risk the chance to ignore and dismiss a great majority of their students’ potential for change and therefore success in life.
APPENDIX E

Alternative Expository Brain Text

Our Amazing Brain: Left versus Right Hemisphere Functions

Did you know that our brains have two distinct hemispheres? The left and right sides of our brains appear similar, and yet they host, for the most part, very distinct capabilities. However there is no such thing as being “right or left brained” despite popular generalizations. What then are the differences in our two hemispheres and how do they affect learning?

The brain is composed of two halves, which appear very similar, connected by a thick group of nerves, and entitled the corpus colosum. The corpus colosum is a kind of cable between these two complex hemispheres. Thus the brain is neither left nor right handed, although our strengths as humans appear to be predominantly one or the other. It is best to consider that the halves of the brain are not distinct hemispheres, but wired together just like a network. Thus the functions of the two halves are not completely separate, but shared in unique ways.

The left side of the brain appears to primarily control language. In addition this side oversees logic, numbers, analysis, critical thinking and academic activities. The left brain is thought to control the perception of counting, measurement and the understanding of present and past. In contrast the right side of the brain is considered to be the artistic and creative half. The right section is thought to control creativity and artistic ability. The right side also is thought to be where imagination, spatial perception and the specifics of language exist; such as intonation and context.
It is interesting to note, that as we all have either a right or left handed preference, as well as an ear and eye preference. However right or left handedness is not attributed to a hemisphere preference. We may conclude then that the complex work of the brain includes shared hemispheric duties. Research tells us that since the corpus collosum is connected to both sides it is difficult to tease apart all of the tasks within the hemispheres. We also do not know if there are sub systems within the hemispheres that are activated by needs in the other.

A typical comment about right and left brain controversy is that right brained children are creative and left brained children are analytical and orderly. However there is no research to back up this claim. It would be very difficult to empirically test. But it is a documented concern that children cease to draw at a certain age, and that they are not encouraged to do so, as adults expect greater and greater ability. This could be allowing the right side of their brains to stagnate.

Critics of Western Civilization blame the reliance on left side brain functions as a reason for lack of creativity. They say that depending on left brain skills like language, computation and reading are damaging students’ creative development. Suggestions, that changing Western curriculums to include artistic expression will improve creativity, are met with some skepticism. The right side of the brain is still not completely established as the creative side.

Pierre Paul Broca (1861) was one of the first researchers to assist us in learning about our brain halves. In his research he discovered that an important area of language skills in within the left frontal lobe now known as Broca’s Area. The work of Broca has continued, and researchers are mapping where functions occur in the brain, through the
limitations of strokes and other dramatic injuries. Their work assists us in understanding where the master controls are in the brain. We also are learning when and where the controls switch on and off, due to injury or trauma.

Currently popular research suggests that the left and right brain do not really speak to each other. However this is probably not true, due to the connection of the corpus callosum, as well as the general nature of the body itself. If there was a reason for both areas to be connected then we can be sure it has to do with overall human functions. Certainly, if one side of the brain could exist independently, than that would have been taken care of by nature. Thus we can be fairly sure that both sides of the brain work together even if one side primarily handles a different set of abilities than the other. Just like a computer, the distribution of effort is predetermined, however some tasks use either one or both halves of the brain. Our brain is amazing, and we continue to learn more about its processes and general nature through medicine and psychological advances.
APPENDIX F

Prediscussion Argument/Counterargument Worksheet Instructions

Fill this out individually and then discuss with your partner incorporating your thoughts from here. You must come to a group conclusion and justify your answer.

<table>
<thead>
<tr>
<th>Arguments For: “Do you agree that intelligence can be changed? Why or why not?”</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Arguments Against: (include reservations, questions, counterexamples, or disagreements you may have with the text).</th>
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<table>
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<th>Your opinion</th>
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After this is completed you will work in your group. Use this worksheet to help make your argument. The first member that logs on is responsible for the conclusion and for posting the first response.

In your group please answer the following question: Based on the following scenario, “Do you agree that intelligence can be changed? Why or why not?”

1. Each member of the group must answer the question separately indicating why they believe as they do. You must post at least three responses plus the conclusion.
2. Then each member must agree or disagree with each others’ statements; giving reasons as to why. No one word responses are acceptable.
3. If you disagree you must say why and point out any problems in your group members’ point of view. If you agree you must also point out why you do and not simply “because”.
4. Finally you must as a group come to a conclusion collectively, weighing all of your points of view and evidence presented. It is all right if the collective conclusion is not 100%, a simple majority should be sufficient.
APPENDIX G

Prediscussion Argument/Counterargument Worksheet Instructions

Fill this out individually and then discuss with your partner incorporating your thoughts from here. You must come to a group conclusion and justify your answer.

<table>
<thead>
<tr>
<th>Arguments For: “Do school uniforms improve grades? Why or why not?”</th>
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<tr>
<td>Arguments Against: (include reservations, questions, counterexamples, or disagreements).</td>
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<tr>
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In your group please answer the following question: Based on the following scenario, “Do school uniforms improve grades? Why or why not?”

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APPENDIX H

Intelligence Survey Post

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2. Rate your views about the changeability of intelligence. If you feel that intelligence can be changed, please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

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5. Can instruction raise peoples’ intelligence? Do you agree or disagree? Please select from the scale below, the number closest to the strength of your agreement. 1 is the lowest and 5 is the highest.

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APPENDIX I

Intelligence Essay Post

1. Consider the following situation, based on your beliefs about intelligence; write a well constructed essay explaining what each student’s view of intelligence is. Please write at least two well defined paragraphs of five sentences each. Answer all parts of the question.

Oscar and Lionel have sat down to study for their physics test. Oscar says “I’m going to do well on this test because I have put in a lot of time studying.” Lionel says “Well I don’t know how I will do; my test scores are always low.” Based on the previous scenario, and if these were your students, how would you respond to them, given what you believe about intelligence?
APPENDIX J

Pre and Post Open Ended Rubric

<table>
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holistic quality 1-3, 1=poor, 2=fair, 3=good
length of answer (in sentences)

Comments:
APPENDIX K

Post Essay Rubric Side 1

<table>
<thead>
<tr>
<th>INTELLIGENCE ESSAY POST</th>
<th>ID no.</th>
<th>Score</th>
<th>Scorer</th>
<th>Score</th>
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Consider the following situation, based on your beliefs about intelligence; write a well constructed essay explaining what each student's view of intelligence is. Please write at least two well defined paragraphs of five sentences each. Answer all parts of the question.

Oscar and Lionel have sat down to study for their physics test. Oscar says "I'm going to do well on this test because I have put in a lot of time studying." Lionel says "Well I don't know how I will do; my test scores are always low." Based on the previous scenario, and if these were your students, how would you respond to them, given what you believe about intelligence?

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<tr>
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<th>#3</th>
<th>#2</th>
<th>#1</th>
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</thead>
<tbody>
<tr>
<td>Good=3, Fair=2, Poor=1</td>
<td>Provides reasons for each student's approach to studying. 2. Provides the student's view of intelligence and their own view as a teacher. 3. Provides response to both students based on their own view of intelligence. 4. Essay will be well constructed, clear and precise.</td>
<td>May answer vaguely about student and personal view of intelligence. 2. May give teaching solution to problem. 3. Essay may have some language errors and be unclear.</td>
<td>Does not give a personal approach to students' situation. 2. May be rambling, unclear and not answer more than one question if any (does not mention intelligence). 3. May have many language errors, will be a few sentences only.</td>
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<th>Fixed-3</th>
<th>Both-2</th>
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<td>- Refer to reading the ref text in the study</td>
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</table>
APPENDIX L
Post Essay Rubric Side 2

Anchor Example 3

Oscar believes that the effort he puts into studying will result in a superior test grade. He has an incremental view of intelligence. He believes that intelligence can be changed or improved; studying hard for the test is a strategy that successful students accept and use. Lionel has a fixed view of intelligence, he is fatalistic. Lionel won’t put in too much time studying because he expects to do poorly.

As a teacher I would encourage Lionel to stop talking negatively about his test scores, and to look for other strategies to improve his grades. Perhaps he has not been taking enough notes or not rewriting his notes. Lionel needs to try to get a better grade and to believe that he can do better. Students who dismiss strategies like studying long and hard will fulfill their expectations. Oscar is a successful student and even if his IQ or innate intelligence is higher than Lionel, he attributes his success to his own effort. Oscar also has a positive expectation which reinforces his goal to do well on the test.

Two paragraphs of five sentences

Anchor example 2

One paragraph of five sentences +

Oscar does well because he studies. Lionel needs to study more. Perhaps Lionel could use some study strategies to help him. The teacher should try to suggest some things to help. Oscar believes he is intelligent but Lionel does not think he is intelligent. Teachers can help students with strategies.

Anchor example 1

Oscar and Lionel are different types of students. Oscar studies more, he believes in his intelligence. Lionel has no self esteem, uses excuses for his performance. The teacher can help Lionel by giving him ways to study. The teacher believes both students are intelligent.
APPENDIX M

IRB Approval

Social/Behavioral IRB – Exempt Review
Approved as Exempt

DATE: April 24, 2008

TO: Dr. Michael Nussbaum, Educational Psychology

FROM: Office for the Protection of Research Subjects

RE: Notification of IRB Action by Dr. Paul Jones, Co-Chair
Protocol Title: Exploring Preservice Teachers' Views of Intelligence
OPRS# 0803-2669

This memorandum is notification that the project referenced above has been reviewed by
the UNLV Social/Behavioral Institutional Review Board (IRB) as indicated in Federal
regulatory statutes 45CFR46.

PLEASE NOTE:
Attached to this approval notice is the official Informed Consent/Assent (IC/IA) Form
for this study. The IC/IA contains an official approval stamp. Only copies of this official
IC/IA form may be used when obtaining consent. Please keep the original for your
records.

The protocol has been reviewed and deemed exempt from IRB review. It is not in need
of further review or approval by the IRB.

Any changes to the exempt protocol may cause this project to require a different level of
IRB review. Should any changes need to be made, please submit a Modification Form.

If you have questions or require any assistance, please contact the Office for the
Protection of Research Subjects at OPRSHumanSubjects@unlv.edu or call 895-2794.
## APPENDIX N

### Sample Qualitative Scoring Sheets

<table>
<thead>
<tr>
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<td>Essay</td>
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</tr>
<tr>
<td>Score A:</td>
<td>1</td>
</tr>
<tr>
<td>Score H:</td>
<td>2</td>
</tr>
<tr>
<td>Pre:</td>
<td></td>
</tr>
<tr>
<td>Intelligence is not something that you’re necessarily born with, it is something that’s established over time with how much you’re willing to learn.</td>
<td></td>
</tr>
<tr>
<td>Post: Intelligence is something that is acquired through experience, association and time. Life can make us more intelligent through its lessons and trial and error. Also, intelligence can be acquired through hard work and perseverance. Anyone who has a drive to learn will accomplish their goal eventually.</td>
<td></td>
</tr>
<tr>
<td>Essay Post:</td>
<td></td>
</tr>
<tr>
<td>Oscar is a young man who believes in the power of studying. He is convinced that because he studied for the test, he will do well. I firmly believe that when it comes to intelligence, anything can be learned if you are motivated enough. Taking the time an</td>
<td></td>
</tr>
</tbody>
</table>
ID: 23
Condition: 1

PQ1: 1
PQ2: 4  PQ3: 5
PQ4: 3  PQ5: 4

Pre:
I would tend to agree with the Webster Dictionary’s definition in that it is the “ability to learn and understand or/ and to deal with new or trying situations”.

PPQ1: 0
Ppq2: 5  Ppq3: 1
Ppq4: 4  Ppq5: 5

Disc. Organizer
1) Do you agree that intelligence can be changed? Why/ Why not? I do agree that intelligence is changeable. The article does an excellent job in illustrating this. For example what would teachers do if intelligence were predestined at birth? There would be no reason to teach nor would there be an act called No Child Left Behind. I do agree that our educational system relies too heavily upon standardized tests. I would even go as far as to say that those tests can be gender bias and equally discriminatory.

2) Disagree
I would have to disagree that effort and intelligence have a direct correlation. To illustrate, anyone that easily receives concepts as opposed to those that put out more effort to retain those concepts is more or less intelligent is hard to believe. I had to work harder in math and needed processes to understand the concepts. Compared to someone who just got the concepts in my opinion would be more intelligent in that they had an aptitude or strength in that area and they didn't have to exude much energy or effort. In that situation I would have to acknowledge that their strength or intelligence in that particular area is better.

3) Opinion
Without adequate knowledge or an antithesis I would disagree that effort and intelligence have a direct correlation. Instead in my opinion intelligence is directly linked to instruction and experience.
Disc. (other member’s ID 95) continued

Subject: Re:Discussion-Response to 23  Author: 23
In conclusion, I feel that no child is left behind. That if you put in as much effort to instruct a child especially in higher thinking that a child will learn through effort or through aptitude. A person's intelligence is as good as the person that develops it. In my opinion it's a lot like potential. If it is not discovered nor worked it may not exist.

Subject: Discussion-Response to 23  Author: 95
HI 23! I totally agree with your opinion, Intelligence can be change. I truly believe that Education plays a great role in Enhancing everyone’s intelligence. When I was in Grade School I always thought that Math was a very complicated subject, but as I study and learn Math in school, more and more I believe that Math is not that hard of subject. It only takes a person’s self belief and the willing to learn a subject. I Totally believe that I am much smarter now than when I was in High school. Education truly is the key to changing a person’s Intelligence.

Subject: Conclusion- Author: 95
23 thinks that Intelligence can be learned and I do agree with her. I therefore I conclude that our group have decided that It can be learn rather than It is in-born. I had mention in my first post that I myself had experience how education enhances my Intelligence over the years. Learning can make a big difference on a person’s intelligence. Education is a fuel to our brain.

Subject: DISCUSSION CONDITION 1  Author: 23
I do believe that intelligence can be changed because its the ability to learn and the ability to approach and solve problems. This ability in my opinion is a learned ability. I do believe that we may be born with or without the capacity to learn but I don't think that weighs heavily on our ability to learn. Even those with learning disabilities I believe have the ability to learn and the capacity of intelligence on some level. I don't believe that standard tests assess intelligence rather I believe it assess your experience and even status. For example if a standardized test asks a question about football in relation to mathematics and you are not that familiar with football then how do you answer that question and if you get the question wrong does that mean you aren't intelligent? I believe that intelligence can be changed by instruction, exposure, and experience along with many other factors in life.

Subject: Re:DISCUSSION CONDITION 1  Author: 95
HI 23! I totally agree with your opinion, Intelligence can be change. I truly believe that Education plays a great role in Enhancing everyone’s intelligence. When I was in Grade School I always thought that Math was a very complicated subject, but as I study and learn Math in school, more and more I believe that Math is not that hard of subject. It only takes a person’s self belief and the willing to learn a subject. I Totally believe that I am much smarter now than when I was in High school. Education truly is the key to changing a person’s Intelligence.

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**Disc. Organizer**

**Disc. (other member’s ID: 119)**

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<tr>
<td>PQ4:1</td>
<td>PQ5:4</td>
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**Score A: 1**  **Score H: 2**

**Pre:**

how smart one is

**Post:** being able to problem solve

Oscar has a positive view of intelligence. Oscar believes if he studies hard he will do well on his test. Oscar has a good attitude about his education where as if he puts effort into his studies he will do well. I would tell Oscar to keep up the good work.
There are different types of intelligence. But a broad definition of it is how smart someone is at something.

Essay Post: Based on the following scenario it is apparent that Oscar believes he can achieve a good score through hard work. This would support the belief that intelligence can be a measure by how hard a person is willing to work at solving a problem. Oscar is willing to work hard and study in order to solve the problem of scoring well on test.

Lionel on the other hand does not share the intelligence that Oscar has. Lionel on the other hand may be a student who shows intelligence in another area. For example maybe he does well on class presentations. Lionel’s scenario would support the belief in multiple intelligences.

As their instructor I would of course encourage both boys to study. Maybe for Lionel I would develop other ways of studying for the test, or if he still scored poorly I would develop and alternative method of assessment.
Intelligence to me means knowledge of many things, not just academics. It also includes knowledge about the world around us, how to relate to people, how to handle problems that one encounters. There is much intelligence, like being intelligent about art or music or even survival. People can be intelligent in many, many ways and a true intelligent person has knowledge about many, many things and is not just book smart.

I define intelligence as having knowledge about many things and many aspects of life. Intelligence to me, is not just being book smart, but being people smart and having the skills necessary to solve problems. Intelligence is being aware of the world around you and society, as well as being academically successful.

Post Essay: It appears that Oscar’s view of intelligence is that if you study hard, you can definitely gain the knowledge to be able to pass a test. He apparently feels confident that he will do really well because he has put effort into studying. Lionel however does not feel confident that he will pass the test because he has not done well in his previous exams. It seems however that Lionel has given up on himself and does not have the confidence to succeed. Lionel perhaps, may even believe that his inability to get high scores on his previous test was due to lack of intelligence rather than because maybe he did not study hard enough or found productive ways to acquire the information he needed in order to pass.

If these were my students, I would first praise Oscar for having put so much effort in studying for his test and then ask him if this has always helped him do well on tests. I then try to find out from Lionel how he goes about studying for a test. I would then try to assist Lionel in acquiring the knowledge he needs to be able to feel confident enough about the test. I would even enlist Oscar’s help because sometimes students learn best from other students. I would try to start a dialog about the information that is going to be given in order to get both student further thinking about the material, and make connections to their real world. I would help Lionel understand that getting a high grade has nothing to do with being smart or not, but about having acquired the information necessary in a manner that one can relate to using several different methods and by truly putting the right kind of effort. I would assure him that even though he might have done poorly on his previous tests, he could still do really well on the next one.
| ID: 18  |
| Condition: 1  |
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| **PQ4**: 3 | **PQ5**: 4  |
| **Disc. Organizer**  |
| **Disc. (other member’s ID)** 33  |
| **PQ1**: 1  |
| **PQ2**: 4 | **PQ3**: 5  |
| **PQ4**: 4 | **PQ5**: 4  |

**Essay**

**Score A:** | **Score H:**
---|---
Pre: Intelligence is not only book smarts. It is also how you relate to the world around you.

Post: Intelligence is not only book smarts. It is also how you relate to the world around you.

Post:
Intelligence is measurable in several different ways. Oscar says he will do well because he has studied a lot for his exam. Lionel is worried because he usually does poorly on exams. There could be a few reasons for Lionel’s doubt of himself. Both could be very intelligent, but they prefer different testing methods. Oscar might like written exams while Lionel freezes when give a written exam. Oscar might be better at studying from a text, while Lionel likes to have discussions about the in class lectures.

If I were the teacher, I would have to make Lionel take the exam because it is unfair to other students to make an exception for him. I would however give him an oral exam to see if his performance increases at all. If it does, then I know that Lionel like to discuss the material rather than write it on paper. As long as he knows the information from the test, then I am happy as a teacher. I would mix up his test to have it partly oral and partly written to give him an opportunity to succeed. I would hope that this would lessen his anxiety about written exams.
ID: 31
Condition: 1

PQ1: 0
PQ2: 5  PQ3: 5
PQ4: 5  PQ5: 3

Disc. Organizer
Disc. (other member’s ID 60)
PQ1: 0
PQ2: 5  PQ3: 5
PQ4: 5  PQ5: 

Essay
Score A: 1  Score H: 3
Pre:
Intelligence is the ability to learn something, problem solve, and think abstractly.

Post:
Intelligence is a measurement of a person’s ability to problem solve, think logically, and think abstractly.

Post Essay:
I would respond by informing them that intelligence is changeable. First, I’d let each student know that if you think you will do well, you usually do—if you think you will score low, you usually will. So positive thinking will impact your grades some, so be positive. Secondly, Oscar did himself good by studying for the test and it’s not clear whether Lionel did or not but if he did, he has nothing to worry about. Last, I’d suggest Oscar study with Lionel and pass on tips that have proven to work well for him and show Lionel it’s all about preparation and perseverance when problem solving.
ID: 80
Condition: 1

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**Disc. Organizer**

**Disc. (other member’s ID 25 dropped from analysis )**

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**Essay**

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<thead>
<tr>
<th>Score A: n/a</th>
<th>Score H: 2</th>
</tr>
</thead>
</table>

**Pre:**

knowledge that a person has gained based on experience

**Post:**

intelligence is peoples level of functioning as a combination of natural ability and experiences

**Post Essay:**

Based on this scenario, I would try to get more information from each student. If Lionel has not studied much in the past and his scores have been consistently lower, it would make sense that the two coincide. Studying can definitely help raise students scores and their confidence going into a test. Just like Oscar who is excited about getting his grade back because he knows he has invested time and energy to ensure a decent grade. It also seems that Lionel may a student who has given up due to regularly receiving low scores.

I would assume that Lionel needs more encouragement. Maybe school is not a priority in his home or maybe he has never had a teacher take a genuine interest in his abilities to achieve. After the test i would review his score and his previous work. It’s important for me to know if he has major deficiencies or just a lack of effort. Either way I know that there are ways to reach out to Lionel and ensure that his progress in my class is steadily improving.

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<td>pPQ4: 3</td>
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**Essay**

**Score A:** | **Score H:**
---|---

**Pre:**
Being well rounded in all areas of life, book smarts, common sense, morality, being open minded, etc. I’m not sure that I believe in intelligence at all because there are so many aspects of the world to master. I think intelligence is knowing you can always learn more.

**Post:**
The ability to learn, solve problems, and understand concepts/

**Post Essay:**
These two boys and different views about if intelligence is changeable or not. Oscar believes that intelligence is changeable. He believes that if he studies hard he can become more intelligent about the material and therefore improve his test scores. Lionel on the other hand does not think that intelligence is changeable. He believes that no matter what his test scores are always low and this one will be too. I don’t think either boy has the completely right answer.

As a teacher I wouldn’t want any of my students to feel the way Lionel does, however I also wouldn’t want any of my students to think that just because they study they will get better grades. I would tell Oscar how proud I am of him for working to hard and then ask him about his study habits. I would want to make sure that he was studying the best way and really comprehending the material. I would tell Lionel that just because his past test scores were low doesn’t mean that all his scores have to be low. I think it would also help to give him a little bit of a personal story about Organic Chemistry and me in college. I would explain that at first my scores were terrible but I started going to a group study class, doing lots of practice problems, and going to my instructor with questions and I improved all my scores. Then I would help him to build some effective study habits and hopefully help him to build some self esteem.
Intelligence goes beyond a person’s mental capabilities. It is being able to comprehend the information you receive and in return store the information for a later use. Intelligence is physical, emotional and mental. It’s being able to use your own mind to reason what is true or not and being able to back up your opinion.

Post:
Intelligence is one’s knowledge of things around them and it shows the effort one puts into learning.

Post Essay: Oscar has a well understanding that in order to do well you must study. He knows his efforts will payoff with a high grade on the test. He knows that reviewing and studying will keep the information fresh in his mind in order to be able to use it on the test. Anyone is capable of doing well if they put in the time and effort. If intelligence is a person’s ability to solve a problem and the only way they are able to solve the problem is by practicing the problem and reviewing it. As Oscar’s teacher i would let him know that his efforts will definitely pay off and he will be reinforced by his test score.

Lionel has been conditioned to believe that he can’t do well because his past test scores have been low. He is not going to be motivated to do well because he believes he has no control of his results. He is what most critics would say fall under their argument that people are born with their intelligence but this is just not so. As Lionel’s teacher i would suggest he study and review to see if he is understanding what is being taught. I would also suggest Lionel come see me for any additional help. He may not be able to process the information since every student learns differently. I would encourage him to put more effort into his work and set a goal. His previous test results have been associated to failure therefore he will continue to fail. Lionel needs to use some positive re-inforcers while he studies and slowly his test scores will improve.
Essay

<table>
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<tr>
<th>Score A:1</th>
<th>Score H:2</th>
</tr>
</thead>
</table>

Pre:
Intelligence is a person’s aptitude in mental knowledge such as problem solving and IQ together with cognitive and inter/intra personal knowledge.

Post:
Intelligence is the process of learning new things and ideas which can influence a change in your personal life or thought, as well as the ability to master certain subjects at a time through dedication, strong study skills and motivation.

Post Essay:
If these were my two students, I would sit down and have a chat with both. I would use positive reinforcement towards Oscar by congratulating him on studying. That is a great skill to posses and it does prepare a student for a test. Intelligence can be learned even when it is nonexistent at first. Because they both recognize that Physics is hard, Oscar has taken personal responsibility of his actions by stating that he is going to do well because he studied for this test. He is being optimistic that as a result of studying, his grade will be high. This is an important key for success in mastering further intelligence.

Secondly, I would speak to Lionel and ask a few questions about his studying skills. Does he have a quiet place at home to study? Is there a certain area of Physics that he doesn’t understand? Based on his score of the test I would offer before and after school help on whatever he is not understanding, so that his test scores can improve. Hopefully teaching him the valuable lessons of homework, dedication and studying will enable him to succeed not only in this class, but also in any others that he may be struggling with.
ID:  109
Condition:1
PQ1:1
PQ2:4  PQ3:5
PQ4:5  PQ5:4
Disc. Organizer
Disc. (other member’s ID       41                      )
pPQ1:1
pPQ2:5  pPQ3:5
pPQ4:4  pPQ5:5
Score A:1  Score H:2
Pre:
Intelligence is measured by tests. I feel that to be intelligent is not to be necessarily measured by tests. One person may be intelligent in math and another in reading. There are those that may be intelligent in “real world” situations such as changing a tire or balancing people’s money. Intelligence is a measure of many different aspects in life I believe.

Post:
(I believe I already answered and did this survey but I will re-do it again).
Intelligence is measured by tests. I feel that intelligence can be changed and also learned by one’s self. Intelligence can be measured in different ways. Some people may be intelligent in one area more than another.

Post Essay:
Oscar’s view of intelligence is that he feels if he studies the best he can and comprehends what he has learned he will be able to do fine on the physics test. I would tell Oscar that I hope he does well also and that studying is a great way to “get in shape” for the upcoming test. I would encourage him to keep it up. I believe that learning in school, for Oscar, is making his intelligence expand into many possibilities. Oscar is on the right track to growing into a young adulthood. Lionel does not have a view on intelligence it seems. He seems discouraged and that whatever he does will not matter because his test scores are always low. If Lionel was my student I would encourage him and try to relate a personal story about myself to him. I would also help him with study strategies to improve his tests. I would try and build up Lionel’s confidence and make him feel competent.
ID:       22  
Condition:1

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**Disc. Organizer**

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Score A:1 | Score H:3

**Pre:**

Intelligence is one’s ability to be able to learn from experience and to be able to comprehend what happened and how it can change and impact their lives. Intelligence is gained throughout one’s life and is not established at birth. As one goes from childhood to adolescence and adulthood intelligence grows and is developed more.

**Post:**

Intelligence is gained through experience and is not established when one is born. There is no certain amount of intelligence that one can have. Intelligence is learned from the environment and is build upon through education and from the environment.

**Post Essay:**

Oscar is confident that he will do good on the test. He has been studying and dedicated time and effort to do well on the physics test. Lionel doesn’t probably study as much as Oscar does. He is not understanding the material in class and not asking the teacher for help with anything. If Lionel would understand the material and put in time and effort studying for the exam he would be just as confident as Oscar to do well on the exam.

I wouldn’t necessarily say that Lionel is more or less intelligent then Oscar. I think that Lionel is probably not as determined as Oscar. Lionel seems to be more determined to do well of the physics test and since Lionel has been getting low test scores he probably doesn’t care about the test as Oscar does. In my opinion Oscar isn’t more intelligent Lionel, he just cares more about what he will get as a grade in physics and since Lionel has been getting low scores to begin with he doesn’t put as much effort (time) into his studying.
ID:  25   Condition:1

PQ1:0
PQ2:2   PQ3:3
PQ4:2   PQ5:2

Disc. Organizer

Disc. (other member’s ID  80  )

pPQ1:0
pPQ2:2   pPQ3:2
pPQ4:2   pPQ5:2

Score A:   Score H:

Pre Q1:
How a person takes in (process) information and stores the information for later use.

Post Q1:
A predetermined ability that cannot be increased. Your ability to access your full potential is increased through teaching.

Post Essay:
If Oscar and Lionel were my students, I would sit down with them together and talk about why each person feels this way. I would start the conversation with Oscar because he feels confident in his ability to study. I would ask Oscar to explain how he learned to study, how he came up with his study routine, and does he use this technique with every class. Then I would ask Lionel to explain his study method, using the same questions as I did with Oscar. I would encourage the two boys to work together in developing a new study plan for Lionel. I would meet with Lionel individually to teach him how to monitor his progress with his new study plan. As Lionel’s teacher, I would want to talk with Lionel individually to see if anything was going on at home that might be interfering with his school work. Then I would check his school files to see if this had been a concern in any of the previous school years. The information that I found would determine my next move with Lionel. I think working with Oscar would benefit Lionel right away, even I didn’t find anything that could explain why Lionel was struggling on his tests. Oscar may have a higher natural ability when it comes to Physics than Lionel. I would have to help Lionel understand his natural abilities, and explain to him that he may have to work twice as hard as Oscar to get the same grade.
VITA

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Presentations:


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Committee Member, LeAnn G. Putney, Ph.D.
Graduate Faculty Representative, Emily Lin, Ph.D.