CTE Teachers' Perspectives on the Process of CTE and Science Content Integration: A Grounded Theory

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Dedication

This dissertation is dedicated to my family. My wife Sheila, my sons Keaton and Carson, and my little girl Katie. I love you all very much. Without your love I would not have been able to accomplish the task of completing this dissertation.

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Abstract

The integration of career and technical education (CTE) and academic curricular content that capitalizes on natural and inherent connections represents a challenge for CTE professionals. The research question that was used to guide the current study was: What are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers.

The CTE teachers expressed that the process of CTE and science content integration was a process of evolutionizing. From the perspective of the CTE teachers involved integrating CTE and science content resulted in their programs of study being adapted into something different than they were before the process of integration was begun. The CTE teachers revealed that the evolutions in their programs of study and themselves were associated with three other categories within the grounded theory: (a) connecting; (b) enacting; and (c) futuring. The process of CTE and science content integration represents a deep and complex episode for CTE teachers. The process of CTE and science content integration requires connecting to others, putting ideas into action, and an orienting towards the future.

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Chapter 1

INTRODUCTION

After the 3:30 P.M. bell signals the end of the school day, an agricultural education teacher named Hinata is creating instructional plans and typing them into her faculty computer. Hinata is planning instructional experiences that will assist her students in constructing an accurate understanding of the agronomic impact of plant transpiration. She is carefully designing her instructional activities to include opportunities for experimentation with a variety of plants and a sequence of temperatures. Hinata's instructional plans purposefully embed the utilization of the scientific method as a means to discover the effect that temperature has on plant transpiration. Hinata's instructional plans also account for student learning opportunities which arise through the creation of tables and graphs which are suitable for data comparison and reporting. Hinata is creating instructional plans designed to provide her students with knowledge building experiences that target plant transpiration, the scientific method, and data reporting. However, Hinata's planning process is also focusing on creating opportunities for students to recognize the importance of being able to transfer understandings across domains of knowledge and situational contexts. Clearly, Hinata is engaging in a process that connects content from different disciplines and fields of study within the unifying context of agriculture.

As an agricultural educator, Hinata is planning instructional content for a Career and Technical Education (CTE) program of study. Hinata's agricultural education program of study has gone through a process which has culminated in the creation of instructional plans and learning objectives that are designed to integrate CTE and science instructional content within an agricultural context. The agricultural education CTE program of study has been designed to take advantage of integrating the science content that is inherent to the field of agriculture within classroom and laboratory instructional experiences.

While the short vignette of Hinata's instructional planning process is interesting, it also is likely to raise questions. Why did Hinata start to integrate science? How did Hinata engage the process of CTE and science content integration? What aspects of the process of CTE and science content integration are critical for success? By deconstructing the vignette of Hinata's experience it is possible to paint a picture that will serve as a descriptive bridge into an exploration of a more refined understanding of CTE programs of study and the process of CTE and science content integration.

Prefacing CTE and Science Content Integration

Historically, CTE programs of study have been considered to be separate from the academic subjects (i.e., math, science, social studies, English language arts) that tend to be recognized as the core of the U.S. educational system (Gordon, 2008; Thompson, 1996). From a conceptual perspective, CTE programs of study have traditionally focused on curriculum and instructional practices which were based on the industry specific skills and technologies that would assist students in transitioning into skilled wage employment (Gordon, 2008; Stewart, Moore, & Flowers, 2004). However, as the educational reform movement has moved forward and broadened its agenda, its tendrils have extended deeply into the realm of CTE (Stearn & Stearns, 2006). One of the main outcomes of that reach has been to provide an impetus for reimaging what CTE is and what it might become for future populations of students (DeLuca, Plank, & Estacion, 2006; Warnick & Thompson, 2007). It is clear that, CTE must be adapted to account for the sociological and technological advances which continually transform the nature of work and life (Weimer, 2003). CTE is currently defined by federal legislation as:

> Organized educational activities that offer a sequence of courses that provides individuals with the academic and technical knowledge and skills the individuals need to prepare for further education and for careers in current or emerging employment sectors. Career and technical education includes competency-based applied learning that contributes to student's academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills (Carl D. Perkins Career & Technical Education Act, 2006, p. 4).

In general, modern CTE programs may be characterized as programs of study which include: (1) curricular content in the areas of: (a) agriculture; (b) business / marketing; (c) computer/communications technology; (d) construction; (e) trade and industrial; (f) transportation; (g) health care; (j) public safety; and (k) food service / hospitality; (2) authentic contextualized competency-based classroom and laboratory instruction; and (3) Work Based Learning (WBL) experiences (Association for Career and Technical Education, 2011).

Many CTE programs of study are well aligned with the current definition of CTE delineated within federal legislation. However, some CTE programs need to engage in adaptive processes in order to meet the expectations identified within the current definition (Brister & Swortzel, 2007; Fletcher & Zirkle, 2009; Ricketts, Duncan, & Peake, 2006; Washburn & Myers, 2010; Young, Edwards, & Leising, 2009). One of the central themes embedded within the movement to adapt CTE to the future needs of students is to utilize CTE as a context for a broader set of student outcomes (Stearn & Stearns, 2006; Stewart, Moore, & Flowers, 2004). One facet within the broader set of student outcomes is to utilize CTE programs of study as a places and spaces in which academic content can be contextualized. This strategy has been explicitly encouraged since the enactment of the 1990 amendments to the Carl Perkins Act which stated that the basic federal grant to individual states for vocational education be spent on programs that “integrate academic and vocational education” (Carl D. Perkins Vocational and Applied Technology Education Act Amendments, 1990, p. 6).

In light of the present study, it is particularly useful to highlight that the current legislative definition of CTE explicitly includes providing individuals with academic knowledge and skills. Further, the legislation implies that it is essential for CTE programs of study to integrate experiences with academic content into student learning activities. The explicit inclusion of academic content experiences as an essential component of CTE programs of study represents an important change in how CTE is conceptualized (Camp, 1983; Fletcher & Zirkle, 2009; Gordon, 2008; Stearn and Stearns, 2006). The legislative outcomes also serve as evidence that the inclusion of academic content in CTE programs of study has gained credibility and prominence (Brister & Swortzel, 2007; Castellano, Stringfield, & Stone, 2003; Rojewski, 2002).

One of the most active discourses within the realm of CTE has encompassed the integration of CTE and science instructional content (Blaschweid & Thompson, 2002; Brister & Swortzel, 2007; Conroy & Walker, 2000; Hyslop, 2010; National Research Center for Career and Technical Education, 2010; Osborne, 2000; Washburn & Myers, 2010). Going back to the vignette at the beginning of this introduction, clearly Hinata was engaged in creating learning activities designed to assist her students in constructing new understandings through the contextualization of science concepts within authentic learning activities. It is those contextualized understandings that epitomize the potential that CTE and science content integration cultivates within CTE programs of study.

Contextualizing CTE and Science Content Integration

CTE and science content integration is being advanced by policy decisions (Fletcher & Zirkle, 2009). Perhaps more importantly however, the policy decisions are being driven by calls for improvement in science educational opportunities by a spectrum of stakeholders including: (a) researcher, (b) practitioner, and (c) business and industry groups (National Science Teachers Association, 2007). Researchers and practitioners recognized that college and career ready persons should be able to utilize science content knowledge as one of their many tools for reasoning, decision making, and problem solving across domains of knowledge (Hyslop, 2010; Kerr, 2006; Mestre, 2005; Myers & Washburn, 2008). Further, concerns from business and industry regarding economic competitiveness stress the central importance of a science education that will allow the U.S. to keep pace with its global competitors (National Science Teachers Association, 2007). The National Research Council (2007) noted that science understanding and ability enhances the capability of all learners to provide meaningful and productive contributions to society.

The process of CTE and science content integration supports students' learning activities and problem solving in ways that reflect the real-world nature of authentic tasks and challenges (Karweit, 1993). Learning is nested within interactions with the environment and the mind of the learner seeks meaning through the interpretation of those contextualized interactions (Perkins, 1999). It is important to recognize that the process of CTE and science content integration creates opportunities for CTE educators to construct contextualized authentic learning experiences. When learning is contextualized, learning activities and the actual physical environment provide scaffolding structures which propagate knowledge construction, facilitate long term memory encoding, and promote organization for memory recall (Clifford & Wilson, 2000). When knowledge and experiences associated with CTE and science content integration are contextualized, students do not need to construct artificial connections between what they are learning and how it fits into their reality (Gredler, 2001).

CTE programs of study can and do provide students with learning opportunities associated with CTE and science content integration (Balschweid & Thompson, 2002; Ricketts, Duncan, & Peake, 2006). Myers and Washburn (2008) noted that a number of prominent researchers (Balschweid & Thompson, 2002; Balschweid, Thompson, & Cole, 2000; Conroy & Walker, 2000; Enderlin & Osborne, 1992; Mabie & Baker, 1996; Parr, Edwards, & Leising, 2006; Persinger & Gliem, 1987; Roegge & Russell, 1990; Stone, Alfeld, Pearson, Lewis, & Jensen, 2005; Young, Edwards, & Leising, 2009) have begun to establish a solid knowledge base within the area of CTE and science content integration. However, there are questions surrounding CTE and science content integration that need to be addressed so that teachers can optimize the learning experiences of today's students.

Problem Statement

Perhaps in order to move forward, it would be useful to reexamine the vignette from the opening of this introduction. Hinata was creating instructional plans designed to provide her students with knowledge building experiences that integrate CTE and science content. Clearly, Hinata was engaging in a process that connected content from different disciplines and fields of study within a unifying context. Inherent within Hinata's process of CTE and science content integration was the creation of opportunities for students to recognize the importance of being able to transfer understandings across domains of knowledge and situational contexts. How did Hinata determine what science content was appropriate to integrate and how did she enact the process of CTE and science content integration?

While there are many questions regarding curriculum integration, CTE teachers, school environments, CTE content, and science content that are important to the overall understanding of CTE and science content integration, there has been little research completed that addresses CTE and science content integration as a process (Edwards, 2004; Myers & Washburn, 2008; Spindler, 2010). As Edwards (2004) noted, the research base regarding how teachers think about and conduct curriculum integration in secondary schools is, for the most part, undeveloped. More specifically, very little information exists in the literature regarding how CTE teachers make sense of CTE and science content integration, particularly with respect to the creation of learning objectives that will guide the instructional activities utilized to engage students (Scott & Sarkees-Wircenski, 2008; Warnick & Thompson, 2007).

It is clear that the existing research literature does little to assist in understanding the process of CTE and science content integration based upon the experiences and perspectives of CTE teachers (Fetcher & Zirkle, 2009). In fact, there has been no recent research that frames CTE and science content integration as process which may be experienced by CTE teachers. Further, there is a dearth of research findings that illustrate specific methods, actions, supports, and resources which facilitate the process of CTE and science content integration (Edwards, 2004; Stearn & Stearns, 2006; Washburn & Myers; 2010).

Much of the research regarding CTE and science content integration has focused on perceptions of its merit and worth rather than on questions of how the process is or might be carried out (Ricketts, Duncan, & Peake, 2006; Spindler, 2010; Warnick & Thompson, 2007). Research needs to be enacted that will assist in identifying, developing, and connecting the phenomena that are the building blocks of the mechanism that initiates, drives, and sustains the CTE and science integration process (Washburn & Myers, 2010). Research is needed that investigates the process of CTE and science content integration from the perspective of CTE teachers in order to describe their lived experiences (Fletcher & Zirkle, 2009; Myers & Washburn, 2008). Investigating the lived experiences of teachers will serve to provide a more comprehensive basis for understanding CTE and science content integration, and in particular, the process of CTE and science content integration (Spindler, 2010; Warnick & Thompson, 2007). The calls for research in this vein of inquiry might be best investigated by the implementation of a grounded theory research study.

Grounded theory provides a means to address a vein of inquiry that had not yet been tapped and could not be tapped easily by use of other methods. In fact, grounded theory as a method of research is designed to address new avenues of inquiry (Strauss & Corbin, 1990). Further, given a lack of knowledge regarding the process of CTE and science integration from the perspective of CTE teachers, it was necessary to utilize a method which focused on eliminating the impact of researcher assumptions on the research outcomes. Grounded theory is ideal in this regard because it focuses on the facts that arise from the data rather than fitting the data into preconceived silos (Creswell, 2005).

Grounded theory methods are not directed at confirming a theory within a given set of parameters. Instead, the researcher seeks to obtain emergent categories at different levels of abstraction which conceptualize the phenomena of interest (Strauss & Corbin, 1990). In addition, the purpose of grounded theory research is not to construct grand theory, but rather to create a conceptual depiction which can be applied in order to understand particular phenomena more deeply. Grand theories are a class of theories rather than a particular one. Examples of grand theories include social cognitive theory and psychoanalytic theory. Grand theories usually attempt to forward an overarching explanation of social life, history, or human experience (Camp, 2001). A Grand theory is usually recognized as a comprehensive assemblage of ideas and concepts (Haskell, 2001). Social scientists often use grand theories as a basis for exploration, but consider smaller theories and recent research as well.

Grounded theory research emphasizes the role of interpretive understanding and seeks to construct a grounded theory that consists of a set of concepts and postulated connections between those concepts (Creswell, 2005). A grounded theory may be thought of as a simplification that can exist at many levels, and one that is aimed at clarifying and explaining some aspect of the world and our experiences of it (Groenewald, 2008). The grounded theory that emerges from a study then may serve as a model or framework that has implications for understanding or action. In the case of the current study, not only does the grounded theory add to the understanding of the process of CTE and science content integration, it provides a basis for the implementation of activities and resources for CTE and science integrating CTE teachers. Relating back to the calls for research in this vein of inquiry, the grounded theory method facilitates the identification, development, and connection of the phenomena that are the building blocks of the mechanism that initiates, drives, and sustains the CTE and science integration process.

One common goal of grounded theory research is to construct a conceptual explication of a progression of events. In the case of this study, the research was directed at creating an understanding of the process of CTE and science content integration at a conceptual level. Utilizing the grounded theory method for the current study had the goal of generating concepts which transcend time and place to explain CTE teachers' perceptions, experiences, and actions within the process of CTE and science content integration (Bryant & Charmaz, 2007).

The findings of this study will construct a grounded theory which illuminates the process of CTE and science content integration from the perspective of CTE teachers. An additional reason to utilize grounded theory for this research was that it incorporated a research design which had not been previously implemented in the area of inquiry. As

Creswell (2005), noted, by employing a variety of research designs to respond to questions encapsulating a vein of research, it is possible to construct a deeper and more contextualized understanding of the area of inquiry. Further, the strongest cases for the use of grounded theory are in addressing inquiries that are directed at: (a) creating information regarding phenomena about which little is currently known; or (b) cultivating and framing new perspectives in a familiar vein of inquiry (Patton, 2002). Grounded theory research, is by definition, most appropriately directed at developing ideas where no substantive theoretical frame and or a dearth of findings exist to guide research or practice. Therefore, the fact that there exists a dearth of findings which describe, explicate, or evaluate the process of CTE and science content integration supports the utilization of grounded theory methods within the current study.

Utilizing a grounded theory approach to study the question of how CTE teachers integrate science content into their programs of study facilitated the creation of new knowledge through the lens of a unique perspective. The procedures utilized within the current study were designed to facilitate the construction of a grounded theory that emerged from, and was grounded in the data (Charmaz, 2006; Strauss & Corbin, 1997). By employing grounded theory methodology it was possible to construct a theory which explicates the: (a) meanings, (b) interactions, and (c) contexts which are integral to the process of CTE and science content integration from the perspective of CTE teachers. It was critical that such research be undertaken in order to create a more holistic frame of reference regarding the process of CTE and science content integration. In addition, the findings of the current study should serve as a basis for practical applications and further substantive research within the realm of CTE and science content integration.

Research Question

The research question that was used to guide the current study was: What are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers.

The following questions were used to provide direction to the research process:

1) What is important about career and technical education?
2) Prior to teaching, what kind of experiences did you have related science?
3) When you think about integrating CTE and science content what comes to mind?
4) How did the process of integrating science into the (insert program name) program of study begin?
5) What kinds of experiences have you had while engaged in the integration of science into the (insert program name) program of study?
6) What are the current and future programmatic opportunities regarding the integration of CTE and science content?

Research Audience

The findings, conclusions, and recommendations of this study should be useful to a number of audiences. One audience consists of researchers who are studying CTE and science content integration, curriculum development, or the professional development needs of CTE teachers. Other audiences who will benefit from this research include federal and state education department representatives and policy makers who need information about best practices, synergistic empowerments, and inherent barriers to high quality CTE and science content integration. In addition, CTE teachers and school administrators should find that the research findings assist them in organizing and engaging in the process of CTE and science content integration. In particular the research findings will provide (a) CTE teachers with insight into the experience of engaging in the process of CTE and science content integration; and (b) administrators with an understanding of the needs and perspectives of CTE teachers regarding CTE and science integration. Overall, this research provides findings, conclusions, and recommendations that are useful in further developing the capacity of CTE programs of study to construct and enact high quality student learning experiences pertaining to CTE and science content integration.

Definitions of Terms

AXIAL CODING. A set of procedures whereby data are put back together in new ways after open coding, by making connections between categories (Strauss & Corbin, 1990, p.96).

BOCES. Boards of Cooperative Educational Services are public organizations that were created by the New York State Legislature in 1948 to provide shared educational programs and services to school districts. BOCES typically provide the following programs and services: (a) career and technical education (secondary and adult students); (b) education for exceptional children; (c) centers for workforce development.

CONSTANT COMPARISION. Code subsequent interviews (or data from other sources) with existing data sets and the emerging theory in mind. Comparison of data sets to data sets and comparing data sets to the developing theory throughout the data collection process (Glaser & Strauss, 1967).

CORE CATEGORY. A core category is the main theme, storyline, or process that subsumes and integrates all lower level categories in a grounded theory. The core category encapsulates the data efficiently at the most abstract level, and is the category with the strongest explanatory power (Charmaz, 2006).

GERUND. The form of a verb when functioning as a noun; A noun formed from a verb, denoting an action or state. In English, the gerund, like the present participle is formed in –ing: the living is easy. Grounded theorists use gerunds to identify categories and theoretical elements in order to indicate action and change (Bryant & Charmaz, 2007)

GRAND THEORY. Grand theories are a class of theories. Examples of grand theories include social cognitive theory and psychoanalytic theory. Grand theories usually attempt to forward an overarching explanation of social life, history, or human experience (Camp, 2001). A Grand theory is usually recognized as a comprehensive assemblage of ideas and concepts (Haskell, 2001).

GROUNDED THEORY (method). A method of qualitative research that builds theory from the inductive analysis of data. Rather than starting with a theoretical framework or perspective, the grounded theory research builds theory directly from the data. The focus is on building, generating, or constructing a theory or theoretical model rather than testing an existing theory (Glaser & Strauss, 1967).

GROUNDED THEORY. The result of a conceptual analysis of patterned relationships that form a model or set of concepts and propositions that pertains to some actual phenomena; Provides an understanding of phenomena or forms the basis for action with respect to them (Glaser, 1992; Charmaz, 2006).

MEMOING. The act of recording reflective notes about what is being learned from the data. Memos accumulate as written ideas or diagrams about concepts and their relationships. Memos are notes by the researcher to themself about some hypothesis regarding a category or property and especially critical in defining relationships between categories (Groenewald, 2008).

NEW VISIONS PROGRAM: New Visions programs are one-year, honors-level courses that turn area businesses into classrooms for highly motivated, academically successful high school seniors. New Visions programs are available in: Health Careers, Human Services & Special/Elementary Education, Law & Government, and Journalism & Media Studies.

OPEN CODING. The process of breaking down, examining, comparing, conceptualizing, and categorizing data (Strauss & Corbin, 1990, p. 61).

SCIENCE CONTENT. Includes factual knowledge as well as knowledge of science as a process; including laboratory skills and techniques.

SELECTIVE CODING. The process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development (Strauss & Corbin, 1990, p.116).

THEORETICAL SATURATION. Theoretical saturation signals the point in grounded theory studies at which theorizing the events under investigation is considered to have come to a sufficiently comprehensive end. At this point, researchers are comfortable that the properties and dimensions of the concepts and conceptual relationships selected to render the target phenomenon are fully described and that they have captured its complexity and variation (Glaser & Strauss, 1967).

Assumptions and Limitations

This study sought to explain the unique experiences of each individual, therefore overgeneralizing the findings to the general population of CTE teachers is unwarranted. The participant frame was obtained from a self-selected sample of CTE teachers that had participated in a previous related research study and may not be representative of all CTE teachers. The CTE teachers who participated in the research study had already enacted the process of CTE and science integration and worked within CTE programs of study that were actively integrating CTE and science. By selecting CTE teacher participants that are known to have engaged in CTE and science integration it was possible raise the credibility and reliability facets of the research data. It is assumed that the responses provided by the participants to the researcher were honest and accurate in nature.

Chapter 2

REVIEW OF LITERATURE

The epistemological lens through which qualitative studies are viewed is different than the lens through which quantitative studies are viewed. Research using quantitative methods is driven by the inclusion of a robust review of literature which is utilized to illuminate relevant previous research, reveal disjunctions in knowledge, and delineate a guiding theoretical or conceptual framework. In contrast, research utilizing qualitative methods purposefully utilizes a minimalist or no review of literature prior to beginning the collection of research data. In fact, within the boundary of grounded theory methodologies researchers are counseled to analyze at least the first iteration of collected data before conducting a review of the related literature (Glaser 1992; Glaser and Strauss, 1967).

The methods of grounded theory are designed to reveal rather than test or duplicate concepts and hypotheses. It is possible that a close review of previous research could have a constraining effect on the open discovery of a theory (Charmaz, 2006; Glaser, 1992; Glaser and Strauss, 1967; Strauss and Corbin, 1990). Within the bounds of grounded theory it is critical to attend to the idea that the researcher must attempt to eliminate preconceptions in order to let a theoretical framework emerge from the data that is collected. However, as Strauss and Corbin (1990) point out, it is also important for researchers to have a base level of knowledge that will allow them to be sensitive to the generation of theory from the first data samples. It should be noted that Straus and Corbin (1990) also stress that the theoretical framework should be revealed through an analysis of the data that is assembled and not constructed from a study of the literature.

In the present study, a minimal review of literature was completed in order to establish a base level of knowledge and understanding of CTE and science integration and the other types of research that have been utilized within the area of study. In addition, the related literature was reviewed in order to construct the preliminary problem statement and guiding research questions. Methodologically, such a minimal review of the related literature is not problematic, as long as precautions are taken to eliminate the effect it may manifest on the responses of the research participants.

Educational Reform

The United States has been and continues to be engaged in an enduring period of educational reform that has spanned at least the last two decades (Edwards, 2004; Elmore, 1995; Fletcher & Zirkle, 2009). Much of the reform movement has been driven by calls to raise academic standards, increase accountability, and identify opportunities for improvement through systemic change (Edwards, 2004). In regards to the educational reform movement, CTE has made moves to focus more on dropout prevention, attainment of basic academic skills, and connections to postsecondary learning opportunities (Fletcher & Zirkle, 2009; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006). Further, throughout the past decade educational reformers have consistently agreed that there needs to be more of a connection between the basic skills such as science and mathematics and the real world (Stern & Stearns, 2006). Literature and reports put forth by researchers and policy analysts have indicated that mathematics and science curricula in U.S. secondary schools lack overall coherence, depth, and continuity (Fletcher & Zirkle, 2009). In addition, Fletcher and Zirkle (2009) note that researchers and policy analysts have pointed out that the most innovative science curricula are driving instruction that focuses on inquiry, connections between disciplines, concern for societal implications, and support for a science based way of knowing.

Need for Improved Science Instruction

Providing high-quality instruction quickly surfaces in reports on education as one of the primary cornerstones for solving the national problem of poor math and science performance among American students (Kerr, 2006). Quite possibly this is because the typical method of instruction in schools seems to strangle the innate curiosity of students to learn and discover. Further, the secondary science education system has not been successful as a whole in maximizing student achievement in classrooms or laboratories. In fact, research reveals that secondary science education in the United States performs rather poorly (Kerr, 2006).

Some researchers cite the fact that large numbers of students avoid science in secondary and postsecondary education to posit that, overall, the delivery of science in the U.S. is filled with gloom and doom (Blaschweid & Thompson, 2000). Still others have labeled “science education” as a misnomer and suggest that science in schools has little to do with science as it is actually practiced (Conroy & Walker, 2000). However, newer standards targeting science call for a new conception of science instruction (National Research Council, 1999). The kinds of “inquiry-oriented” instruction described in the standards treat learning as an active process that is geared towards implementing higher order learning objectives and experiential learning activities that support the scientific process.

Not only are changes afoot in science education as a field of study, increasingly, content area teachers such as CTE teachers are being called upon to enhance student achievement in math, science, and reading (Belcher, McCaslin, & Headley, 1996; Conroy & Walker, 2000, Park & Osborne, 2007). As Parr, Edwards, and Leising (2006) noted, there is an underlying disconnection between subject matter silos in secondary education that is likely a factor in students' misunderstandings and inabilities to utilize what they experience in course work in practical ways.

Contextualized Science Instruction

In an effort to address overall student achievement and the need to create learning environments that address the lack of coherence, depth, and continuity within academic studies, CTE policy and research frameworks have begun to focus more on contextualizing academic content (Carl D. Perkins Career and Technical Education Act, 2006). In particular, CTE policies and research frameworks have operationalized the contextualization of academic content through the utilization of authentic CTE based student learning experiences. While the theoretical conception of integrating CTE and academic content has its roots in the ideas of John Dewey, it has only gained traction on a large scale fairly recently. As Flecther and Zirkle (2009) highlighted, the new modus operandi for CTE is to prepare students to be college and career ready. This new focus has identified need for CTE constituents to redesign the ways in which curricula are constructed and aligned.

One of the most critical facets of education, at any level, is to assist students in the development of their ability to transfer knowledge and skills to novel situations which they may be faced with (Park & Osborne, 2007). Transfer may be defined as one's ability to utilize previous knowledge to construct meaningful understanding in new situations in order to address challenges or solve problems (Blumberg, 2009). In order for transfer to occur it is important that students develop a deep understanding of the content in one domain and then be able to recognize patterns or similarities in situations that will afford their transfer of knowledge or skills (Park & Osborne, 2007). It is likely that contextualizing the content and skills to be learned will assist students in developing their ability to transfer what they have learned across domains (Snow, 2002).

While CTE programs of study focus, for the most part, on assisting students to develop their understanding and skills within the specialty content of the program, they can do more. CTE programs of study have the opportunity to assist students in developing their ability to transfer understandings and skills across domains in order to facilitate meaningful learning and raise overall student achievement. CTE programs of study can offer students experiences which will afford them opportunities to interact with instructional scaffolding that contextualizes CTE and academic content and skills to support the construction of meaningful learning. In addition, meaningful learning will enable students to have a deeper understanding of both the CTE and academic content as standalone complexes because they will achieve a greater understanding of how that content is interconnected within the world the students experience (Snow, 2002).

CTE and Academic Content

As a consequence of the impact of the reform movement and of current educational legislation, the redesign of traditional CTE programs of study is moving towards a model which seamlessly integrates CTE and academic pathways (Castellano et al, 2003; DeLuca, Plank, & Estacion, 2006; Fletcher & Zirkle, 2009; Gordon, 2008; Scott & Sarkees-Wircenski, 2008). Therefore, one outcome of the redesign is that curricula that have been traditionally separated are being integrated. The main purpose of the integrating outcome is to construct contextualized learning environments that utilize authentic applications to prepare students for college and career readiness.

Research reveals that CTE programs of study already can and do offer students opportunities to engage in authentic learning experiences that support contextualized applications of both technical and academic knowledge (Dyer & Osborne, 1996; Mabie & Baker, 1996; Parr & Edwards, 2004; Ricketts, Duncan, & Peake, 2006). Through careful design and planning, CTE instructors can create authentic learning activities and environments that take advantage of the connections that inherently exist between their technical specialty and academic content. Further, it is possible for CTE instructors to support the learning needs of all students more effectively by explicitly highlighting and guiding students through the processes of: (a) engaging in higher order or more complex levels of cognitive processing, and (b) constructing different types of knowledge to form a more holistic understanding of the world (Knobloch, 2003; Krathwohl, 2002; NSTA, 2007; Scriber & Akiba, 2009; Smith, Desimone, & Ueno, 2005).

There is often an expectation that academic subjects will be integrated holistically and seamlessly into secondary CTE programs using the academic content inherent to the context of each specialty area (Stewart, Moore, & Flowers, 2004). Research findings indicate that the most effective CTE and academic content integration emerges as an outcome of classroom and laboratory experiences that foster contextualized learning environments (Ricketts, Duncan, & Peake, 2006; Stone, Alfeld, Pearson, Lewis, & Jensen, 2005). The central strength of CTE and academic integration is grounded in the fact that, by definition, CTE programs and courses of study offer opportunities to link learned knowledge and skills directly with authentic applications (Castellano, Stringfield, Stone, 2003).

Today, secondary CTE programs may focus on a diverse array of subject areas such as electrical systems, GIS technology, horticulture, and green construction. The variety of possible subject areas within CTE programs creates a context in which there exists a multitude of opportunities for the integration of CTE and academic content (Balschweid & Thompson, 2002; Ricketts, Duncan, & Peake, 2006). As Myers and Washburn (2008) noted, a number of prominent researchers (Balschweid & Thompson, 2002; Balschweid, Thompson, & Cole, 2000; Conroy & Walker, 2000; Enderlin & Osborne, 1992; Mabie & Baker, 1996; Parr, Edwards, & Leising, 2006; Persinger & Gliem, 1987; Roegge & Russell, 1990; Stone, Alfeld, Pearson, Lewis, & Jensen, 2005; Young, Edwards, & Leising, 2009) have begun to establish a solid knowledge base within the area of CTE and academic integration.

CTE and Science Content

In particular, this study is concerned with the integration of CTE and science content. But why is it important to focus specifically on the integration of CTE and science? There is little doubt that the connections between CTE and science play an important role in our society, given the wide range of practical applications for scientific methods, tools, and discoveries within the context of technical occupations and technical training (Warnick & Thompson, 2007). As a consequence, CTE teachers must be prepared to integrate science into their instructional practices and to do so in pedagogically effective ways (Ricketts, Duncan, & Peake, 2006). Further support for research into the process of CTE and science integration is evidenced by the Nation's Report Card (National Assessment of Educational Progress, 2002) which states that 53% of high school seniors have partial or better mastery at the 12th grade level in science, yet only 18% are considered to be proficient or better (Washburn & Myers, 2010).

According to Chun (2010), a major goal of teaching is to prepare students to be able to adapt knowledge to a variety of challenging problems and settings. One of the most effective techniques for assisting students to develop adaptability is through employment laboratory activities (National Association of Science Teachers, 2007). Through the proper employment of laboratory activities both CTE and science teachers have the opportunity to engage their students in complex cognitive processing that requires students to translate static knowledge and skills into activities which they can connect to and experience in an active contextualized form (Bloom, 2007).

However, laboratory activities are often not employed properly and they fail to properly engage students in higher order cognitive processes that require them to exert their mental muscles. In many cases, laboratory exercises in CTE and science courses of study are little more than activities with per-determined outcomes (Myers & Washburn, 2008). If CTE teachers are going to integrate CTE and science content they should aim at integrating higher order cognitive processes which foster the practice of scientific methods.

CTE and Science Integration and Higher Order Cognitive Processes

As Myers and Washburn (2008) noted, the scientific and technological literacy needs of individuals entering careers are becoming increasingly important. Employees in today's job market need to know how to learn, reason, think creatively, make decisions, and solve problems (National Science Teachers Association, 2007). It is essential for CTE programs of study are to offer students substantive assistance in the area of science. It is also important for those very same CTE programs to be able to create instructional experiences for students that utilize higher order cognitive processes in conjunction with the understandings and skills that are necessary for career and college readiness. Further, one of the major goals of science education is to improve the higher order thinking skills of students (Brister & Swortzel, 2007; Fletcher & Zirkle, 2009; Resnick ,1987). Therefore, in order for CTE programs of study to optimize the integration of science an emphasis should also be placed on assisting students in further developing their higher order cognitive abilities.

In order to infuse integrated science that assist students in developing their higher order cognitive processes, it is important that CTE teachers recognize higher order cognitive skills and processes as distinct and explicit educational objectives (Zohar & Dori, 2003). By creating instruction that explicitly focuses on higher order cognitive processes, CTE programs of study can assist students in developing technical, scientific, and higher order thinking skills and abilities utilizing a gestalt like environment that supports real world understanding.

Further, Yerrick (2000) stated that creating an explicit focus on higher order cognitive process outcomes may be particularly important for students in traditionally non-college track programs of study. This is because research has found that students in lower track classrooms are less likely to be exposed to instruction that fosters higher order cognitive processing skills and abilities. Additional support for CTE and science integration that fosters higher levels of cognitive processing comes from the National Science Teachers Association (2007) which advocates that students should learn through addressing higher order inquiries about the world as a coherent whole by way of interdisciplinary links, real-world applications, and connections to the world of work.

It is clear that CTE can enrich the experiences of students and provide an essential context in which they can develop vocational and science understandings and skills (Ricketts, Duncan, & Peake, 2006; Washburn & Myers, 2010; Young, Edwards, & Leising, 2009). However, it is important to be cognizant of the fact that contextualizing science within CTE programs of study is likely to make it necessary for CTE teachers to develop or adapt: curricular content, teaching strategies, and learning resources. It is critical that researchers, CTE teachers, science teachers, and administrators work together to bring about a shift in emphasis within CTE and science content integration. CTE and science content integrating learning activities should assist students in simultaneously developing their CTE and science understandings while engaging them in the higher order cognitive processes necessary for career and college readiness (Fletcher & Zirkle, 2009).

CTE and Science Integration Questions from the Literature

It is clearly becoming more important to examine teachers' experiences and the environmental facets and factors that may support or impede their use of CTE and science integrating learning objectives that engage students in higher levels of cognitive processing. While CTE and science integration is prevalent in CTE programs of study, the pressing issue currently centers on how science is or is not being integrated into the teaching and learning process. One possible negative consequence of poor CTE and science integration may be compromised student understandings or achievement (Stearn & Stearns, 2006; Thompson, 1996). Further, Myers and Washburn (2008) determined much more research needs to be enacted to form a more comprehensive understanding of CTE and academic integration. In particular, more research needs to be conducted that assists in defining the following two concepts: (a) how CTE and academic integration is being operationalized within CTE programs of study, and (b) how the integration of CTE and academic content and learning experiences affect overall student achievement (Edwards, 2004; Myers & Washburn, 2008

Table 1 delineates specific recommendations for further research that were gleaned from the literature. The recommendations in Table 1 are based on research publications that have synthesized previous research that was conducted from 1988 through 2005. The recommendations are critical to include in this review of literature because they speak directly to both the question being addressed by the current research study and the design that will be enacted in order to create information that responds to the research question.

Table 1
Recommendations for Further Research

Author(s)	Recommendation
Swortzel 2007:	Further research should be conducted to determine if science credit is being gained through Ag program participation and if it is warranted
Washburn & Myers 2010:	Research should determine if teachers are utilizing teacher-oriented or student-oriented inquiry strategies. Research should identify factors influencing CTE teachers current and planned levels of science integration. Investigations should determine whether CTE teacher preparation and professional development experiences are important for science integration
Warnick & Thompson 2007:	Programmatic factors should be investigated to begin to form a model for integration. Research should address the possible need for professional development in how to integrate CTE and science. Qualitative research should explore the lives of teachers that integrate science to determine predictors and experiences of those integrating science

Table 1 illustrates that recent research is calling for further examinations of factors that influence CTE and science integration. In particular such investigations should be used to begin to develop a model for the integration of CTE and science content. Table 1 reveals that researchers (Warnick & Thompson, 2007; Washburn & Myers, 2010) believe a better understanding of how professional development experiences and needs may affect CTE and science content integration. In addition, Table 1 illustrates that Warnick and Thompson (2007), specifically call for the enactment of qualitative research that could address the experiences of CTE teachers engaged in the process of CTE and science content integration.

The prevailing wisdom regarding the overall success of any new innovation in secondary schools states that it will be heavily dependent upon the active involvement of teachers (Shelley-Tolbert, Conroy, & Dailey, 2000). In the case of constructing CTE and science integrating learning contexts, it will require the creation and implementation of a new or revised curriculum for CTE programs of study. Previous research indicated that curricular innovations require teachers to be introduced to the new subject domain, have an understanding of the elements of the innovation, adopt the innovation, and acquire the new knowledge, skills, and routines needed to adequately teach the new subject (Park & Osborne, 2007; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006; Warnick, & Thompson, 2007).

The current study will provide guidance to CTE teachers, administrators, and providers of professional development regarding the process of integrating CTE and science content. It is critical that a more holistic understanding of how CTE teachers integrate CTE and science content within CTE programs of study be created. The understandings that arise from the current study will assist greatly in the organization and enactment of future research activities and utilization of targeted professional development resources.

Chapter 3

RESEARCH DESIGN AND METHODS

Chapter three consists of a description of the research design and methods that were utilized during the data collection and analysis portions of the study. Chapter three begins with a brief description of the perspectives of qualitative and grounded theory research. Next the chapter provides sections that describe the participant selection and the data collection and analysis procedures that were utilized during the course of the research study. Chapter three concludes with the researcher's statement of researcher subjectivity which provides insight into the perspectives and proclivities of the researcher.

Based on the contents of Chapters one and two, it is clear that further research regarding the process of CTE and science content integration is warranted. More specifically, research regarding the process of CTE and science content integration is needed to elucidate; (a) the nature of the process, (b) the process as an experience, and (c) factors that influenced the process. To date there has been no research that has addressed CTE teachers' perspectives of and experiences with the process of CTE and science content integration. Therefore, The research question that was used to guide the current study was: What are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers.

A qualitative approach was utilized in this study as a means to better understand the process in which CTE teachers engage in to integrate CTE and science content. As defined by Denzin and Lincoln (1994), qualitative research is a multi-faceted method, involving an interpretive and naturalistic approach to carrying out inquiry. Qualitative studies create information by constructing inquiries that investigate phenomena in their natural settings and through the interpretation of the meaning people attach to those phenomena.

Qualitative Epistemology and Theoretical Perspective

While quantitative research stresses the importance of generalizability, the goal of the qualitative approach is “to understand the particular in depth, rather than finding out what is generally true of many” (Merriam, 1995, p. 57). In order to achieve a sound understanding of the research, thick description is utilized to detail the participants’ perceptions and experiences. Schwandt (2007), stated that “to thickly describe perceptions and experiences is actually to begin to interpret them by recording the circumstances, meanings, intentions, strategies, motivations, and so on that characterize particular episodes. It is this interpretive characteristic of description rather than detail per se that makes it thick” (2007, p. 296). In that view, the thick descriptions incorporated within the current qualitative study will include the cultural framework and meanings of the CTE teachers in order to construct an emic account of the CTE teachers’ perceptions and experiences (Patton, 2002).

Epistemology is concerned with the study of knowledge and justified belief (Charmaz, 2006). A theoretical perspective is a lens that provides a way of looking at the world as it exists and through which it is possible to make sense of perceptions and experiences. An epistemological theoretical perspective revolves around the concept of knowledge and embodies a way of perceiving knowing and our experiences with knowing (Wellman, 1990). Constructivism provides an example of an epistemological theoretical perspective.

Constructivism contends that meaning arises as a result of our experiences with the realities of the world. Further, constructivism forwards the notion that knowledge and truth are not discovered, but rather they are constructed in the mind (Perkins, 1999). Constructivism disavows the notion of an objective external reality independent from individuals from which knowledge may be collected or gained (Charmaz, 2000). Rather constructivism asserts that knowledge is constructed from perceptions of and experiences with social interactions embedded within specific environments (Perkins, 1999).

This research study is be guided by a constructivist epistemological perspective. Each CTE teacher participant had the opportunity to share their unique understandings and experiences which were specific to their participation in a process of CTE and science content integration. Utilizing a constructivist perspective fostered a focus on the individual experiences of the research participants and served to support an acknowledgement of how each participant constructed their understanding of the world (Charmaz, 2000). The research procedures engaged the researcher and participants in a process of constructing a detailed narrative. Narrative data in grounded theory research is analyzed line by line. Grounded theory data analysis focuses on employing levels of codes around to coalesced disparate strands of data into categories. The final outcome of the current study will be a grounded theory of CTE teachers' perceptions of and experiences with the process of CTE and science content integration.

Qualitative Measures of Research Quality

Overall, the purposes of qualitative and quantitative research are the same: to create information that can be utilized to create understandings often for the purposes of making decisions about phenomena. However, quality qualitative and quantitative research methodologies also have distinct differences and criteria for judging quality in one perspective may not be germane within the other perspective (Creswell, 2005). Table 2 illustrates the qualitative and quantitative conceptualizations of the important characteristics of high quality research.

Table 2
Equivalent Measures of Research Quality in Qualitative and Quantitative Research Methodologies

Quantitative Research	Qualitative Research
Internal validity	Credibility
External validity	Transferability
Reliability	Dependability
Objectivity	Confirmability

Note: Adapted from Creswell (2005)

Within qualitative research credibility can be defined as the methodological procedures and sources used to establish a high degree of harmony between the participants' expressions and the researcher's interpretations of them (Creswell, 2005). Charmaz (2000), states that transferability implies that the results of the research can be transferred to other contexts and situations beyond the scope of the study context.

Dependability is often defined as an indication that the results are consistently linked to revealed data and that the findings are an accurate expression of the meanings intended by the participants which support for a replication of the study (Creswell, 2005). Confirmability is concerned with providing evidence that the researcher's interpretations of participants' constructions are rooted in the participants' constructions and that data analysis and the resulting findings and conclusions can be verified as reflective of and grounded in the participants' perceptions (Mavetera & Kroeze, 2009).

According to Merriam (1995), there are five central concepts that qualitative researchers regard in their establishment of the quality criteria listed in Table 2: (a) time, was sufficient time utilized to gain an understanding of the participants and their context; (b) angles, was the data viewed in a holistic way from a variety of perspectives with subjects that are closely connected to the context being studied; (c) colleagues, were supports from knowledgeable external agents utilized to review and critique the data analysis; (d) triangulation, were other sources of data sought out and compared to the collected research data and findings; and (e) member checks, were participants asked to check that the data analysis was accurate and consistent with their beliefs and perceptions of the context being studied.

A variety of strategies and techniques were employed to support the overall quality of the current research. Sufficient time and space were given to the data collection process to support both the credibility and confirmability of the research outcomes. Sixty to 80 minute initial interviews and 40 minute follow-up interviews were conducted with 14 participants to provide a sufficient amount of time to understand the expressions and contexts of the CTE teacher participants. In addition, the researchers' experiences as a CTE teacher added to the overall element of time devoted to the study. The CTE teaching experiences of the researcher allowed for insight into the experiences and contexts of the CTE teacher participants that may have taken much longer to develop through other means (Guzey, 2010).

The research study employed colleagues as external agents to address issues of credibility, transferability, dependability, and confirmability of the data collection and analysis processes (Charmaz, 2006). Two external agents compared the theme of the research with: (a) the selection of participants; (b) the articulations between the transcript data, open codes, and axial codes; (c) the articulations between the axial codes, selective codes, and categories that formed the grounded theory. The external agents also assisted in providing credibility, dependability, and confirmability by reviewing the methods utilized within the study and monitoring the harmony between the CTE teachers' expressions and the researcher's interpretations to ensure that the grounded theory was reflective of the participants' experiences (Creswell, 2005). The external agents also supported the transferability of the research outcomes by serving as sources of alternative perspectives which increases the likelihood of the results being more transferable to other contexts and situations (Merriam, 1995).

The concept of triangulation was utilized within the framework of the study to address credibility, transferability, and dependability of the data analysis and research outcomes (Charmaz, 2006). Triangulation in the case of the current study, was addressed by reviewing the findings of previous research and through the creation of an audit trail. By comparing the data and findings of the current study to previous research it is possible to add an additional anchor point for the specific findings and conclusions illustrated in chapters four and five (Creswell, 2005). Further, if the findings of the current study are supported within existing literature the credibility, transferability, and dependability of the current study are strengthened (Mavetera & Kroeze, 2009). An audit trail was utilized and shared with external agents to establish consistency between the interview data and the proposed findings and to facilitate the writing of the research outcomes in a way that increases the ability of others to replicate the study (Merriam, 1995). Within the framework of the audit trail the researcher documented the data collection process, the development of the open codes, selective codes, and axial codes, as well as, the development of the grounded theory (Merriam, 1995).

Member checks were employed within the research study as a way to support the credibility, dependability, and confirmability of the research outcomes (Charmaz, 2006). Member checks consisted of forty minute follow-up interviews during which the CTE teachers were asked to check that the ideas and expressions which emerged from the data analysis represented an accurate description of their perceptions and experiences in relation to the process of CTE and science content integration. Member checks support credibility by examining the harmony between the expressions of the participants and the interpretations of those expressions (Charmaz, 2005). In addition, member checks support dependability and confirmability by determining that the findings are an accurate representation of the participants intended meanings and that the conclusions arise from accurate representations of the participants' perceptions and experiences (Patton, 2002).

Grounded Theory

Grounded theory refers simultaneously to a method of qualitative inquiry and the products of that inquiry (Charmaz, 2006). Grounded theory method is orientated towards theorizing social and psychosocial processes that arise from the interactions between people, their contexts and interpretations of self and meaning (Locke, 2001). Charmaz (2006, p. 178) posits, “We can view grounded theories as products of emergent processes that occur through interaction. Researchers construct their respective products from the fabric of the interactions, both witnessed and lived.” At its core the grounded theory method consists of a set of systematic, but flexible, guidelines for conducting inductive qualitative inquiry aimed toward theory construction (Eyles, Leydon, Lewith, & Brien, 2011). The data analysis process facilitates the emergence of codes (i.e., open, axial, and selective) from the data which are utilized to construct, in the case of the current study, a grounded theory of CTE teachers’ perspectives of and experiences with the process of CTE and science content integration (Strauss & Corbin, 1997).

Grounded theory developed from the codification of the methods that its originators, sociologists Barney G. Glaser and Anselm L. Strauss (1967), used in their study of the social organization of dying in hospitals. The constructivist version of grounded theory is utilized in the current study and retains the key facets of the method as it was first conceived (Charmaz, 2000). The constructivist version of grounded theory recognizes the researcher as an active agent in the research process, particularly in the developing dialogue between the researcher(s) and data from which codes, categories, and eventually a grounded theory results (Charmaz, 2000; Mavetera

& Kroeze, 2009). Therefore, the constructivist form of the method strengthens the basic tenets of grounded theory by attending to issues such as reflexivity, the research context, the inescapable effect of prior knowledge, and existing literature (Charmaz, 2006; Groenewald, 2011).

Research Design

Data analysis is an integral part of qualitative research and constitutes an essential stepping-stone toward both gathering data and linking findings with substantive concepts (Creswell, 2005). The steps in the grounded theory research process include: (a) simultaneous data collection and analysis, (b) the practice of writing memos during and after data collection, (c) the use of some sort of coding, (d) the use of writing as a tool for analysis, and (e) the development of concepts and the connection of those concepts to the existent research literature.

A description of the analytic steps utilized within grounded theory research illustrate how it differs from other social science research approaches. However, the analytic steps in grounded theory occur sequentially, simultaneously, and serendipitously which are rather difficult to describe in a cogent manner (Fernandez, 2004). One reason for that difficulty is that grounded theory is an iterative spiral of data collection and data analysis crisscrossed by developing threads of coalescing concepts and abstractions (Patton, 2002). A grounded theory is constructed by following the iterative spiral and forming conceptual elements this process is grounded within the data and represents the researcher's understanding of the phenomena under investigation (Fernandez, 2004). It is important to recognize that the theory that is developed through grounded theory methods is most often not at the level of grand theory. More often the theory that is developed through grounded theory methods is a conceptual representation of a phenomenon of interest which can be applied to further research and or practice.

Figure 1 is a conceptual illustration of the general analytic process within the grounded theory method of research. The researcher begins by collecting data, often in the form of interview data. Simultaneous to the data collection is note taking which assists the researcher in organizing her/his thoughts and the data for later analysis. As the research process progresses the researcher engages in the complex process of memoing which serves to determine how the labyrinth of data connects to form an integrated grounded theory. Once memoing is complete the researcher sorts the codes and memos to create a cogent grounded theory which has a core category that explicates the central theme of the collected data. The final step in the grounded theory research process is writing the research report.

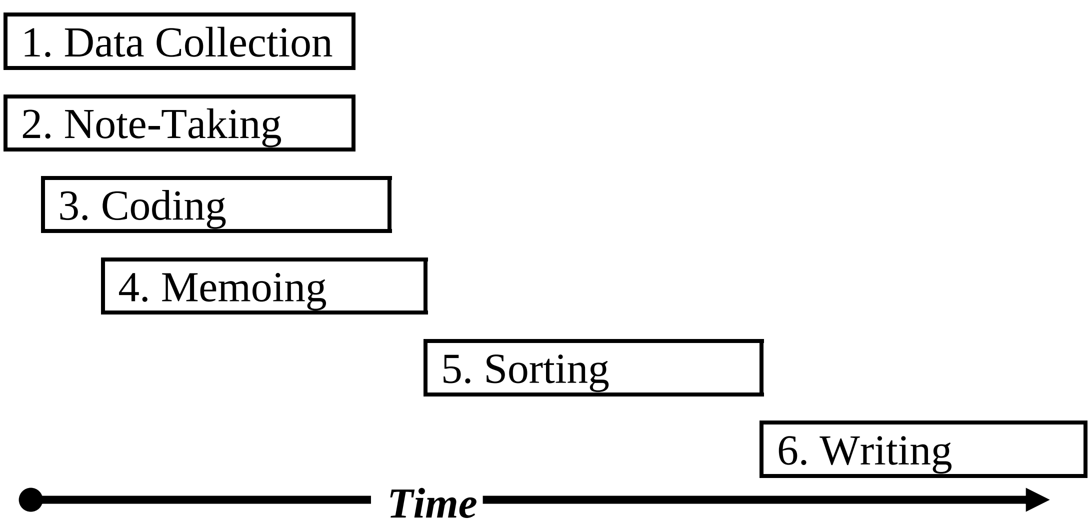
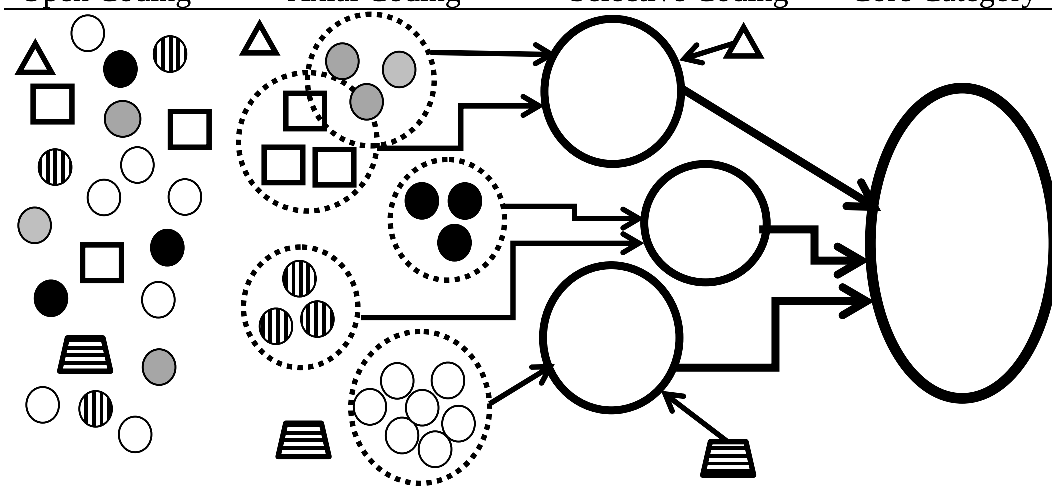


Figure 1. A conceptual illustration of the data collection, analysis, and reporting process in grounded theory research studies (Creswell, 2005)

Figure 2 represents a conceptualization of the simultaneous data collection and analysis process which forms an essential element of the grounded theory method. Figure 2 illustrates that the open coding process consists of gleaning words, phrases, and ideas from the narrative data gathered from in depth interviews. During open coding the main objective is to begin to organize the data and begin to comprehend it. Open coding consists of a close line-by-line reading of the data in order to identify as many concepts as possible without being concerned with how they are connected (Schwandt, 2007).



Open Coding	Axial Coding	Selective Coding	Core Category
Development and refinement of codes within the constant comparative method; line –by-line scrutiny of data.	Relationships between codes are identified and links between them are articulated. Categories begin to develop and theory appears to coalesce around them. Memos and diagrams are powerful tools during this stage.	Used to saturate weak categories and fill gaps by returning to the original material and/or coding new data.	Core categories are theoretical and abstract. Core categories subsume and integrate all lower categories in a grounded theory and form the most complete encapsulation of the data.

Figure 2. A conceptual illustration of the three iterative stages of coding outlined in grounded theory procedures (Charmas, 2006; Strauss & Corbin, 1997)

Figure 2 illustrates that the process of open coding forms the basis for axial coding. During the process of axial coding the data is reassembled in order to begin to identify connections between elements that were coded within the open coding process. As the axial coding process progresses coded elements coalesce to form categories. Figure 2 illustrates that following axial coding the researchers employ the process of selective coding. The selective coding stage is utilized to refine data categories by filling gaps and reviewing coded elements in order to assess the density of the categories that have been established. The selective coding process integrates the connections between the coalescing categories and further strengthens within category connections as well.

Figure 2 reveals that the process of selective coding is followed by the formation of a core category. Formation of a core category is a key milestone within the grounded theory research process. The formation of a core category represents a point at which the properties and dimensions of the central concepts and conceptual relationships have emerged from the data. It is also the point at which the category which best captures the essence of the phenomena being investigated in all its complexity and variation emerges from the fog (Groenewald, 2008).

To clarify some of the forgoing discussion, it may be useful to refine the description coding processes. Within the grounded theory research process, slices of data substantively related to the research area are coded in order to identify elements or facets of interest (Charmaz, 2006). The identified elements of interest may take the form of words, phrases, incidents, or other similar phenomena. The coded elements of interest are then compared to each other utilizing the constant comparative method of analysis. The constant comparative method is utilized to identify (a) the properties that the coded elements share; (b) conceptual categories around which the coded elements coalesce; and (c) connections between the individual categories (Bryant & Charmaz, 2007).

As coded elements and connections of theoretical interest are distinguished, the coding of the data becomes more theoretically oriented and is thusly labeled selective or theoretical coding. The selective codes are regulators that transform the descriptive data into an abstract or theoretical structure which represent higher level categories (Patton, 2002). Within the process of selective coding the researcher scrutinizes elements within the data that reinforce or diverge from emerging hypothetical connections between coded elements (Charmaz, 2002). At this point additional slices of data are sought in order to assess the robustness of the emerging tentative connections. The additional slices of data are collected from additional participants or through follow-up data collection with existing participants.

Within the grounded theory method the utilization of memos and memo writing is emphasized as component of the coding process (Patton, 2002). Memoing is the act of recording reflective notes about what the researcher is learning from the data (Creswell, 2005). Memos accumulate as written ideas or records about concepts and their relationships. They are notes by the researcher to themself about some hypothesis regarding a category or property and especially relationships between categories (Strauss & Corbin, 1997). The memos also provide a reflective space for researchers to address concepts and coded elements in order to explore the data and allow connecting bridges to emerge. The memos themselves in turn be considered data, being coded and analyzed through the constant comparative method in order to generate conceptual insight and elaboration of the grounded theory under development (Charmaz, 2006).

Sorting is a critical step within the grounded theory method of research. Whether using one of the various computer programs available or using a hand method, sorting involves the constant comparison of memos to determine how the labyrinth of data connects to form an integrated grounded theory (Bryant & Charmaz, 2007). Through sorting, the researcher can literally see the framework of the grounded theory being built. Sorting is part of a continuous spiral of data collection and analysis that the researcher engages in throughout a grounded research study.

Once the researcher is able to construct an adequate account of the phenomenon and no new categories or significant codes are being developed a point of theoretical saturation is attained (Creswell, 2005). Theoretical saturation signals the point in grounded theory studies at which theorizing the events under investigation is considered to have come to a sufficiently comprehensive end. At this point, researchers are comfortable that the properties and dimensions of the concepts and conceptual relationships selected to render the target phenomenon are fully described and that they have captured its complexity and variation (Glaser & Strauss, 1967).

At the point of theoretical saturation the categories have been made sufficiently clear and dense enough to form a substantive grounded theory which explicates the phenomena being investigated. Once theoretical saturation has been attained the researcher begins writing the research report. However, it should be noted that within the writing process ideas may shift and new elements may emerge from the data and the researcher should be prepared to go back to the data and address new twists in the evolving grounded theory (Bryant and Charmaz, 2007).

Based on the forgoing discussion of the qualitative perspective and the brief description of the methods specific to grounded theory, the impetus for utilizing grounded theory as a research method for the current study should be more understandable. It is critical to recognize the utility of grounded theory as the method of inquiry for this research because constructing a grounded theory which explicates the process of CTE and science integration will serve the following purposes:

1 Problems and challenges regarding CTE and science integration can be more accurately articulated and understood. Facets of the CTE and science integration process may be revealed and contextualized through an understanding of their relationship to CTE teachers and other elements critical in the CTE and science integration process. It is likely that the findings created through the current study will create such information and enable the construction of a more robust model of CTE and science integration than is currently available.

2 The creation of grounded theory will construct an explicit conceptual structure that can serve as a guide for subsequent inquiry regarding the process of CTE and science content integration.

More specifically, a grounded theory constructed through carrying out the current study will serve to provide a focus to the planning and enactment of subsequent research inquiries. It will provide a way to understand variables and their relationships and it will also provide a focus for research design selection, procedural planning, as well as, data collection, analysis, and interpretation.

3 A logical structure or grounded theory is the set of terms and relationships within which a question or problem is formulated and solved. However, it is also true that through the construction of a grounded theory of CTE teachers' perspectives of and experiences with the process of CTE and science content integration, a conceptual framework will be depicted that will assist others in conceiving, considering, and comparing alternative frameworks or ideas.

As part of the research design, grounded theory researchers should not consider the research question as a statement that focuses and identifies the unit under study (Glaser, 1992; Glaser and Strauss, 1967). Many research methodologies call for a research question that guides the method of data collection and identifies the unit of analysis. By contrast, the research focus of grounded theory method, becomes clear during data collection and analysis of the data through the constant comparison method. The researcher does not start with a problem statement but with an interest in the field; thus the researcher cannot derive overly specific research questions (Glaser, 1992; Glaser and Strauss, 1967).

However, Strauss and Corbin (1990) advise researchers to start with a preliminary theory or hypothesis which may take the form a research question. This theory is intended to guide the researcher and define the scope of the study. They argue that, without such a guide, the researcher would be faced with too many aspects to consider in a single research project. In constructing a question to guide the research, the researcher should structure it in such a way that it leaves flexibility and freedom for an in-depth exploration. It should not restrict the investigator, but rather, should function solely as a guide (Strauss and Corbin, 1990). As the research progresses, the scope of the research question is narrowed and focused, altering concepts and relationships to concepts that are inductively arrived at after analysis of the initial data samples.

The research question that was used to guide the current study was: What are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers.

In addition to the guiding question, the following questions were utilized with the CTE teacher participants to provide a common point of entry into the research interview episodes.

1) What is important about career and technical education?

2) Prior to teaching, what kind of experiences did you have related science?

3) When you think about integrating CTE and science what comes to mind?

4) How did the process of integrating science into the (insert program name) program of study begin?

5) What kinds of experiences have you had while engaged in the integration of science into the (insert program name) program of study?

6) What are the opportunities regarding the integration of CTE and science content?

Participant Selection

In a previous research study (Spindler, 2010), the researcher utilized Bloom's revised taxonomy (Krathwohl, 2002) as a means to classify CTE and science integrating learning objectives. CTE programs of study were identified that had integrated CTE and science content through the utilization of higher order learning objectives as defined by Bloom's revised taxonomy. Potential participants for the current grounded theory research study were selected from those CTE programs that have demonstrated the utilization of CTE and science integration through the inclusion of higher order CTE and science integrating learning objectives within their New York State Educational Department program approval or re-approval documents. Therefore, it should be noted that the participants in the current study have been purposefully selected because they have already engaged in the process of integrating CTE and science content.

Criterion sampling was utilized to identify and select potential interview participants for the study. This type of sampling advocates the selection of information-rich cases for study to provide thorough understanding and insight rather than empirical generalizations generated by quantitative studies (Patton, 2002). More specifically, a criterion sample (Patton, 2002) was utilized to select CTE teachers who have enacted a process of integrating CTE and science content within their CTE program of study utilizing higher order learning objectives. By selecting CTE teachers that have already enacted the process of CTE and science integration it is possible to be sure that the participants will have a perspective on the process of integration.

The criterion sampling method utilized in the study assists in developing the credibility of the research outcomes. Engaging CTE teacher participants who have already enacted the process of CTE and science content integration increases the likelihood that the data sources are credible and apropos to the current study. In addition, engaging CTE teachers that have submitted state approval documents ensures that the participants have enacted a comprehensive and thorough process of CTE and science content integration.

Fourteen potential research participants were selected from a population of twenty-four potential participants. However, several of the potential participants taught in the same school or BOCES program so the actual number of potential participants was nineteen. The fourteen research participants were selected primarily by focusing on their area of certification. The research protocol was directed at studying the process of CTE and science content integration within (a) agriculture, (b) health occupations, (c) culinary arts, and (d) automotive technology CTE programs of study. Therefore, it was determined that an equal number of participants from each of the four types of CTE programs of study would be selected for the research study.

The name and CTE program of study for all nineteen potential participants were written on sheets of paper which were then randomly selected from a box. The random selection continued until an equal number of CTE teachers representing each of the four CTE programs of study were selected. In all, sixteen teachers were selected as potential research participants. During the research process, two of the teachers selected to participate dropped out of the study and the other three potential research participants had be utilized within test interviews to pilot the research questioning processes and hone the questioning skills of the researcher. It was deemed inappropriate to include the three pilot interview participants with the research study because the data would have been compromised (Glaser, 2005).

In order to recruit research participants to the study, a cover letter describing the study and a link to an informational webpage where the CTE teachers could indicate their willingness to participate was mailed and emailed to potential participants. The mail and email documents explained the purpose and importance of the study, the value of their participation, and the data collection methods. After receipt of the initial reply email or submission through the research study webpage, interview dates and times with the CTE teachers were arranged using email.

The criterion sample was selected from a pool of CTE teachers that participated in a previous study (Spindler, 2010). The potential research participants consisted of state certified (a) agriculture; (b) health occupations; (c) culinary arts; and (d) automotive technology secondary CTE teachers working in urban, suburban, and rural comprehensive schools and career and technical education centers in the state of New York. The previous study created information about the CTE and science integrating learning objectives CTE programs of study had created and included in state program approval documents. All of the CTE teacher participants are teachers in CTE programs which submitted self-study reports to the state which are necessary for state program approval or re-approval. Each self-study report provides a comprehensive description of the current CTE program and includes, among other items: a statement of the program goals and objectives; a delineation of the program curriculum including all course, unit, and lesson level learning objectives; specifications of laboratory equipment; examples of student assessments; and a narrative describing the professional development activities of the instructors. Most of the self-study reports also specifically delineate objectives targeted at integrating science content into the CTE program of study.

Given that the process of integrating science concepts into CTE courses and programs should begin with a clear specification of the educational goals and objectives (Hoachlander, 1999), it is possible to use the existence of such goals and objectives as a means to select a purposive criterion sample. Explicitly aligning instruction and learning activities with well written goals and objectives helps to ensure that learning activities and assessments are focused and germane to the academic and career challenges students will face in the future (Blumberg, 2009). Moreover, if instructional goals and objectives are structured and organized appropriately, learning activities will support the acquisition of a range of knowledge types at variety of cognitive processing levels (Blumberg, 2009).

Bloom's revised taxonomy (Anderson, Krathwohl, et al. 2001) is an effective tool for writing, organizing, and analyzing learning goals and objectives (Blumberg, 2009). Bloom's revised taxonomy (Anderson, Krathwohl, et al. 2001) allows researchers and educators to conceptually chunk large amounts of complex information in order to bring more precision to applied practice. One of the strengths of the revised taxonomy is that it can be employed as a syntactic logic tool at the macro level for curriculum planning and program assessment and at the micro level for lesson planning and student assessment (Cannon & Feinstein, 2005).

In the revised taxonomy, learning objectives can be described and represented using a two-dimensional taxonomic table (Anderson, Krathwohl, et al. 2001). Table 3 illustrates that four dimensions or types of knowledge are categorized on the vertical axis within the two-dimensional taxonomic table of the revised taxonomy and that six levels of cognitive processing that are illustrated on the horizontal access of the table. The intersection of the four categories of the knowledge dimension and six categories of the cognitive process dimension form twenty-four discrete cells which afford educators the opportunity to more precisely classify learning objectives based upon the specific facets of the intersecting dimensions. (Krathwohl, 2002).

One of the central strengths of the taxonomic table is that it provides a framework for describing learning objectives by the type of knowledge to be gained and the cognitive process employed to facilitate the actual learning. Classifying science integrating learning objectives using the taxonomic table provides a visual map that educational professionals can use to make sure they are: (a) addressing a variety of types and levels of knowledge, and (b) to efficiently constructing and aligning learning objectives with pertinent standards and assessment techniques.

Table 3
A Two-Dimensional Illustration of the Relationship Between the Knowledge and Cognitive Processing Dimensions of Bloom's Revised Taxonomy

	Cognitive process dimension					
KD	Remember	Understand	Apply	Analyze	Evaluate	Create
F	A1	A2	A3	A4	A5	A6
C	B1	B2	B3	B4	B5	B6
P	C1	C2	C3	C4	C5	C6
M	D1	D2	D3	D4	D5	D6

Note. Adapted from Krathwohl, 2002. p. 216. KD = knowledge dimension; F = factual; C = conceptual; P = procedural; M = metacognitive

In order to use Bloom's revised Taxonomy it is necessary to understand that any learning objective will fall under one of the six discrete categories of cognitive processing and at the same time will also be linked to one of the four discrete categories of knowledge dimension. The object in a learning objective is used to determine whether the learning objective is supporting factual, conceptual, procedural, or meta-cognitive knowledge acquisition. The verb in a learning objective is used to determine which cognitive process dimension is being applied in the learning process: remembering, understanding, applying, analyzing, evaluating, or creating.

Once the knowledge and cognitive process dimensions are determined, learning objectives can be correctly placed in the taxonomic table. Learning objectives placed in the upper left hand corner of the taxonomic table tend to be more concrete, simple, structured, and require less learner independence. As the taxonomic niches traverse the table diagonally toward the lower right hand corner, the learning objectives tend to be more abstract, complex, open, multifaceted, and require greater learner independence.

It may be beneficial to provide several examples in order to more clearly delineate the process enacted by the coders to classify each of the science integrating learning objectives. To that end, table 4 illustrates three example learning objectives that were classified within the process of the research study. For brevity, only the essential elements of the example learning objectives are presented.

Table 4

Example Learning Objective Statements and Their Classifications

	Learning Objective Statement	Classification
1	Identify the 16 essential elements all plants need for life, growth, and reproduction	A1
2	Analyze the relationship between the design of a landscape and its impact on the surrounding ecosystem	B4
3	Evaluate the efficacy of patient care plans based on real-time patient data analysis procedures	C5

Table 4 illustrates that the object in learning objective one was as follows: the 16 essential elements all plants need for life, growth, and reproduction. Learning objective one required learners to demonstrate a type of knowledge that represents a basic building block which would be utilized in the construction of different types of knowledge. More specifically the object of the learning objective required students to demonstrate knowledge of technical vocabulary, a type of factual knowledge.

Therefore, learning objective one was classified as being within the factual knowledge category of the knowledge dimension of Bloom's revised taxonomy.

Table 4 demonstrates that the verb in learning objective one required learners to identify information. In this case, to identify the required information depends only on the learners' ability to recognize or recall, therefore, learning objective one was classified as being within the remember category of the cognitive process dimension of Bloom's revised taxonomy. Once both dimensions of a learning objective have been classified it can be placed into one of the 24 cells created by the intersection of the knowledge and cognitive process dimensions of the taxonomic table illustrated in Table 3. Using Table 3 as a guide, objective one would most appropriately be placed in cell A1 at the upper left hand corner of the taxonomic table.

Table 4 demonstrates that the verb in learning objective two required learners to analyze information. In this case, the analysis required depends on the learners' ability to recall information and then use it to assess a situation. Using Table 3 as a guide, objective one would most appropriately be placed in cells B4 or C4 depending upon whether the student will be using factual or conceptual knowledge dimension.

Table 4 illustrates that the object in learning objective three was as follows: the efficacy of patient care plans based on real-time patient data. The object of the learning objective sentence required students to demonstrate knowledge of subject specific techniques, as well as, knowledge of criteria for determining when to use appropriate medical procedures. Therefore, learning objective three was classified as being within the procedural knowledge category of the knowledge dimension of Bloom's revised taxonomy.

Table 4 demonstrates that the verb in learning objective three required learners to evaluate situations based upon data. In order to demonstrate the ability to complete the required evaluations learners must be able to enact appropriate interpretation and appraisal techniques that lead to accurate judgments. Therefore, learning objective three was classified as being within the evaluate category of the cognitive process dimension of Bloom's revised taxonomy. Utilizing Table 3 as a guide, objective three would most appropriately be placed in cell C5 at the lower right hand corner of the taxonomic table.

Data Collection and Analysis

The process of grounded theory method allows for the development of a grounded theory using data that are systematically gathered and analyzed. Grounded theory focuses on a method that facilitates the establishment of a close connection between the data collection, analysis, and resulting theory (Strauss & Corbin, 1998), this connection encourages the researcher to create a conceptual understanding of concrete realities that were expressed during interviews (Charmaz, 2003).

The use of grounded theory offers the benefits of theory derived from data that is more likely to resemble "reality" than is theory derived by putting together a series of concepts based on experience or solely through speculation. Grounded theory because it is drawn from the data, is likely to offer insight, enhance understanding, and provide a meaningful guide to action (Strauss & Corbin, 1998, p. 12).

The first step in the data collection process was to construct an interview question guide (Appendix B) that was appropriate for beginning the in depth interviews. The external agents reviewed the interview question guide and made suggestions for edits based on their knowledge of CTE, CTE and science integration, and grounded theory methods of research. The interview question guide and the constructivist perspective utilized within the study fostered the ability of participants to express their perceptions about the process of integrating CTE and science content within CTE programs of study. In addition, the inclusion of questions about the experiences of the teachers allowed them to explain how different perceptions and experiences impacted the process of CTE and science content integration within their CTE programs of study.

Prior to collecting data for the study, the researcher conducted three separate pilot interviews with research study participants to address: (a) the challenges of interviewing participants, (b) the efficacy of the guiding question, and (c) to receive feedback regarding the interview and open coding processes from the external agents. The pilot interviews were conducted and the external agents provided feedback to the researcher. As a result, of the pilot interviews the original research questioning strategy was adjusted and the researcher became more mindful of letting the data emerge through questioning and not exhibiting biasing behaviors such as head nodding.

The pilot interviews served as a testing situation for the use of the data recording equipment. The researcher employed a microphone and a laptop computer with voice a to text software platform to transcribe the CTE teachers' interviews directly to digital text. The voice to text software calibration process took approximately five minutes and consisted of the CTE teachers reading several short passages of text. As a back-up each interview were recorded using a digital recorder in case the primary method of data collection failed. The data from the pilot interviews were not included in the final research report.

Data for the current study were collected utilizing fourteen in depth interviews. The use of interviewing allowed the researcher to understand the experiences of the CTE teachers and the meaning they constructed from those experiences (Charmaz, 2006). During the interview process the researcher was careful to provide enough time to capture the perceptions and experiences of the participants as they related to the context of interest. In addition, the researcher asked questions of the CTE teachers which arose from the researcher’s CTE teacher educator and CTE teacher experiences. By asking the CTE teachers probing questions from a variety of perspectives, the researcher was able to improve the likelihood that the results of the study would exhibit greater transferability and dependability (Creswell, 2005; Patton, 2002).

Interviews were conducted in order to describe how each CTE teacher made meaning of their perceptions of and experiences with the process of CTE and science content integration. A semi-structured format was utilized to organize the sixty to eighty minutes interviews. The researcher utilized a question guide (appendix B) to enter the interview process. However, probing questions formed the majority of the questions utilized in order to expand and clarify statements made by the participants (Hatch, 2002). All of the CTE teacher interviews were conducted face-to-face in public buildings within secluded private spaces. With the consent of the participants, all of the interviews were audio taped for transcription and data analysis.

Once all the initial interviews had been conducted and a substantial amount of effort had been directed at engaging in the constant comparative method, open, axial, and tentative selective codes emerged from the data. In addition, coded elements had begun to coalesce around concepts. The names of the concepts that best encapsulated the coalescing coded elements were evolutionizing, enacting, connecting, and futuring. The external agents were asked to review the initial transcript data and the open, axial, and selective codes that emerged from the data. Both external agents agreed with the direction of the research study and neither made anything more than minor suggestions regarding the organization of the emerging coded elements.

However, the researcher was not yet comfortable with marking the aforementioned concepts as categories and did not recognize that a point of theoretical saturation (Charmaz, 2006) had occurred. Thus, the next step in the research process was to schedule forty minute follow-up phone interviews with the CTE teachers. Prior to the phone interviews the CTE teachers were emailed transcripts of their original interviews and illustrations of the open codes that had emerged from the data. The CTE teachers were asked to review the transcripts and diagrams of the open codes in order to engage in a process of member checking the data. The member checks served as a way to support the credibility, dependability, and confirmability of the eventual research outcomes.

All of the 14 CTE teachers participated in the follow-up phone interviews. Within the interview process the CTE teachers were asked to respond to the documents they had been sent. In particular, the CTE teachers were asked to speak to whether the details in the transcripts and open code diagrams they had been sent were in harmony with their intended expressions. Further, the CTE teachers were asked to refine some of their previous statements to add flavor and detail to the already existing data. Throughout the follow-up interviews the participants were also encouraged to go in new directions and talk about any new ideas they had concerning the process of CTE and science content integration. The purposes for asking the CTE teachers about new directions were to: (a) possibly capture new information that was not part of the existing tapestry of data and (b) to assist in affirming the credibility of the coalescing categories. When using member checks, if the new data does not capture novel information the researcher has a more robust confirmation that the existing data and coalescing categories are an accurate representation of the participants' experiences and expressions.

In wake of the follow-up phone interviews, the researcher continued to enact the constant comparative method which facilitated the emergence of new elements from the combination of the original interview data and the follow-up phone interview data. Coding of the new elements added to the overall tapestry of the developing grounded theory and memoing was employed to further organize the data and add strength to the credibility of the final research outcomes. Within the process the researcher attain a satisfactory level of theoretical saturation which resulted in no new coded elements emerging from the data. The external agents were asked to listen to the researcher describe the developing grounded theory and review the data coding and memoing process. Both external agents agreed that the research process had attained an adequate level of theoretical saturation regarding the research area being investigated. The collegial checks of the data analysis and memoing process added strength to the credibility, dependability, and confirmability of the research outcomes and specifically served as a more robust way to establish theoretical saturation.

Once theoretical saturation had been attained the researcher engaged in the process of sorting. Conceptually, sorting is utilizing the connections between the coded elements to bring together a labyrinth of data. Sorting is also a process that coalesces the coded elements around a core category and several or more subsidiary categories which encapsulate the story of the research participants.

Within the framework of the research study I utilized the software program NVivo 7 for much of the grounded theory data analysis. NVivo is a software platform designed to support analytic methods used to build and test grounded theory from unstructured qualitative data. According to (Groenewald, 2008), the benefits of software use include a substantially faster ability to conduce mechanical tasks such as coding and retrieving. However, the true ability of the software platform is to create more time for the researcher to engage in more robust and thorough data analysis sessions. I utilized the NVivo software platform to analyze all the digital transcribed data generated through the data collection process. I also utilized NVivo to analyze all of the researcher notes and memos created during all the stages of the research process up until the process of sorting began.

The case for the use of software in grounded theory is debatable and several prominent researchers have challenged the use of software to analyze data. Researchers are primarily concerned that the software may foreclose on the interplay among creative insights, memoing, and a continuing development of codes that result from an ongoing connection with the raw data (Bryant & Charmaz, 2007). In addition, some grounded theory researchers argue that the software imposes a structure that may imperceptibly constrain the data analysis and therefore reduce the credibility and dependability of the research outcomes (Groenewald, 2008). However, as Konopasek (2008, p. 5) points out, the real data analysis is always done by the researcher and the software is only there to provide assistance and support in ways that extend the organizational capacities of the researcher.

As a check to the utilization of the NVivo software platform and as a way to support triangulation within the research study, the researcher also engaged in line by line coding of the research data. Segments of the interview transcript data were randomly selected from a pool consisting of all of the interview transcript data. Random selection was carried out by using a random number generator to: (a) select the interview number (1-14; 15-28), (b) select the minute to begin the segment, and (c) select the minute to end the segment. No remarkable differences were noted in the data analysis by either the researcher or the external agents that reviewed the coding outcomes of both the NVivo and line by line by hand analysis. It is worth mentioning, however, that such an attempt at improving triangulation is also a step at improving the credibility, transferability, and dependability of the research outcomes. Checking the data line-by-line against the raw data and the results of the software based analysis is a way of assessing the “fit” of the data to the overall storyline formed by the grounded theory.

It is important to recognize that the simultaneous enactment of the data collection and analysis processes forms an essential component of the grounded theory method utilized for the current study. The open coding process consisted of gleaning words, phrases, and ideas from the narrative data gathered from in depth interviews. During open coding the main objective was to begin to organize the data and begin to comprehend it. Open coding consisted of a close line-by-line reading of the data in order to identify as many concepts as possible without being concerned with how they were connected (Schwandt, 2007). During the open coding stage of the research process the researcher interrogated the data to identify concepts of interest: What is going on here? What was done? Who was involved? What is the meaning of the actions? What was the intent? Who benefited? What were the actual outcomes? For example, within the open coding process data regarding the perceptions of the school towards the CTE program of study may be interrogated by asking: what are the perceptions; what is at the root of negative perceptions; what is at the root of positive perceptions; and are the perceptions stable? The identification, labeling, and interrogation of concepts within the open coding process set the stage for the process of axial coding.

The process of open coding formed the basis for the axial coding carried out by the researcher. During the process of axial coding the data were reassembled in order to begin to identify connections between elements that were coded within the open coding process. Constructing connections between concepts included expanding the properties of the coded elements to determine variations in their dimensions and scope. As the axial coding process continued coded elements coalesced to form categories. However, within the axial coding process the categories were not completely formed and only a vague outline of the category boundaries began to emerge. During axial coding the coded elements within coalescing bundles became connected by threads which later came to define specific relationships. Within the axial coding process the coalescing bundles of coded elements were questioned in order to explore their boundaries. Within the questioning of the data the following elements were critical points of information for each of the forming categories: (a) context (e.g., where, when, and why); (b) actions (e.g., strategies and responses); and (c) consequences.

Axial coding derives its name from the attention during this phase on the analysis of intense coding around the “axis” of one category of interest at a time (Patton, 2002). The researcher followed the recommendation of Schwandt (2007) and sought answers to a series of questions about each of the coalescing categories. For example, the category of evolutionizing was identified as a coalescing category when analyzing the interview data. Therefore, the researcher asked the questions of the data: how often are evolutionizing acts completed; who carries out evolutionizing acts; and what are the outcomes of evolutionizing acts. As new information was constructed from nexus of the existing coded elements and the researcher’s data questioning, new coded elements emerged from the data. The new coded elements assisted in identifying and filling in the categories of the developing grounded theory while facilitating the emergence of connecting threads that brought coherence to the entire frame of reference.

Following axial coding the researcher employed the process of selective coding. Within the process of selective coding, the core category of evolutionizing coalesced and formed the basis for the integration of the other three major categories: (a) connecting, (b) enacting, and (c) futuring. During the selective coding process the coalescing categories emerged more completely from the data. The selective coding process solidified the core category of evolutionizing as the central theme of the research regarding CTE teachers' perceptions of and experiences with the process of CTE and science content integration.

Throughout the selective coding process memos and diagrams were utilized to integrate the connections between the coalescing categories and to further strengthen the existing connecting themes within the categories as well. The selective coding stage was utilized to refine the categories by filling gaps and returning to the original and follow-up interview data to review coded elements and assess the density of the categories that had been established. During the axial stage some of the data from the initial interviews was reconceptualized as being within the boundaries of established categories. For example, originally reviewing material did not seem well connected to any of the other coded elements or coalescing categories. However, after reanalyzing the original data in connection with the follow-up phone interview data the concept of reviewing material was connected to enacting planning.

As the axial coding process drew to a conclusion, the core category of evolutionizing was recognized as the dominant theme within the storyline of the study. By reexamining the data the researcher was able to: (a) create greater credibility and dependability within the research outcomes, and (b) attain the point of theoretical saturation. However, in generating a grounded theory it is impossible to determine exactly when to stop searching for more details. The signals associated with the appropriate place to stop include finding no new emergent aspects of categories and discovering no new relationships within analysis procedures.

Theoretical saturation signals the point in grounded theory studies at which theorizing the events under investigation is considered to have come to a sufficiently comprehensive end (Creswell, 2005). Theoretical saturation represents a moment in space time during which the properties and dimensions of the concepts and conceptual relationships that have emerged from the data have been fully described and they have capture the essence of the phenomena being investigated in all its complexity and variation (Groenewald, 2008, p. 7). Once theoretical saturation is reached the researcher is ready to begin the sorting process which is utilized to assemble the jigsaw puzzle grounded theory that is lurking beneath the surface of the categories and codes. However, determining when theoretical saturation has been attained is a very difficult concept to comprehend.

The achievement of theoretical saturation is a function of the theoretical proclivities of individual researchers which are a function of their prior research experiences, their experiences with the context, and the judgments of their colleagues (Merriam, 1995). In a very real sense theoretical saturation is a process that is particular to an individual researcher working on a particular study. When theoretical saturation is reached depends on such factors as sample variation, length of time in the field of study, and researcher experience (Groenewald, 2008). Moreover, because theories are always subject to revision, theoretical saturation represents what Barney Glaser and Anselm Strauss (1967) described as a pause in the never-ending process of theory development (Charmaz, 2006).

It is difficult to address the research analysis aspect of grounded theory research. The researcher is left with the difficult realization that while the report is not an explication of grounded theory methods themselves a certain level of explanation will prove to be useful to readers. What follows is a necessarily simplified illustration of theoretical saturation intended to clarify its defining features.

The researcher conducts a study to understand CTE teachers' perceptions of and experiences with the process of CTE and science content integration. The researcher begins to theorize, from the interview data that two types of problem solving exist for CTE teachers during the integration process: preventative and non-preventative. In preventative problem solving, the CTE teachers stay in command of what is happening in the process of CTE and science content integration and are able to adjust to challenges. The researcher discerns what she/he initially believes to be three analytically distinct strategies the CTE teachers utilized to problem solve through prevention: (a) full-preventative, where every detailed of problem prevention is planned and followed; (b) partial preventative, in which problem prevention addresses most of the critical events in the integration process; and (c) selective preventative, some events and logistics are associated with problem prevention based on selective factors. In non-preventative problem solving, CTE teachers lose control of the process of CTE and science content integration. Problems arise and with no problem prevention planning the process of CTE and science content integration is jeopardized.

Theoretical saturation will have been achieved when the researcher, utilizing sampling and the constant comparative method, is able to address a number of questions. For example, do the concepts of preventative, non-preventative, full-preventative, partial preventative, and selective preventative problem solving exhaust the variation in the types of and strategies for problem solving? Should the categorization of problem solving be refined to encapsulate additional types and strategies? Are both of the categories exhaustive or mutually exclusive? Are there particular circumstances that affect the CTE teachers' decisions to engage in full-preventative or partial preventative problem solving? If the coding outcomes are changed do the results illustrate that CTE teachers move from one strategy to another as part of the process of CTE and science content integration? In reality, theoretical saturation is achieved only to the degree that the researcher's rendering of the data within the context is sufficiently developed to answer the forgoing questions and many other similarly probing queries (Schwandt, 2007).

However, it should be recognized that theoretical saturation does not in and of itself require researchers to gather more data. Through enactment of the constant comparative method of data analysis, the researcher develops a heightened level of theoretical sensitivity (Charmaz, 2006). Such a heightened level of theoretical sensitivity to the data enables the researcher to discern ideas and concepts they may not have previously noted. It is important to recognize that part of the concept of theoretical saturation is accounting for negative or divergent episodes participants describe within the data that do not fit well with the established codes and categories (Glaser, 2005).

Researcher Subjectivity

Since this study will employ the use of a qualitative methodology, it will allow for the combination of the researcher and human interaction to serve as the research instrument in retelling the participants' stories and experiences within the process of CTE and content science integration (Creswell, 2005). It is critical for researchers to maintain objectivity and detachment from the data collection and analysis process (Glaser & Strauss, 1967). However, the researcher's prior experience as an agricultural education teacher and FFA advisor may influence the probing questions which will be components of the interview process. Therefore, it is important that the researcher employ measures to reduce the potential impact of biasing interview questions and unintentional overt responses so that the research process results in the construction of the most accurate representation of the participants' experiences as possible (Charmaz, 2006).

It is generally understood that both positivistic and naturalistic research paradigms have the potential to be utilized to conduct research. It is also generally accepted that the some of the principles of the positivistic research paradigm are in direct conflict with principles of the naturalistic research paradigm (Creswell, 2005). For example, differing beliefs regarding the role of values in inquiry creates incompatible views on the overall function of research design and the researcher between the positivist and naturalist paradigms (Charmaz, 2006).

Positivistic research focuses on approaches that promote the use of research designs that are objective and value-free in nature. However, in contrast naturalistic research approaches acknowledge the multiple influences researchers exercise on research as it is being conducted and summarized (Strauss & Corbin, 1997). In order to address the influence the researcher brings to the research context it is first necessary to understand the subjectivity of the researcher. Documenting the tacit understandings and beliefs the researcher brings to the research context allows for a more robust and comprehensive monitoring of the researcher's perspectives that could unduly influence the outcomes of the study (Charmaz, 2006; Creswell, 2005).

The subjectivity statement of the researcher for the current study is provided in the remainder of this chapter: I was born and raised in Winnebago County, Wisconsin. I grew up in the back of a quiet neighborhood in Oshkosh, a city of approximately 48,000 residents. However, I often spent large segments of time at my grandparent's farm. When I was in third grade my parents purchased my grandparents farm and my grandfather retired from milking cows and doing field work to enjoy fishing and traveling.

The farm is bordered by a river that makes a long arc around the farm from the north western edge all the way around to the south eastern edge. Once my parents purchased the land, they began planting four of the large fields with trees and renting most of the other land to one of the neighbors. My family began living at the farm on the weekends; at first in a tent and then in an old camper. From late spring through late fall we would spend most of our weekends at the farm working on one thing or another.

However, it wasn't always work on the farm; there was also a lot of learning. I began learning about birds, first by sight, and then by call. I scoured the river banks looking for frogs and salamanders while devising ways to catch the small fish that swam in the river. Over time, I began making connections between nature and agriculture. I saw how important it was to care for the land and environment. I also began to be interested in science as an endeavor and the links between my experiences and what I learned in school. However, those connections were links that I made and they were not fostered by the experiences I had in school.

I attended Oshkosh West High School from 1987-1991. I did not participate in agricultural education as a high school student, which of course means that I also did not participate in FFA, mostly because I did not recognize that it was available as an option. I did however participate in two other CTE programs of study because I stumbled into them. I participated in a building trades program by studying drafting and a graphic arts program which focused on lithographic printing. Had I understood the options available to me at the time I would have participated in the CTE programs of study more completely by taking advantage of Career and Technical Student Organizations (CTSO) and work based learning opportunities.

Neither of the CTE programs that I participated in had any explicit connections to academic studies. Both programs were focused on developing occupational skills and the instructors never seemed to take the time to create a context which fostered knowledge construction that supported connections across domains of knowledge. However, I enjoyed my experiences and I recognized that I could have taken the knowledge I had gained through the CTE courses and translated that into a career focus.

While in high school I was also doing a lot of work on the farm; most of the time I was working with trees and raising pheasants. While on the farm I was also learning by listening to my grandfather and by observing the interface agricultural practices had with the natural environment: (a) the river crossing for the tractor; (b) the terraced edges around the fields; (c) the riparian zones my grandfather had planted many years ago; and (d) the animals, birds, and insects crisscrossing the river, fields, and growing woodlands. I learned about erosion control, seed production, the effect of weeds on crop yields, and the effects of fertilizers. I also learned how to use what I knew or could discover to solve problems. For example, I had to experiment with different methods of feeding the pheasants I was raising when I would be gone for more than two days.

However, I still did not really make any connections between what I was learning on the farm and what I was experiencing in science courses at school.
As a high school student I took biology, chemistry, advanced biology, and advanced chemistry. In those courses I learned a lot of science facts and I also learned how to complete simple “recipe” labs which had planned specific results. However, I did not learn a great deal about the scientific method and utilizing my own ability to solve problems.

When I look back, I believe that I did not learn more about science as a process because the study of science had mostly been reduced to the study of facts which were divorced from authentic contexts. There were very few opportunities for me to practice skills associated with higher order cognitive processes and even fewer opportunities to conduct a process which did not have predetermined outcomes. For me the study of sciences was replaced by the memorization of facts related to science.

When I moved on to my undergraduate studies at the University of Wisconsin Eau Claire, I immediately determined that I would major in biology and that I would minor in chemistry. Overall, my studies at the UW Eau Claire did little to improve my ability to carry out the scientific process from beginning to end. Again, I learned a large volume of science facts and laboratory skills, however, for the most part I did not gain skills in applying those facts within a cohesive and systematic process of discovery. In particular, my undergraduate studies did very little to assist me in properly framing a formal research study based on previous findings and questions from the literature. As I reflect on my experiences as a science major, it seemed like the curriculum and instruction were driven by a desire to "weed-out" people who were not medical school or Ph.D. candidate material through a strict regimen of rote memorization.

However, embedded within my undergraduate experiences were two courses, plant anatomy and organic chemistry lab, that did help me to construct a deeper and more contextualized understanding of science as a process of learning and discovery. Not only did those two courses assist me in understanding facts, but they also fostered my ability to respond to questions and address challenges by utilizing science as a process. In addition, within those two courses of study the process of science, or the scientific method, was employed as an instructional technique. The employment of the scientific method not only served to help me construct an understanding of the process science employs, it also helped me to making meaningful connections to the facts that I was learning as well.

Near the end of my undergraduate experience I came to realize that I was not equipped for employment as a biologist or chemist. As I began looking for positions, it became clear that I would need at least a Master's degree unless I wanted to be a field technician collecting musk ox scat on the mosquito infested tundra during the short summers in Northern Canada. I knew a lot of science facts and I had acquired laboratory and field skills, however, they were without an overall frame of reference or context. Perhaps if I had completed an internship I would have been better able to make sense of my opportunities and challenges, but at the time I did not recognize that as an option.

During the fall of 1995, my final semester as an undergraduate student, I applied to: (a) participate in an Emergency Medical Technician (EMT) program of study because I was interested in the medical field, (b) the School of Education at University of Minnesota because I had enjoyed tutoring freshman biology and chemistry students, and (c) the College of Agriculture at the University of Minnesota because I was interested in agronomy. During the following spring, I participated in the EMT program and became nationally certified and I awaited responses from the University of Minnesota. During that spring I determined that teaching was my passion and that I would attend the University of Minnesota to become a secondary teacher.

By this time I recognized science as a noble endeavor and clearly understood that most students did not find very meaningful or interesting. I knew I wanted to teach about science, however, I didn't want to be pigeonholed into teaching what I had been taught in high school. When I received my acceptance letter to the School of Education at the University of Minnesota, included in the materials was a letter from Dr. Roland Peterson, Professor of Agricultural Education. Dr. Peterson's letter highlighted agricultural education as a field of study and provided contact information. I remember thinking that it seemed like an interesting opportunity and that I would be able to teach a broader content area using agriculture as a context for instructional activities. When I read that letter, somehow my experiences growing up on the farm and my formal educational experiences were connected in a way they had not been connected previously.

I scheduled a meeting with Dr. Peterson, drove to the University of Minnesota, and walked into room 320 in the Vo-Tech building for the first time. Dr. Peterson met with me for about 2 hours and provided me with detailed information regarding the program and the course work that I would need to complete in order to graduate. Since I did not have formal course work in agriculture, I needed to take a few courses to obtain the necessary transcripted credit hours.

Over the next two years I took courses in agronomy, forestry, animal science, soils science, and applied economics, in addition to my teacher preparation courses. Overall, I found my College of Agriculture coursework to be more authentically framed than my previous undergraduate science course work. In particular, I found that the agronomy and soils courses were the most oriented towards teaching and utilizing the scientific method.

While working on my Master's degree I was employed as a graduate assistant for the a middle school project and as a laboratory technician in a genetics laboratory. The middle school project was directed by Dr. Peterson and it was designed to take advantage of the resources available on the University of Minnesota-St. Paul Campus by: (a) providing science instruction to middle school students using agriculture as a context; and (b) pairing College of Agriculture students with small groups of middle school students to complete a research based science project.

My other work as a Master's degree student was in a genetics laboratory across the road from the Vo-Tech building. My work in the genetics laboratory was mostly skilled based. I produced chemical solutions, poured sterile agar plates, and ran gel electrophoresis apparatus. Several of the researchers encouraged me to think about going into genetics as a field of study. However, I believed that I could always go that direction at a later time if I wanted.

After my two years at the University of Minnesota I began teaching agricultural education at Elk River Area High School in Elk River, Minnesota. When I began teaching at Elk River, the Agricultural Department had two pathways for students. The first was an agricultural business pathway and the second was a horticulture and landscape pathway. During my first year at Elk River we eliminated the agricultural business pathway and developed an agricultural science and technology pathway. The reason behind the development of the new pathway was the implementation of the Minnesota Profiles of Learning and it was in the Agricultural Department's best interest to minimize its competition with the Business Department.

The agricultural science and technology pathway focused on utilizing agricultural content as a context for: (a) creating experiences that helped students to understand technology and agricultural applications of technology, and (b) assisting students in gaining a meaningful understanding of science as a process. The agricultural science and technology pathway specifically focused on projects in the following areas: (a) hydroponics, (b) aquaculture, (c) solar energy, and (d) robotics. By focusing on the aforementioned areas, my colleague and I were able to contextualize and embed foundational concepts, such as: (a) technological literacy; (b) principles of technological systems, design, and utilization; (c) scientific literacy; and (d) principles of physical and biological science.

The new agricultural science pathway my colleague and I developed at Elk River was very successful with respect to gaining student enrollment and it was changing the way the school personnel viewed the agricultural program. However, after three years at Elk River, severe budget cuts facilitated my move to a different school. I taught for one year at Milaca High School in Milaca, Minnesota. During the fall of my year at Milaca I was recruited back to the University of Minnesota to pursue a doctoral degree in agricultural education. I finished out the year at Milaca and moved on to a different phase of my life.

In July of 2002, I began work as a graduate assistant at the University of Minnesota. My role as a graduate students was to serve as a coordinator of the Minnesota Teacher Induction Program (TIP). The overall function of TIP was to assist entry level agricultural educators in the state of Minnesota during their crucial first year of teaching. As the TIP coordinator, I facilitated the organization and development of mentoring relationships, created professional development experiences and resources for the entry level teachers, contributed to the construction of survey instruments, and analyzed data for program evaluation and research publication.

I began taking course work to complete my doctoral studies during the fall of 2002 and I completed the course work in my program by the end of the 2005 fall semester. During my course work I was able to construct a better understanding of research and research methods. In addition, my course work helped me to gain a better understanding of how to write about research in order to disseminate the findings. While in the middle of my graduate program, I moved from working with Dr. Richard Joerger and TIP to working at the National Research Center for Career and Technical Education (NRCCTE) under the direction of Dr. James Stone III, Dr. Corinne Alfeld, and Dr. Donna Pearson.

While working at the NRCCTE, I was part of a study that explored the impact that Career and Technical Student Organizations (CTSOs) had on students.

Simultaneously, the NRCCTE was engaged in a landmark CTE and math study which found that embedding math content within CTE programs of study had positive effects on the math achievement of students. That NRCCTE study piqued my curiosity and led me to further develop my understanding of how science and CTE could be integrated.

Since my time working at the NRCCTE, it has taken me a while to construct the current research study and there have been many stops along the way. I believe though that I can trace the land mark events that have led me to where I am right now. The formation of my understanding of science and CTE and how they can be integrated has its roots in my experiences on the farm. The farm was a space where the context drove my knowledge construction and natural challenges facilitated processes of discovery. My formal schooling experiences have served to provide me with an understanding of how science education is enacted and the extent to which science facts, divorced from meaningful contexts, for the basis of the instruction. Finally, my experiences as a teacher and researcher have refined my understanding of science and CTE as content areas and pathways of student development that could be integrated to improve overall student understanding and achievement.

Chapter 4

RESULTS AND FINDINGS

The research question that was used to guide this study was: what are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, this study sought to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers. The research process constructed a grounded theory which explicates the lived experiences of CTE teachers that have engaged in the process of CTE and science content integration. Chapter four provides: (a) a general description of the developed grounded theory; (b) description of the participants; and (c) a detailed delineation of the categories and codes that formed the developed grounded theory. The chapter will then be concluded with a summary which will serve to encapsulate the grounded theory and provide linkages to a discussion of the implications of the research.

Description of the Grounded Theory

The grounded theory constructed from the data consists of one core category identified as evolutionizing, and three other categories: (a) connecting; (b) enacting; and (c) futuring (see Figure 3). A core category in a grounded theory research study is the main storyline of the narrative data and it integrates subsidiary categories in a grounded theory. The core category encapsulates the data efficiently at the most abstract level, and is the category with the strongest explanatory power (Charmaz, 2006). In most cases, the grounded theory research process results in the creation of a core category and several other categories that are labeled with gerunds. A gerund is the form of a verb when it functions as a noun or a noun formed from a verb which denotes an action or state (Bryant & Charmaz, 2007; Glaser & Strauss, 1967). In addition, the core category and subsidiary categories, in almost all cases, take the form of abstract concepts.

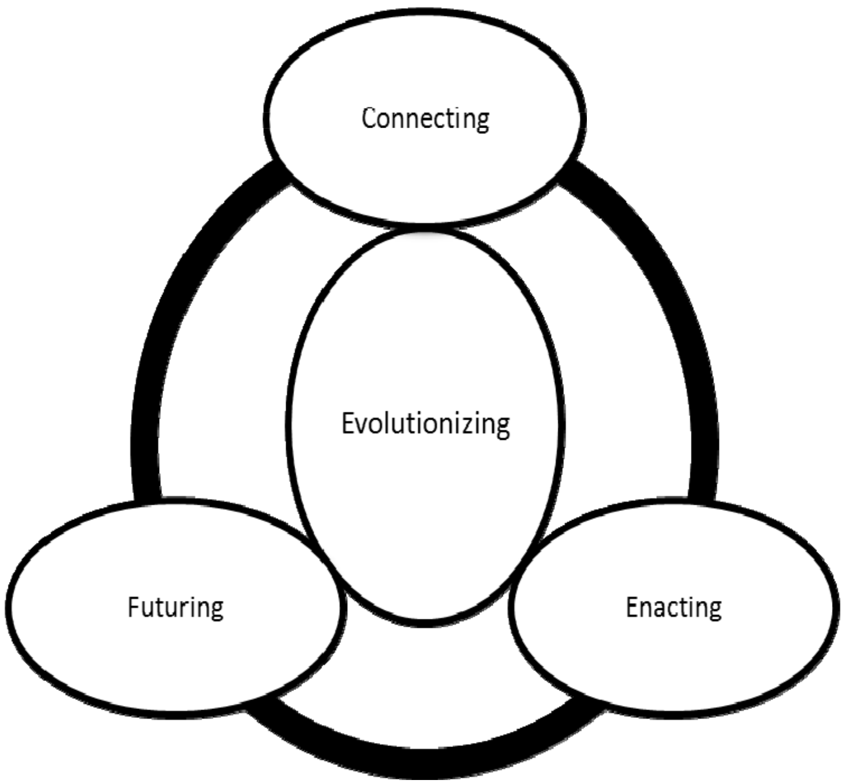


Figure 3. A graphic representation of a grounded theory of CTE Teachers' perspectives of and experiences with the process of CTE and science content integration

In the current study, the core category of evolutionizing illustrates that the main theme within the process of CTE and science content integration was a complete and ongoing transformation of the program of study including: (a) instructional content and practices; (b) program goals and objectives; and (c) ways that the CTE teachers reflected, problem solved, and collaborated. Evolutionizing emerged as the central action and core category within the process of CTE and science content integration. Conceptually, the core category of evolutionizing (a) subsumes the other three categories; (b) links to the other three categories; and (c) facilitates linkages between the other three categories.

There is some debate as to whether categories, including the core category, of a grounded theory analysis should be considered to have "emerged" from the data or whether categories should be conceptualized as having been constructed by, and hence an interpretation of, the researcher (Patton, 2002). The dominant position within grounded theory research today is toward constructivist interpretations (Creswell, 2005). Therefore, in light of the dominant view, it is accurate to state that while codes emerge from the data, the grounded theory and categories which populate the theory are constructed from the codes which emerged from the analysis of the data (Charmaz, 2006). It also follows then that the terms utilized to encapsulate the categories provided the best way to represent the overriding themes which arose from the CTE teachers' experiences. Embedded within the description of each category, selective code, and axial code which form the grounded theory, is a depiction of how the term representing the category or code encapsulates the main thrust of the data.

Description of the Participants

To provide details regarding the characteristics of the participants' backgrounds and their teaching experiences, biographical sketches have been included within the results. The biographical sketches are intended to assist readers in further understanding the perspectives of the CTE teacher participants. In an effort to protect the confidentiality of the participants, pseudonyms have been utilized to enable a more robust discussion of the findings.

Itachi

Itachi is an agricultural education teacher at a BOCES center. He obtained a Bachelor’s degree in animal science from a comprehensive 4-year college. He worked as a laboratory technician for three years before going back to school to complete a teacher preparation program to obtain a Master’s degree in agricultural education and state certification as an agricultural educator. Itachi has been teaching for seven years. Itachi’s program serves junior and senior level students during two block period sessions each day. The first year of the program is directed at assisting students to gain an understanding of general animal science knowledge and skill competencies. The second year of the program focuses on applications of biotechnology in animal science.

Temari

Temari is an agricultural educator working in a program with one other instructor at a rural comprehensive high school. She received a Bachelor’s degree in agricultural education from a land grant institution in 1991 and has been teaching high school agriculture ever since. Temari has also worked on a dairy farm and run a small strawberry operation for fifteen years. Temari teaches the following courses: animal science, plant science, aquaculture, forestry, and advanced animal science. The other courses in the program are focused on agricultural mechanics.

Gara

Gara is an agricultural education instructor working in a multi-instructor program at a large BOCES center. He obtained an Associate's degree in horticultural science from a technical college and later completed a Bachelor's degree in horticulture at a land grant institution. After working for five years in the horticulture industry, Gara went back to school for a Master's degree in agricultural education. Gara has been an agricultural educator for six years. Gara teaches half of the day and works as a work based learning coordinator for the other half. The student population in Gara's program consists of juniors and seniors. For the most part Gara works with the juniors. Gara teaches one class as part of an extended block schedule each day. The class is focused on introducing students to horticulture as a science and a vocation.

Kakashi

Kakashi is an agricultural educator working in a semi-rural comprehensive high school. The program that Kakashi works in has two other agricultural education instructors. Kakashi has a Bachelor's and a Master's degree from a land grant institution in agricultural education. Kakashi has been teaching 15 years and has owned a small working farm for the same amount of time. Kakashi has worked with the New York Department of Environmental Conservation on several wildlife projects including population estimations of grouse, turkey, and salmon. Kakashi teaches the following courses: natural resource management, agroecology, aquaculture, and forestry.

Sakura

Sakura is a health occupations instructor working in a program with two instructors at a BOCES center. She obtained an Associate's degree in nursing from a community college and later completed a Bachelor's degree in radiation therapy. After working for nine years as a nurse and four years as a radiation therapist, Sakura went back to school for a Master's degree in health careers education. Sakura has been a CTE teacher for fourteen years. Sakura's program serves junior and senior level students and adult learners during two extended block periods each day. Sakura teaches classes that are focused on assisting students to gain competence in health related occupations and obtain certification as a nurse's aide. Sakura teaches courses in anatomy and physiology.

Shino

Shino is a health occupations instructor working in a multi-instructor department at a BOCES center. Shino has a Bachelor's degree in nursing from a 4-year comprehensive liberal arts college and a Master's degree in health careers education. Shino has seven years of nursing experience and six years of teaching experience. Shino's program serves high school juniors and seniors that are part of a two-year new program of study to gain certification as home health aides or nurse's assistants. Shino teaches: anatomy and physiology and health assessment.

Kiba

Kiba is a health occupations instructor at a BOCES center. She has completed : (a) a Bachelor's degree in leisure studies; (b) a hospital based Registered Nurse (RN) certification program; and (c) a Master's degree in health careers education. Kiba has fourteen years of experience as an RN and sixteen years of experiences as a CTE teacher. Kiba teaches anatomy and physiology and patient care in a program for high school juniors and seniors. Students that successfully complete the program are eligible to take the New York State nursing assistant exam or the New York State health aide exam.

Kabuto

Kabuto is a health occupations instructor at a BOCES center in a health occupations technology program. Kabuto has a Bachelor's degree in technology education and is a certified medical assistant. Kabuto has four years of experience as a technology teacher and four years of experience as a health occupations instructor. Kabuto is currently working on obtaining a Master's degree in health careers education. Kabuto's program serves junior and senior level students during two extended block periods each day. Kabuto teaches the following courses: (a) technology in health care; and (b) measurement, reporting, and environmental monitoring in health care.

Madara

Madara is a culinary arts instructor working at a BOCES center. Madara has a Bachelor's degree in culinary arts from a culinary institute and a Master's degree in education. Madara has seventeen years of culinary experience and nine years of teaching experience. Madara's program serves high school juniors and seniors that are part of a two year new program of study to gain the National Restaurant Association's ProStart/School-to-Career certificate. The program emphasizes the following technical skills: (a) food safety; (b) sanitation; (c) kitchen safety; (d) cooking methods; (e) equipment use.

Saske

Saske is an instructor at a BOCES center in a culinary arts program. He has: (a) an Associate's degree in culinary arts from a technical college; (b) a Bachelor's degree in culinary arts institute; (c) a certification as a culinary professional (CCP); and (d) a Master's degree in culinary arts education. Saske has 10 years of experience as a culinary arts professional and seven years as a culinary arts instructor. Saske's program serves junior and senior level students during two extended block periods each day. Saske teaches courses that emphasize the following technical skills: (a) nutrition planning; (b) sanitation; (c) food production; and (d) baking.

Naruto

Naruto is a culinary arts instructor working in a hospitality and tourism program with three other instructors at a BOCES center. He obtained an Associate's degree in culinary arts from a community college and later completed a bachelor's degree in culinary arts education. Naruto has eleven years of culinary experience as a chef and eight years of experiences as a culinary arts instructor at the secondary level. Naruto's program serves junior and senior level students during two extended block periods each day.   Naruto teaches classes that are focused on assisting students to gain competence in hospitality and tourism occupations and obtain the National Restaurant Association's ProStart/School-to-Career certificate.

Sai

Sai is an automotive technology teacher working in program with one other instructor at a suburban comprehensive high school.   He has an Associate's degree in automotive technology and a Bachelor's degree in automotive technology education from a 4-year liberal arts college. Sai is a certified ASE technician with twenty years of field experience and twelve years of teaching experience. Sai's program works with 9^{th}, 10^{th}, 11^{th}, and 12^{th} grade students. Seniors that have enough completed enough course work have the option to participate in the automotive coop program. Sai teaches the following courses: (a) automotive fundamentals; (b) automotive electrical systems; (c) engines; (d) drive lines and gears

Neji

Neji is an automotive technology teacher working in program with two other instructors at a BOCES center. He has an Associate's degree in automotive technology and a Bachelor's degree in automotive technology education from a 4-year liberal arts college. Neji is a certified ASE technician with twelve years of field experience and eight years of teaching experience. Neji's program serves junior and senior level students two extended block periods each day. Neji teaches courses which stress the following areas: (a) the fundamentals of automotive repairs; (b) fuel and ignition controls; and (c) electronic systems.

Darui

Darui is an automotive technology teacher working in an automotive program at a suburban comprehensive high school. He has a Bachelor's degree in automotive technology education from a 4-year liberal arts college. Darui is a certified ASE technician with fifteen years of field experience and eight years of teaching experience. Darui's program works with 10^{th}, 11^{th}, and 12^{th} grade students. Darui also spends 1/3 of his time serving as his school's work-based learning coordinator. Darui teaches the following courses: (a) fundamentals of automotive technology; (b) advanced automotive technology; and (c) speed and power.

Table 5 provides a summary of the participants' relevant work experience characteristics. Table 5 illustrates the number of years each participant has worked in their specialty field and the number of years they have worked as a CTE teacher. In addition, Table 5 also provides information about where the participants teach and the subject area of their CTE program of study. Table 5 demonstrates that the participants' have a range of working and teaching experience. Table 5 reveals that majority of the participants work within CTE programs housed at a BOCES.

Table 5
Characteristics of Participants

Name	W	T	School setting	CTE Program of Study
Itachi	3	7	BOCES Center	Agriculture
Temari	15	13	Rural High School	Agriculture
Gara	5	6	BOCES Center	Agriculture
Kakashi	15	15	Semi-Rural High School	Agriculture
Sakura	13	14	BOCES Center	Health Occupations
Shino	7	6	BOCES Center	Health Occupations
Kiba	14	16	BOCES Center	Health Occupations
Kabuto	3	8	BOCES Center	Health Occupations
Madara	17	9	BOCES Center	Culinary Arts
Saske	10	7	BOCES Center	Culinary Arts
Naruto	11	8	BOCES Center	Culinary Arts
Sai	20	12	Suburban High School	Automotive Technology
Neji	12	8	BOCES Center	Automotive Technology
Darui	15	8	Suburban High School	Automotive Technology

Note: W = years of experience work experience in specialty area; T = years of teaching experience

Categories and Codes that Formed the Developed Grounded Theory

Within the current study the use of coding resulted in the emergence of 139 open codes, 27 axial codes, and 11 selective codes. Figure 4 provides a visual illustration which depicts the relationships between the open, axial, and selective codes. Figure 4 illustrates that core category of the grounded theory was evolutionizing and that the three subsidiary categories were enacting, connecting, and futuring. Figure 4 also reveals that one selective and two axial codes subsumed underneath the core category had additional connections to codes subsumed underneath subsidiary categories.

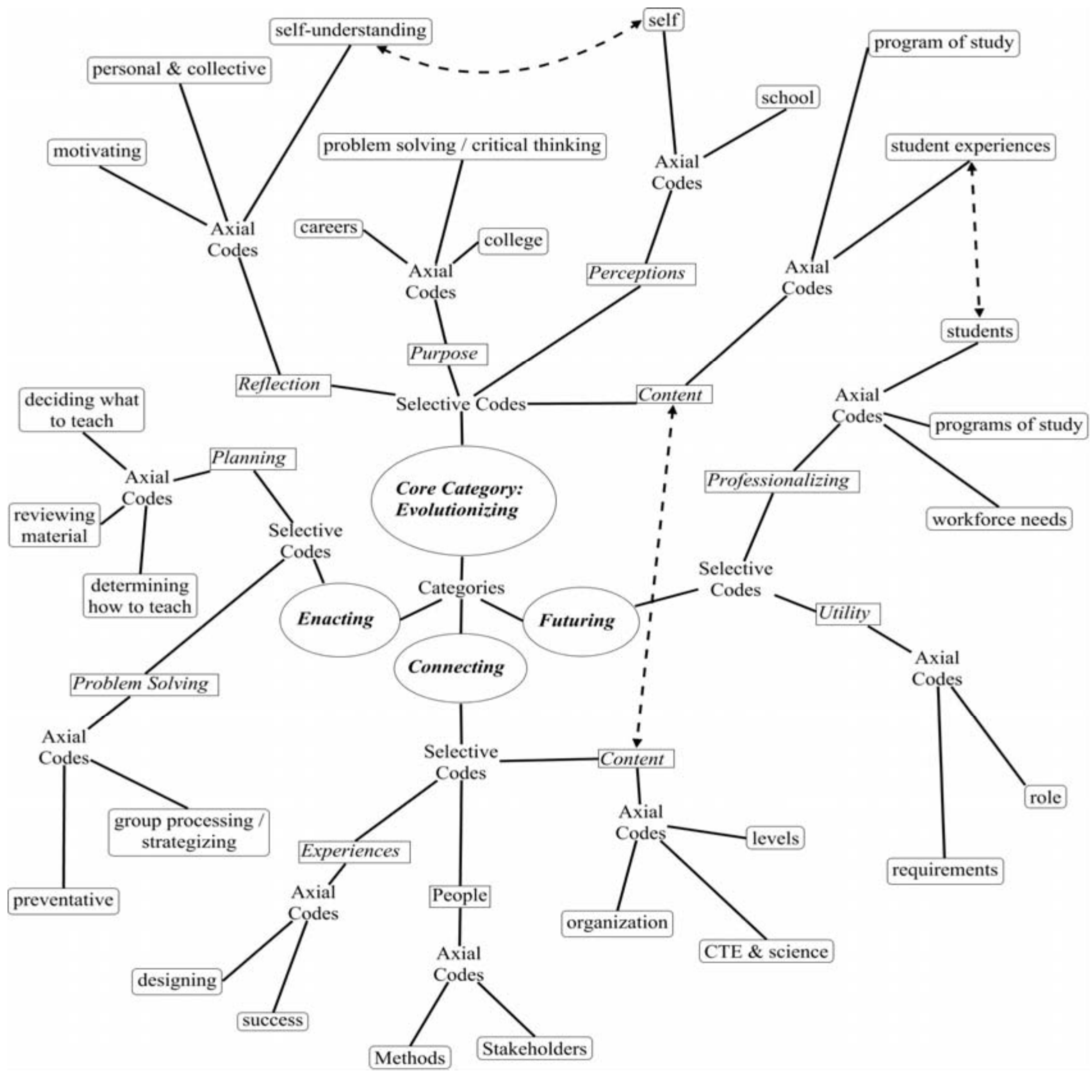


Figure 4. A visual illustration of a grounded theory of CTE teachers' perspectives of and experiences with the process of CTE and science content integration

The results, findings, and discussion sections of the current study will employ a system similar to that utilized by Pope-Davis, Toporek, Ortega-Villalobos, Ligiero, Brittain-Powell, and Liu, (2002) and Richie, Fassinger, Linn, Johnson, Prosser, and Robinson, (1997) to discuss participant responses: (a) the words *all*, *almost all*, and *vast majority* indicate that the response emerged from 11 or more of the participants (b) the words *many*, *most*, and *a majority*, indicate that the response emerged in more than half (eight or more) of the participants; (c) the words *some*, *several*, or *a number of* indicates a response characteristic of less than half but more than three participants; and (d) a few indicates a response that was endorsed by three or fewer participants.

Evolutionizing

The categories of the grounded theory are described by utilizing the illustrative quotations that formed the axial and selective codes within each of the categories. The core category evolutionizing was constructed from the data and was formed on the basis of the selective codes presented in Table 6. Table 6 illustrates that the core category of evolutionizing was framed by participants as being related to four selective codes which emerged during data collection and analysis: (a) evolutionizing reflection; (b) evolutionizing perceptions; (c) evolutionizing content; and (d) evolutionizing purpose(s). The selective codes which emerged add dimensions and properties to delineate and explain the different factors that contribute to the overall story line which is defined by the core category of evolutionizing. Terms that were expressed by participants during interviews that related to the core category are as follows: taking action; adapting; completely transforming; selecting; finding niches; repurposing;

creating; natural; in harmony; and guiding.

Table 6

Selective Codes and Example Quotes Which Compose the Core Category of Evolutionizing

Selective Codes	Examples
1.1 Evolutionizing reflection	"I needed a lot of reflecting and I went through a period of taking stock of what I had done in the past and then I created new strategies for teaching CTE and science together , I needed to feel like my instruction had improved and students will benefit" (Kiba)
	Integrating science and working with a science teacher…it didn't happen all at once and over time our ideas got better and we are still adding to them. Having things so organized (for state program approval) is a big help for going back and reflecting and then re-adapting everything" (Itachi)
1.2 Evolutionizing perceptions	"My ideas needed to change. Integrating science into the program has made a huge impact on the way I see the program and how it fits…I had to get started with it (CTE and science content integration) first before I realized how I viewed the program was shifting. I look at the students differently too, it's about more than technical competencies"(Sai)
	"Part of integrating CTE and science content really required a change in how the school (principal and other teachers) sees the program. It's not a place just to stick students anymore…It needs to be seen as a place that opens options for students" (Kakashi)
1.3 Evolutionizing content	"I took the position that I was transforming and adapting the content to make something new. We spliced different specialties together and now we have a program that is built for the long haul…I feel like the program is more sustainable" (Temari)
1.4 Evolutionizing purpose	"Science integration affects the DNA of the entire program…My work on integrating CTE and science content was driven when I focused on getting kids to college and careers. The vibe of the program has transformed over time" (Shino)
	"For me, the integration of science has to really be driven by a desire to rebuild the program as a pathway with many

potential outcomes" (Madara)

"Integrating CTE and science shifts a lot. The purposes of the program have been reconstructed…I start with the purposes and objectives we added to help kids with academic or college connections not just career experience"(Neji)

Evolutionizing Reflection. The selective code of reflection was composed of three axial codes: (a) motivating; (b) self-understanding; and (c) personal and collective. Twelve of the participants discussed the involvement of reflection in the process of CTE and science content integration. The participants credited reflection as a major component of building the activation energy to begin the process and the sustaining energy to continually work on the process of CTE and science integration. Kabuto stated,

> Reflection and taking stock of where the program was…was like a huge initiator and part of getting ready to work on the devil in the details kind of stuff and then making sure everything was lining up.

A majority of the participants indicated they were motivated by reflecting on the affordances that integrating CTE and science would create with respect to working with students. Naruto stated,

> I thought a lot about how the process of integrating science will create opportunities for us to bring in different guest speakers and see a lot of the content on a deeper level; what is the effect of hand and food washing and how…exactly how…does food go bad and what can we do to prevent it.

Most of the CTE teachers indicated they took time to reflect on the process of CTE and science content integration specifically because it tended to motivate them. The CTE teachers viewed the process of CTE and science content integration as laborious and would utilize reflection as a means to reconnect with the process and invigorate themselves. Shino stated,

> When I would get bogged down or I didn't want to really work on the science thing. I found myself reflecting about the process and…I could tell that just thinking my way through it and deliberately engaging in it through my mind was a big help.

Another axial code associated with the selective code of reflection was self-understanding. Almost all of the participants revealed that reflecting about self-understanding was a critical component in the process of integrating CTE and science content. One aspect of self-understanding was reflecting on what knowledge they brought to the process and how they needed to adapt their knowledge or resources to address challenges they faced. Naruto stated,

> For me recognizing that I was not a science person or a science teacher was important. I never avoided science as a student and I recognize that it is important for students and our society. I thought about how I would need help and what ways of working together with the science teacher would work for me.

The participants also expressed that when they over estimated their knowledge and abilities the process of CTE and science content integration was impeded. Saske related that

> I had to sit back and evaluate what I could and couldn't do by myself…my understanding of myself had to be reformed. Once I did that it was easier to work through the process and build the new learning objectives with my colleagues.

The data revealed that CTE teachers' self-understanding reflections regarding their teaching style were an important factor in the process of CTE and science content integration. The majority of the CTE teachers engaged in self-understanding reflections regarding how they teach and what instructional strategies made the most sense for them when integrating CTE and science content. Kakashi stated,

> As the integration process went along I imagined putting into practice what I was putting onto paper and then I would change what I had done the day before to match more with my teaching style…but I also made changes in how I understand

teaching to accommodate the new things I wanted to do.

Some of the CTE teachers also revealed self-understanding reflections that were specifically about resources and teaching strategies. The CTE teachers indicated that self-understanding reflections were an important aspect in recognizing the teaching resources they would need and gaining ideas for teaching strategies. Others noted that a lack of reflections regarding self-understanding were an element in creating challenges during trial implementations of the CTE and science integrated content. Neji Stated,

> I didn't reflect back through my understanding of the science integrating learning experiences we were building. I think if I had… and knowing my specialty and my needs, it would have brought up ideas and questions about resources and teaching (techniques and strategies) that I would then have brouht up with my science partners or others.

The majority of the participants communicated that their self-understandings about how they work with others was a facet of the selective code of reflection embedded within the process of CTE and science content integration. The participants indicated that throughout the process of CTE and science content integration they were reflecting about how they were working with others and how that might enhance or inhibit the sharing of resources and equipment. Reflections about how to make cross-discipline working relationships stronger and less artificial was a sentiment expressed by nine of the participants which highlighted the influence of working with others within the selective code of reflecting.

The data reveal that within the core category of evolutionizing the axial code of personal and collective was a component of the selective code of reflection. A number of participants reported that collective reflection was an important influence when working in sessions on the process of CTE and science content integration. Itachi stated "group reflections often changed the direction of what we were doing…it always made it better" and Darui noted

> The integration process changed the way we work together…everything had to fit and be related to both science standards and our automotive content, we group processed in new ways to make it happen.

Evolutionizing Perceptions. The selective code of evolutionizing perceptions was composed of two axial codes: (a) school and (b) self. All of the participants expressed observations regarding how the process of CTE and science content integration involved changing perceptions. Participants revealed that changing perceptions was part of the process of CTE and science content integration from the initial stages to the present time.

Almost all of the participants indicated that without helping to evolve the perceptions of the school, the process of CTE and science content integration would have been much more difficult and to some degree meaningless. Temari stated "without the school (superintendent, principal, and guidance counselors) changing their ideas about the program and expressing their support...I wouldn't have been able to do it" and Madara revealed,

> We could do all the work, but if the perceptions of the BOCES and home school administrators didn't adapt, then the kids wouldn't get the credit for the science lessons they were doing and the process would not have been very useful".

Most of the CTE teachers also indicated that they had to work to change the perceptions of the school. The same participants intimated that when they created presentations for local administrators or invited them to attend conferences and workshops about CTE and science content integration it made a difference. Gara stated,

> Even though my administrator was on board with integrating science into the

> program, once we went to the workshop put on by the CTE resource center she had all these ideas and became a big part of the overall process.

Sai described

> I wanted to provide evidence for the administrators that we could do it. We put together lessons and demonstrated them to the superintendent, principal, and the science department…in the beginning only one of the science teachers was on our side. After we presented the lessons we had a readymade work group and everyone had ideas.

Many of the participants revealed that the evolving perceptions of the school leaders and guidance counselors were still in flux, and that they needed to continue to work on creating a more permanent evolution of the faculty and staff perceptions. Most of the CTE teachers reported that if the conditions were not correct and the environment shifted, all the evolving perceptions of the CTE program that others were forming would easily revert back to their old perceptions. Kakashi stated,

> The science integration process has a lot of meaning in it. To get approval we had we had to create a belief that the Ag program could provide high level science experiences for students. Those beliefs are still fragile and we have to keep helping them to transform into something new rather than going back to the 'ol same old same old.

Almost all of the CTE teachers revealed that the process of CTE and science content integration was affected by evolutionizing their self perceptions. The participants indicated that their perceptions regarding who might participate in their CTE program of study and what the program could help students to become was evolutionized within the process of CTE and science content integration. The majority of the CTE participants noted that the process of CTE and science content integration adapted their perception of the types of students they could attract and the extent of formal education the CTE program could prepare students for. The CTE teachers noted that they perceived their CTE program of study would attract more students that had attained higher levels of academic achievement and aspirations for formal postsecondary studies. Temari stated,

> Originally, I looked at our program as a way to help students learn about work in agriculture. I looked at the kids in the program as non-college bound for the most part. I think integrating science will add more college bound students to our program and help prepare more of the kids who may not have been college bound before to make the leap into some kind of postsecondary program.

Sakura stated,

> the process of integrating science was part and parcel of changing my own perceptions of the program and what pathways it opens up for students. Also my perception of what academic integration is exactly has been evolving and adapting to be a more complete understanding. I think of science integration as an ongoing ever adapting process just like the CTE content.

Evident in Sakura's statement and statements made by the majority of the other CTE teachers was an acknowledgement that the process of CTE and science content integration involved a transformation in how they perceived CTE and academic integration. The CTE teachers noted that the process of CTE and science content integration had helped to evolve their perceptions of CTE and academic integration. Most of the CTE teachers had previously perceived academic integration as a process of watering down their CTE content and having students engaged in academics "during our time with them." However, through engaging in the process of CTE and science content integration their perceptions of CTE and academic integration evolved to be something different. Almost all of the CTE teachers expressed that as a result of engaging in the process of CTE and science integration they perceived it to be a utilization of the context of CTE to provide academic supports for all students. Madara stated,

> Before actually going through the integration process…I identified it as a way for the school to diminish the CTE program. In the process and even more so now I look at it very differently. I conceive of it as a way to use the CTE content to help kids in more ways just by using the connections that are already there.

Within the process of CTE and science content integration the perceptions the CTE teachers held regarding the merit and worth of their previous work experiences also evolved. The majority of CTE teachers reported that they began to perceive their previous work experiences (e.g., mechanic, chef, nurse) as a foundation for their confidence in teaching CTE and science integrated content. First, the CTE teachers expressed that their work experiences assisted them in understanding how to incorporate the science to be integrated into the CTE program of study. Second the CTE teachers perceived themselves to grow in stature with the science teachers because of their extensive work experiences. Shino stated,

> The science teachers I was working with were really impressed with my experiences in the health field. They didn't have similar experiences with science as a vocation. I believe that my work experiences gave me a boost in how I perceived myself in relation to teaching integrated CTE and science…I had a more equal footing and that wasn't something I had experienced before.

Evolutionizing Content. The selective code of evolutionizing content was composed of two axial codes: (a) program of study; and (b) student experiences. All of the participants reported that the process of CTE and science content integration was impacted and formed by elements of evolutionizing content from the perspectives of the program of study and student experiences. With respect to the first axial code, program of study, almost all of the CTE teachers gave voice to the idea that the process of CTE and science content integration involved a deep revision of the overall program. The CTE teachers gave emphasis to abandoning the idea of "slipping some science in where it fit." The majority of the CTE teachers indicated that the process of CTE and science content integration involved a complete revision of the program of study content. Neji stated,

> I gave up the idea of containment and a minor amount of work…I had a full out go at the content to change it…otherwise…it just would have been too piecemeal…it took a lot of time and effort.

Within the same vein of the process of CTE and science content integration was an underlying theme of "cleaning-up the content." The majority of the CTE teachers revealed that as the process of CTE and science content integration advanced and the program of study content evolved, it had the effect of culling outdated and low utility elements. Temari stated,

> As I was working through integrating the program content, I recognized that there were things in the curriculum guides and my syllabi that I didn't even address or were outdated. The process of integrating science helped me to streamline the content more.

Another key element in the process of CTE and science content integration revealed by the participants was that the content was not so much enhanced, as it was changed to be something almost entirely new. From the perspective of the CTE teachers, the process of CTE and science content integration was an alteration of the DNA of the program of study content. The CTE teachers characterized the integration process as a "metamorphosis" and a "series of progressions" that created something that resembled "a new program of study." Kakashi reported,

> It's not that the old content went away, it's more like it was a caterpillar and now it's a butterfly. It's still the same individual, but in a very different form with very different capabilities.

Subsumed underneath the evolutionizing content selective code, the data encapsulating the axial code of program of study also includes statements from all of the CTE teachers regarding the modification of learning goals and objectives. Further, almost all of the CTE teachers reported that the most challenging work connected with the process of CTE and science content integration was at the level of "adding to," "rewriting," "adapting," and "rethinking" the program learning goals and objectives. The same participants articulated an awareness that adding science and integrating science are two very different concepts. The CTE teachers revealed that it was challenging for them to create objectives that effectively integrated science concepts and processes into the CTE content that was essential to their programs of study. More specifically, the CTE teachers indicated that the idea of utilizing objectives that required students to actively connect to the CTE and science content simultaneously in a seamless fashion was very difficult to operationalize. Saske and Gara stated respectively,

> Shaping the learning objectives…you know…what is going to actually happen and what the kids are supposed to get out of it was a big challenge. I mean if you are doing it right…you're hitting two or three birds with one stone. The kids get the CTE learning, the science learning, and practical applications of both…but putting that into place is a hard.

> The real integration is rewriting the content through the learning objectives so that they articulate everything. The process of integrating science really means doing it at different levels…simple facts all the way up to using the science method to teach.

Underlying the statements made by the CTE teachers regarding the process of CTE and science content integration was their recognition of the complexity of the associated challenges and the impact it had on the entire CTE program of study. The CTE teachers perceived that through the content, the program of study as a whole entity is a product of the evolutionizing associated with the CTE and science integration process.

Most of the CTE teachers reported that shifts and adaptations in the content of the program of study resulted in changes that effected programmatic facets such as work-based learning placements, the allocation of resources, and the types of career outcomes that were emphasized. Shino revealed,

> Integrating science has changed a lot about the program…not just what I do in the classroom, but how I talk to the students and the kinds of interests I try to get them to develop. Some of the work-based learning we do has shifted to more shadowing.

Naruto stated,

> Content adaptations and different objectives have shifted our resource use and we needed to spend additional funds on equipment and supplies that were now part of our overall instructional plan…we hadn't considered that in the very beginning.

Most of the CTE teachers disclosed that the process of CTE and science content integration required them to "juggle" the budget and resource sharing they normally utilized. Further, some CTE teachers revealed that the process of CTE and science integration had added a significant amount of cost to the overall program budget. Those same CTE teachers expressed that some choices may need to be made over time to determine which instructional choices had the greatest effect on students. Itachi stated,

> The science integration process is costing the program a little more in different areas. If your budget gets cut we will need to re-evaluate the situation to make decisions about what we want to change or continue to do.

Student experiences was also an axial code which formed a facet of the process of CTE and science content integration. A majority of the CTE teachers indicated that evolutionizing student experiences was an element within the integration process. To be sure the content in and of itself was changing within the process of CTE and science integration, however, the process of integration also encompassed deliberate adaptations directed at guiding students through new varieties of experiences. Most of the CTE teachers made connections to the new varieties of experiences from a classroom and laboratory instructional perspective. Some of the CTE teachers, however, expressed that their new varieties of experiences were also at a programmatic level. Examples included: (a) field experiences; (b) field trips; and (c) course creation.

Most of the CTE teachers reported engaging the CTE and science integration process by redesigning student experiences for increased flexibility and learner centered "ah ha" moments. For some of the CTE teachers, the integration process included organizing the content so that it facilitated more flexible learning experiences for students. The more flexible student learning experiences were centered around supporting a wider range of learning modalities and learning strategies. For example, Naruto and Itachi reported that as they progressed through the CTE and science integration process they addressed at least two learning strategies in each science integrating learning experience they implemented within their programs of study. Neji stated,

> One thing that really helped me to move forward in the science integration process was to focus on providing students with flexibility in the learning environment…meaning we would use different methods and activities to help them learn the same content. I have really reduced my reliance on lecture and increased the amount of activity based learning.

Some of the CTE teachers highlighted learner centered "ah ha" moments as another aspect that is tied into the process of CTE and science content integration. Within the process of integrating science the CTE teachers revealed a connection to increasing the opportunities students would have to problem solve and discover in order to construct new understandings. Some of the CTE teachers shared that in order to address the science in their CTE program of stud more appropriately, the process of CTE and science content integration involved more open ended learning experiences. Rather than setting up static scenarios the CTE teachers allowed students to arrive at their own answers and conclusions. Madara stated,

> In the past, I would have lectured about how various leaveners (e.g, baking soda, and yeast) are used and how they affect baked goods. The process of working on integrating science into the program changed the experiences I saw as important …now I let the students figure it out through experimentation and then we discuss the role of CO2 and it leads to a deeper level of knowledge and more connections to other content…there is a big "ohhh, I get it now" that connects to the chemistry they are taking at their home school.

The subtext of the explicit statements provided by the CTE teachers illustrates that within the process of CTE and science content integration is an adaptation of instructional techniques. For CTE teacher participants, the process of CTE and science integration included embedding methods of instruction that reinforced the concepts of problem solving and discovery in CTE and science.

Evolutionizing Purpose. The data reveal that evolutionizing purpose was an element within the process of CTE and science content integration. The data further reveal that evolutionizing purpose emerged as a selective code which subsumed three axial codes: (a) careers; (b) college; and (c) problem solving/critical thinking. Almost all of the CTE teachers described facets of evolving careers oriented purposes within the process of CTE and science content integration. Most of the CTE teachers reported analyzing how to address a wider variety of career options and opportunities for students. In all cases, the evolutionizing of the careers oriented purpose of the CTE programs of study included transformations which focused on career options which required formal postsecondary educational experiences. Kabuto stated,

> Integrating science (the process) altered the purposes and goals of the program. Changes in the purpose of the program effected the career focus of the program, which has ended up being much more focused on careers that require students to have further training or attend college.

Specifically, CTE teachers revealed that the process of CTE and science content integration was effected by the types of advanced career options available within their field of study. The CTE teachers specified the science that was integrated was, to a large degree, dependent upon the knowledge and skills required for field specific careers. Another way of stating that finding is that the process of CTE and science content integration was designed to build in the science knowledge and problem solving skills students would need in specified career fields. In addition, the integration outcomes created by CTE teachers targeted different professional levels. For example, Neji stated,

> The process of integrating science got us going on different automotive careers (e.g., automotive designer /engineer, fuel cell technician) that require more education. We even went into connections with careers in robotics and robotic vehicles. The process of integrating science opened up the career options for students who are going for different levels of education.

The second axial code within the selective code of evolutionizing purpose is encapsulated in the term college. Almost all of the CTE teachers reported that before engaging in the process of CTE and science content integration they constructed few explicit bridges between their program and formal postsecondary educational experiences. Most of the CTE teachers expressed the idea that "students were either going to college or they weren't." The CTE program of study, in the minds of the CTE teachers, didn't really influence formal postsecondary education choices or outcomes.

Sai recalled,

> The process of integrating science and looking at the program as a pathway for CTE and academics was a game changer for me. The way I looked at it was that I was getting them ready to go out and work in the field as a mechanic. Now I see the whole thing differently…we can have a greater bigger on the college choices that kids make.

Most of the CTE teachers defined the process of CTE and science content integration as having components of repurposing the CTE program of study for college and career readiness. Most of the CTE teachers delved into organizing the program to address different postsecondary programs of study and how students would need to prepare to gain access to those programs. In particular, some of the CTE teachers addressed issues about CTE students and bachelor degree programs. A few of the CTE teachers noting that, historically pathways from CTE programs to Bachelor degrees were not readily accessible for students. Those same CTE teachers also reported that the CTE and science integration process was a key factor in their reconceptualization of their CTE program of study as a "bachelor's degree launching point" for students. Kiba stated,

> The (CTE and science content) integration process was a big push for us to organize the program to highlight different launching points for students…I mean…they could leave the program and work right away or go on for more education. The focus now is that the technical competencies are a beginning to a progression that hopefully involves a college degree (Associates or Bachelor's degree).

The third axial code within the selective code of evolutionizing purpose is encapsulated in the terms problem solving/critical thinking. The data illustrate that within the process of CTE and science content integration was a repurposing of the program of study to facilitate learning through problem solving and critical thinking. A majority of the CTE teachers reported that the purpose of transmitting knowledge was superseded by the purpose of assisting students to develop their problem solving and critical thinking skills in concert with constructing meaningful knowledge of the content itself.

Connecting

The second category of the grounded theory is embodied in the term connecting. The category of connecting was constructed based upon open, axial, and selective codes which emerged through the systematic analysis of the narrative data. Table 7 illustrates the selective codes that formed the foundation for the category of connecting. Table 7 illustrates that the category of connecting was constructed based on three selective codes which emerged during data collection and analysis: (a) connecting people; (b) connecting content; and (c) connecting experiences.

In a broad sense, the category of connecting can be thought of as the evolutions in the connections the CTE teachers and their CTE programs of study experienced or created for students within the process of CTE and science content integration. Terms that were expressed by participants during interviews that were related to the category are as follows: correlate, intertwining, combine, parallel, cooperate, incorporate, interrelated, and organized.

Table 7

Selective Codes and Example Quotes Which Compose the Category of Connecting

Selective Codes	Examples
2.1 Connecting people	"The process of integrating science dealt a lot with the relationships I have with the biology teacher and the principal. Forming the understanding of how we were going to work together was important was a challenge. I relied on my leadership skills" (Itachi)
	"A by-product of the process of integrating science was connecting the science teachers with people I know in health field who they bring in as guest speakers" (Shino)
	"Integrating science into the Ag program combined the work of a number of people who needed to be recognized for their work. Making sure I recognized them as being connected to the program gave them stronger feelings toward the program and I believe (because of that) they are invested in its success" (Kakashi)
2.2 Connecting content	"At first I felt like we were building Frankenstein…you know...putting parts together. But, then I began to see connections in the content and objectives and once I could see the connections…we were hybridizing the program and improving it" (Gara)
	"The process of integrating science in a way scraps some of the discipline boundaries. It supports physics and automotive applications of physics…the connections are made real" (Darui)
	"CTE and science integration is based on naturalistic connections…the connections between the authentic work and the book knowledge students need…I focused on those connections" (Saske)
2.3 Connecting experiences	"Integrating science into the CTE program is also process of looking for connecting experiences for students…where do the curriculums overlap and how as teachers can we make sure those connecting experiences happen" (Temari)

Connecting people. All of the CTE teachers conveyed the idea that connections constructed through relationships are critical to the process of CTE and science content integration. The selective code of connecting people was composed of two axial codes: (a) methods; and (b) stakeholders. Almost all of the CTE teachers reported that the process of CTE and science content integration was impacted by the concepts exemplified in the axial codes of methods and stakeholders. All of the CTE teachers revealed that without establishing genuine connections to people, the process of CTE and science content integration would likely have collapsed.

With respect to the first axial code, methods, almost all of the CTE teachers reported that the process of CTE and science content integration required connections to others as a part of the overall method. Connections to people, were a part of the fabric of the process of CTE and science content integration from the perspective of the CTE teachers. More specifically, most of the CTE teachers pointed out a belief that how they worked with others had an impact on the process of CTE and science content integration and the eventual student outcomes. Madara stated,

> The CTE and science integration process necessitates working with other teachers and departments and even the administration. How you work with your partners is important…planning, organization, respect, and sharing…are all critical. You can't waste people's time and you need to keep moving…stagnant efforts get dropped.

A highly related theme that most of the CTE teachers also noted was that the logistics that surrounded the process of CTE and science content integration may be seen as separate but impossible to separate from the actual science integration itself. Naruto stated,

> Planning meetings, leading meetings, organizing who was going to do what, putting documents together, and all those kinds of tasks were a different part of the process from the actual work on integrating science with CTE, but without it being done nothing would happen.

An additional component of the axial code, methods, is associated with how to enact methods of connecting to people within the process of CTE and science content integration. Almost all of the teachers reported relying on leadership or team building skills they had gained through their professional experiences (e.g., working as an executive chef) or through working with students in Career and Technical Student Organizations (CTSO). The CTE teachers also reported that within the process of CTE and science content integration they were counted on to provide the central leadership role. However, most of the CTE teachers also revealed that they weren't so much in charge of the CTE and science integration process, as they were responsible for coordinating it. Sakura stated,

> No one was really the boss of the process (CTE and science content integration), but, I was the main person involved and I made sure everyone was always on the same page and that the work that was being done was organized. No one else is going to care about the process as much as the CTE teacher…they need to be the guide for the process.

The second axial code, stakeholders, emerged from the data and epitomizes themes that arose from the open coding process. Most of the CTE teachers expressed that the process of CTE and science content integration was influenced by the concept of stakeholders. The CTE teachers reported that as the process of CTE and science content integration progressed, the people they were working with became more attached and involved not only with the integration process, but with the program of study as a whole. Most of the CTE teachers explained that in the beginning of the CTE and science integration process the partners in the process were loosely connected to the program and "disinterested bystanders." However, as the process of CTE and science content integration moved forward the partners became stakeholders in the CTE program of study and began to have a type of ownership of the program. Further, the majority of CTE teachers communicated that creating opportunities to recognize the contribution of the new stakeholders to the program was a component of the process of CTE and science content integration. Itachi stated

> Our program has a holiday party and an end of the year banquet every year and I made sure to invite the people that were working with me on integrating science into the program and I made sure to recognize them and give them a certificate of appreciation. I could tell that made a difference to them.

Connecting Content. The data reveal that connecting content was an element within the process of CTE and science content integration. The data further reveal that connecting content emerged as a selective code which subsumed three axial codes: (a) CTE and science; (b) levels; and (c) organization. All of the CTE teachers described facets of constructing connections between the CTE and science content within the process of CTE and science content integration. Further, all of the CTE teachers reported that it was the connections between the CTE and science content that were a driving force in the integration process. Almost all of the CTE teachers also reported that the CTE and science integration process worked the best when they focused on the CTE content and then overlaid science concepts and methods that fit within the CTE content. However, the CTE teachers also revealed that connecting the content didn't necessarily start from them as individuals, for example, Kakashi stated,

> The workshops I had attended had suggested beginning with the CTE content and we did that almost all the time, but a lot of the time it was the science

> teachers I was working with that saw something in our learning objectives or lessons and they got the ball rolling.

The data also reveal that subsumed underneath the selective code of connecting content the axial code of CTE and science was composed of facets associated with science teachers making connections to CTE content within their classrooms. The CTE teachers reported that as the CTE and science integration process progressed "reverse connections" were implemented within some science courses of study. The data illustrate in some cases that the science teachers were looking for opportunities to connect the content of their courses of study to the "authentic applications" content available with CTE programs. Sai stated,

> Once we were working together and we had completed a substantial amount of integrating science into the auto program, the physics teacher was looking for ways to combine more of what we did (together) and to do more realistic activities with her students…especially in our lab space.

The data illustrate that almost all of the CTE teachers expressed ideas which encapsulate the axial code, levels, within the selective code connecting content. The CTE teachers explained that the CTE and science integration process reflected an examination of the levels of content connections. One aspect of the axial code of levels that almost all of the CTE teachers expressed revolved around the concept which Kiba called "seamless integration." The CTE teachers communicated that within the process of CTE and science content integration they recognized a spectrum from seamless integration to what Sakura labeled "pull-out" science content. The majority of CTE teachers noted that the closer the content to be integrated was toward the seamless end of the spectrum, the more natural it seemed and the easier it was to work with. Similarly, the CTE teachers reported that content and activities that exhibited low levels of seamless fit with the CTE program were challenging to deal with and did not have authentic appeal. Gara stated,

> If something (science content) doesn't fit really well (with the CTE program of study) in an invisible way the process of integrating it is difficult and I am willing to bet the kids will sniff it out as something they don't want to do. Our group avoids topics and activities like that…we don't waste our time.

The data reveal that another aspect of the axial code, levels, envelopes the notion of levels of completeness. Most of the CTE teachers related information regarding the process of CTE and science content integration had varying levels of completeness with respect to the science content that was being integrated. The CTE teachers viewed the central purpose of their program to prepare students for a field of work. And while the process of CTE and science content integration created an evolutionizing of the CTE program purpose, the CTE teachers were quite cognizant of the level of overall science integration. The data reveal that the CTE teachers monitored the overall level of CTE and science content integration based on their CTE needs. Temari stated,

> I don't think there is a magic cutoff point, but the Ag program is a CTE program and the science content should be at the right level of how much time it takes up within the program. We are trying to teach the science that exists within the Ag program and we don't want to go beyond that.

A third facet of the axial code, levels, emerged from the narrative data obtained from some of the CTE teachers. Within the process of CTE and science content integration was a concern regarding levels of difficulty for students. Intuitively, educators understand that different students respond in different ways to challenging learning environments. While engaging in the process of CTE and science content integration some of the CTE teachers focused on assisting students to make connections to their science class learning by addressing more basic content within the CTE program as a way to review. Neji stated,

> I really try to help the kids be successful not just in my program, but in all of their classes. In the process of integrating science I worked with the general science teacher to bring in concepts and activities that connected to CTE and that would serve as building blocks for more higher level things they would be doing.

The third axial code subsumed under the selective code of connecting content was, organization. All of the CTE teachers conveyed that organizing content was a key element in the process of CTE and science content integration. The majority of the CTE teachers explained that the CTE and science integration process was enhanced through first organizing the CTE content. The CTE teachers reported that it was critical that the CTE content was connected appropriately within itself and that the organization was documented in a detailed outline. Further, the CTE teachers reported that the more organized and explicitly described the CTE content was, the easier it was to integrate science content, share revisions, plan for shared resources, and organize overlapping units of study. Reading into the subtext of the data reveals that organizing the CTE content and documenting it facilitates the creation of content connecting opportunities within the CTE and science integration process.

Connecting experiences. The selective code connecting experiences that emerged from the data was composed of two axial codes: (a) designing; and (b) success. The majority of CTE teachers reported that the CTE and science content integrating process included designing connecting experiences for students. The CTE teachers described connecting experiences as student learning opportunities that explicitly linked the CTE and the science classroom content or learning activities. Naruto stated,

> In the integration process (CTE and science content integration) I partnered with one science teacher to do a field trip to a butcher shop to look at cuts of meat and animal anatomy and I partnered with other science teacher to go to an organic farm for a day to learn more about what the word 'organic' means and the science teacher talked about plant nutrients and soil microbes.

Within the design of the connecting experiences was a match between the specific content and the shared use of some instructional resources. However, the method for teaching the content and the way the content was contextualized was purposefully different. Darui stated,

> As I was working on integrating science into the program, I worked with the science teacher to look for activities and experiences that we could connect. I wanted to show the kids that what we were doing had science in it and that science had practical applications…but I also wanted it to be different…same content, different approach.

A majority of CTE teachers explained that the CTE and science integration process was composed of aspects of utilizing connecting experiences to support student success in science and overall learning. More specifically, the integration process was designed to provide students with illustrations of how the CTE content was directly connected to the content in science courses. In that way, the CTE and science integrating process was creating opportunities for students to have success in connecting content, concepts, and activities in an authentic manner. The same CTE teachers reported that the integration process was designed to assist students in connecting experiences with success they had in the CTE program of study into their science courses of study. Saske stated,

> It makes a big difference for students if they have success in one place and then can translate to successes in another place. We designed our integration process to create junctions between CTE and science so kids would have more chances and success and that those successes will build more success.

Enacting

The third category of the grounded theory is encapsulated within the term enacting. In a broad sense the category of enacting can be conceptualized as the evolutions in enacting facets of the CTE programs of study that there were elements of the process of CTE and science content integration. The CTE teachers expressed that evolutions in their enactment of planning, teaching, and problem solving were essential components of the process of CTE and science content integration. Table 8 illustrates that the category of enacting was framed by participants as being related to two selective codes which emerged during data collection and analysis: (a) enacting planning; and (b) enacting problem solving.

Table 8
Selective Codes and Example Quotes Which Compose the Category of Enacting

Selective Codes	Examples
3.1 Enacting planning	"planning, planning, and more planning…integrating science requires a lot of planning" (Naruto)
	"Putting science integration into place in courses is one thing and then planning for it in order to actually do it is more difficult…especially if you are working with others" (Sai)
	" I worked with the science teacher(s) on the planning piece for a looooooong time" (Temari)
3.2 Enacting problem solving	"The science integration process is chock-full of challenges to address and problems to solve…most of them around tools and resources" (Itachi)
	"We encountered problems in the integration process and working together to solve them usually resulted in a better situation for everyone and a deeper level of understanding each other" (Saske)

Terms expressed by participants during interviews that related to the category are as follows: execute, perform, blueprint, map, scheming, deliver, actualize, manage, negotiate, and rehearse.

Enacting planning. The selective code of enacting planning is composed of three axial codes: (a) deciding what to include; (b) determining how to teach; and (c) reviewing material. All of the CTE teachers reported that enacting the process of CTE and science content integration requires an extensive amount of planning. The CTE teachers revealed that comprehensively integrating science into CTE programs by constructing integrating learning objectives and ideas for connecting activities is only a beginning. The more challenging aspect was planning for the actual day-to-day instructional lesson plans. Darui stated,

> Looking at a unit on hydraulics and finding spaces for science integration was part of it. The harder part was unpacking the science and fitting it with the automotive lesson plans. I adapted a lot…I am still figuring out the best places to put some of the content and reorder some of what we used to do.

The majority of the CTE teachers revealed that deciding what exactly to include and in which order to include it was one of the difficult challenges. For example, within the CTE and science integration process, most of the CTE teachers initially struggled with determining whether the practical CTE or scientific theory aspects should be taught or experienced first. Gara stated,

> In planning for CTE and science integration I didn't know which to address first in the my instruction, the CTE content or the science content…I mean they are integrated, but still there are aspects that are different. I start with the CTE and use that as the hook to build the science into the learning experience.

Another aspect of enacting planning that most of the CTE teachers struggled with was how to teach the CTE and science content integrating lessons. Most of the CTE teachers had established methods for teaching their content. However, because the CTE and science content integration had shifted the content and the purpose of their lessons, CTE teachers recognized a need to also address their instructional methods. Darui stated,

> It was a challenge to determine how to teach the integrated content. I am used to using certain methods and strategies, but with the new integrated content came the need to think about how to best teach the integrated content.

The reports of the CTE teachers did not reveal any common techniques for developing ideas regarding which instructional methods to employ with the CTE and science integrated content.

Some CTE teachers communicated that enacting planning within the process of CTE and science content integration involved reviewing material multiple times. Several of the CTE teachers also reported utilizing resources they obtained themselves to review science related concepts and procedures which were components of the CTE and science integrated instructional content. Those same CTE teachers also reported they engaged in multiple reviews of some of the science content in order to check their understanding and reduce the likelihood of making critical errors either in instruction or responding to student queries. Saske stated,

> Integrating the science content required me to keep going back to the resource text and reviewing information…I had to make sure I had it straight in my head and also that I had the specifics.

Enacting problem solving. Almost all of the CTE teachers conveyed the idea that enacting problem solving was an element within the process of CTE and science content integration. The data reveal that the selective code of enacting problem solving was composed of two axial codes: (a) preventive; and (b) group processing/strategizing. The data reveals that the most common problems or challenges that the CTE teachers addressed through preventative and/or group processing strategies were as follows: (a) what exact content to teach, how exactly to teach the content, and how deep to teach the content; (b) resource use and allocation; and (c) fitting the CTE and science content into a required time span. It merits noting that with respect to resource allocation and use, a few of the CTE teachers developed resource calendars or resource use maps to aid in organizing the utilization of resources.

Almost all of the CTE teachers reported attempts to address potential challenges and problems in preventative ways throughout the process of CTE and science content integration. The CTE teachers reported that engaging in the process of CTE and science content integration facilitated the establishment of connections and understandings of the problems that may arise within actual instruction. The CTE teachers revealed that incidents of preventative problem solving were often the result of reflective reviews of the process of CTE and science content integration. Further, the data reveal that detailed reflections regarding the CTE and science integrating content and instructional plans were a strategy for working around problems. Temari stated,

> Within the process of integrating CTE I checked over learning objectives and lesson plans by reviewing them in my mind…I thought about how, when, and where I was going to teach the content and I ran the scenes through my mind to see if everything was congruent.

Most of the CTE teachers also reported enacting problem solving through the utilization of group processing strategies. Most of the CTE and science collaborative groups consisted of CTE teachers, one or two science teachers, and either a curriculum specialist or a special education instructor. The CTE teachers revealed that challenges arising during the process of CTE and science content integration would be brought to the entire group of people working on the integration process. Kiba stated,

> With the science integration process, when problems came up, we would bring them to the whole team and then go from there.

Most of the CTE teachers also reported that problems and challenges were solved by sharing ideas and finding solutions that worked for all of the people collaborating on the process of CTE and science content integration. Almost all of the CTE teachers disclosed that solving problems and addressing problems assisted them in constructing a deeper understanding of the process of CTE and science content integration and of the other professionals they were working with to carry out the process. In particular, most CTE teachers expressed that problem solving through group processing/strategizing was useful for addressing challenges with students with Individual Education Plans (IEP). The CTE teachers also expressed that their main concern with students with IEPs was that they would be able to create appropriate learning supports and differentiated assignments for the CTE and science integrating content. Kakashi stated,

> Integrating science and account for all of the students with special needs on IEPs is a challenge. We worked with the special ed teachers and the aides to put together resource packets and alternative assignments. I think the science teachers were surprised at how much differentiation we use in our instructional planning.

Futuring

The category of futuring was constructed from the data and was formed on the basis of the selective codes presented in Table 9. Table 9 illustrates that the category of futuring was framed by participants as being related to two selective codes which emerged during data collection and analysis: (a) futuring utility; and (b) futuring professionalization. Within the category futuring, the CTE teachers expressed the idea that the process of CTE and science content integration was composed of elements associated with constructing the future. The CTE teachers communicated that the process of CTE and science content integration was a way for them to construct the future of their CTE program of study. Terms that were expressed by participants during interviews that related to the core category are as follows: anticipate, forecast, unfolding, evidence, envision, advantage, productive, relevance, dominant, and expert.

Table 9

Selective Codes and Example Quotes Which Compose the Category of Futuring

Selective Codes	Examples
4.1 Futuring utility	"Currently CTE is in a position to integrate science and other academics by choice. As more requirements are laid onto the education system that may change...I want to be ahead of the curve and I want the program ahead of the curve" (Kiba)
	"CTE has an opportunity to change the role it occupies in the educational system. The process of integrating science is a piece of that change. We need to help our students be better prepared for complex work situations which includes academic preparation" (Madara)
	"The process of integrating science into the program has everything to do with the future. If our program is a place that helps students academically and in a career focus it is much more critical and it's harder for them (BOCES and home school district administrators) to cut our funding" (Shino)
4.2 Futuring professionalization	"The process of integrating science is looking at what students need in the short and long term future…that's what drives the specifics of what is taught and how. The content is critical, but so are the ways we ask students to think and problem solve" (Sai)
	"The process of integrating science provides a better simulation for how science works in reality and the integration also helps to prepare students to use critical thinking which is a part of the long term skill set they need"

(Sakura)

"Employment outlooks indicate that our society needs more individuals with academic knowledge and applied skills…integrating CTE and science is a very good fit and I believe the students and society will benefit" (Itachi)

Futuring utility. Most of the CTE teachers reported that futuring utility was an element within the process of CTE and science content integration. The selective code futuring utility was composed of two axial codes: (a) role, and (b) requirements. The majority of CTE teachers perceived the process of CTE and science content integration raises the future utility of their CTE programs of study.

The CTE teachers revealed that the potential to increase the future utility level of their program of study was an element in their decision to enact the process of CTE and science content integration. Another way to state this finding is to say that the CTE teachers envisioned the future utility of the role their CTE programs of study played would be greater as a result of the process of CTE and science content integration. Sakura stated,

> The function of the program in the home schools and the benefits of the Health Occupations program in the home schools are increased if the program integrates CTE and science content. The program provides more overall value to the school, the students and the parents.

The CTE teachers reported that the process of CTE and science content integration was influenced by the utility for the CTE program to address future requirements. Almost all CTE teachers expressed challenges associated with past and current changes in the requirements students need to satisfy for graduation. Sai stated, "You can't turn around without finding new requirements for students." Most of the CTE teachers communicated that, in their view, more interdisciplinary requirements were going to be part of the future for all students. Most of those same CTE teachers reported that the process of CTE and science integration was a move towards satisfying the future requirements students would have for graduation and for careers. Saske stated,

> I think more interdisciplinary requirements will be part of the future for CTE programs and for students. Almost like going back to the one room school house, but, at least in my case, everything revolves around culinary arts and hospitality for a foundation.

Futuring Professionalization. Almost all CTE teachers indicated that futuring professionalization was a facet that had an impact within the process of CTE and science content integration. Table 9 illustrates that the selective code of futuring professionalization is composed of three axial codes: (a) students; (b) workforce needs; and (c) programs of study. Most of the CTE teachers revealed that within the process of CTE and science content integration was an element of futuring professionalization for students. The CTE teachers indicated that part of the process of CTE and science content integration was an effort to support students' progress towards becoming professionals in their field of specialization. For most of the CTE teachers, recognizing that they wanted to assist students to prepare for their potential futures as professionals was an element within the process of CTE and science content integration. Within the same theme the CTE teachers revealed that the process of CTE and science content integration was effected by their perceptions of the interdisciplinary nature of work. Madara stated,

> Work is more multi-discipline now and people make transformations more often. I may start off as a chef and end up as a buyer for a wholefood specialty market.

Another facet of the futuring professionalization selective code described by the CTE teachers was related to workforce needs. Almost all CTE teachers reported that the CTE and science integration process was affected by employment forecasts. The CTE teachers were concerned with predictions regarding the future needs of professionals in the workforce. In almost every case, CTE teachers directed the CTE and science integration process at not only integrating science, but also infusing career oriented skills (e.g., problem solving, cognitive flexibility, collaboration skills) which were likely to be critical in the future of their students. Itachi stated,

> Integrating science and CTE opened opportunities to create lessons to address other work related skills and abilities students will need in the future. While I am working on the curriculum and integrating I may as well be incorporating concepts and ideas I am getting from employment forecasts and reports about employee deficiencies. Most people don't know how to problem solve on their feet…that is something we can work on in the program.

Slightly less than half of the CTE teachers also reported that the process of CTE and science content integration was a method of maintaining the professional standing of their CTE program of study. Almost all of those same CTE teachers expressed the idea that the integration process was a critical element in the future professional standing of their program of study. Naruto stated,

> The process of integrating science into the culinary program of study is about our students, but it is also about our future students and a high level of professional responsibility to students, the community, and to the program itself.

The CTE teachers also expressed that planning the future of CTE programs of study is a facet of the professionalism and that the process of CTE and science integration is a form of professional planning.

Summary

Grounded theory refers simultaneously to a method of qualitative inquiry and the outcomes of that inquiry (Charmaz, 2006). Within grounded theory methods, Bryant and Charmaz (2007) stress the importance of utilizing data analysis to create theoretical categories instead of trying to "fit" the data into pre-existing categories. Charmaz (2006, p. 252) has also highlighted that grounded theory is adaptive and reflexive in nature, stating that "grounded theory is durable because it accounts for variation; it is flexible and reflexive because researchers can modify their emerging or established analyses as conditions change or further data is gathered"

The grounded theory that was constructed through the current research study is a powerful and comprehensive illustration of the process of CTE and science content integration and is a substantive addition to existing related literature. The current study constructed a grounded theory of CTE Teachers' perspectives of and experiences with the process of CTE and science content integration. Figure 4 presents a visual representation of the grounded theory which was constructed from the data analysis process. The grounded theory presented in Figure 4 represents a conceptualization of the multiple factors that had varying levels of impact on the CTE teachers' past, present, and future CTE and science content integration experiences. A listing of the open codes, axial codes, selective codes, and theoretical categories that form the grounded theory are presented in Appendix C.

In a very real sense the graphic information displayed in Figure 4 provides a map for CTE teachers, administrators, providers of professional development, and researchers. In a landscape devoid of previous findings regarding the process of CTE and science integration, the graphic information in Figure 4 provides interested professionals a place to begin. The visual illustration of the grounded theory (Figure 4) also illustrates one way to think about the professional practices and research questions surrounding CTE and science integration. The visual illustration also demonstrates the relative importance of the presented concepts and actions to the process of integration from the perspective of CTE and science content integrating CTE teacher participants.

The visual illustration of the grounded theory (Figure 4) demonstrates that the core category of the grounded theory of CTE teachers' perspectives of and experiences with the process of CTE and science content integration is evolutionizing. In most cases, grounded theory research results in the creation of a core category that is labeled with a gerund. A gerund is the form of a verb when it functions as a noun or a noun formed from a verb which denotes an action or state (Bryant & Charmaz, 2007; Glaser & Strauss, 1967). Figure 4 also illustrates that the three other categories that form the central nucleus of the grounded theory are: (a) connecting; (b) futuring; and (c) enacting.

The visual illustration of the grounded theory (Figure 4) reveals that the four selective codes which emerged from the data to form the core category of evolutionizing were: (a) reflection; (b) perceptions; (c) content; and (d) purpose. The data illustrate that within the process of CTE and science content integration, the CTE teachers had experiences with personal and collective reflections which were related to motivation and self-understanding. For example, the process of CTE and science content integration was viewed as constructing a reflection lens through which the CTE teachers understanding of their professional teaching practices was evolutionized.

The grounded theory portrayed in Figure 4 illustrates that the concept of connections has an influence on the process of CTE and science content integration from the perspectives of the CTE teachers. Most of the participants expressed a desire to help their students understand that their CTE and science integrating experiences as a connection to academic success. Another aspect of the category of connections was that the CTE teachers worked toward supporting connections with learning content within science department courses of study.

The visual illustration of the grounded theory (Figure 4) demonstrates that content was a selective code within the categories of evolutionizing and connecting. Scholarly thought regarding core categories is that they form the central motif within the narrative that emerges from the data, which is then constructed into a coherent story by the researcher(s). As the main theme of the grounded theory, the core category subsumes and integrates all the lower level categories within the grounded theory and encapsulates the data efficiently at the most abstract level (Groenewald, 2011).   Nested within that frame of reference is the potential to place a facet of the grounded theory within separate categories if the alternative explications of the data result in less favorable configurations of the grounded theory as a complete representation of the described phenomenon (Bryant & Charmaz, 2007). One possible reason for the illustrated relationship between the categories of evolutionizing and connecting and the selective code content may be the very concrete nature of the phenomenon of content in the narrative responses of the CTE teachers.

The visual illustration of the grounded theory (Figure 4) reveals that the category of enacting is connected to the selective codes: (a) planning; and (b) problem solving. The CTE teachers stressed the importance of making determinations about what to teach and how to teach it within the process of CTE and science content integration. All of the CTE teachers emphasized that the process of CTE and science content integration requires detailed planning that involves a substantial investment of time and effort.

Within the process of CTE and science content integration, the CTE teachers encountered occasions that elicited problem solving actions. Most of the CTE teachers found benefits in their ability to prevent problems and challenges from impeding the process of CTE and science content integration. Most of the CTE teachers described occasions in which group processing or strategizing was critical is facilitating the integration process.

The grounded theory illustrated in Figure 4 depicts that the category futuring was composed of two selective codes: utility, and professionalizing. Many of the CTE teachers underscored that the process of CTE and science content integration was an enterprise directed at raising the utility of the CTE program of study to students, the school, and community. In addition, CTE teachers experienced the process of CTE and science content integration as a way to further professionalize their CTE program of study.

Chapter 5

CONCLUSIONS and DISCUSSION

Chapter five consists of a discussion of the conclusions of the study along with the implications and recommendations for practice and future research. The discussion of each conclusion of the current study will be integrated with discussion of its relationship to other findings, conclusions, implications, and recommendations for further research. The contents of chapter five will present the facets of the grounded theory in this order: (a) evolutionizing; (b) connecting; (c) enacting; and (d) futuring.

Grounded theory may be defined as comprising a "systematic, inductive, and comparative approach for conducting inquiry for the purpose of constructing a theory" (Bryant & Charmaz, 2007, p. 1). The course of inquiry was no different for the current study which utilized open, axial, and selective codes which emerged from the data to engage in a conceptual analysis of patterned relationships for the purposes of constructing a grounded theory. The grounded theory research process and therefore, the research outcomes were influenced by what Charmaz (2006, p. 187) labels the social scientific perspective

> The social scientific perspective addresses how realities are made and assumes that people, including researchers, construct the realities in which they participate. Inquiry starts with the experience and asks how members construct it. To the best of their ability, researchers center on a phenomenon, gain multiple view of it, and locate it in its web of connections and constraints. Researchers acknowledge that their interpretation of the studied phenomenon is itself a constructed reality.

This qualitative study utilized grounded theory methodology to address the research question: what are CTE teachers' perspectives of and experiences with the process of CTE and science content integration? And more specifically, this study sought to generate a grounded theory which explicates the process of CTE and science content integration from the perspective of CTE teachers.

The findings of the study were utilized to construct a grounded theory of CTE Teachers' perspectives of and experiences with the process of CTE and science content integration. To carry out this study, a criterion sample was utilized to select CTE teachers who matched the characteristics described in Table 10.

Table 10
Criterion for Sample Selection

	Statement of criterion qualification standard
1)	currently practicing CTE teacher in New York state
2)	CTE teacher with New York State certification in one of the following four areas a) agriculture b) automotive technology c) culinary arts d) health occupations
3)	CTE teacher working in a state approved CTE program of study
4)	CTE teacher in a program of study integrating CTE and science content utilizing higher order learning objectives as defined through an analysis employing Bloom's revised taxonomy

The original sample consisted of 19 potential research participants. Fourteen of the potential CTE teacher participants agreed to participate in the research study. Participants were specifically selected because of their experience with CTE and science content integration. More specifically, all of the participants were selected because their CTE programs of study were identified in an earlier study (Spindler, 2010) as employing CTE and science content integration. Each of the CTE teachers that participated in the study took part in an in-depth interview to share their perceptions and experiences related to the process of CTE and science content integration into CTE programs of study. In addition, all 14 of the research participants participated in follow-up interviews to provide clarification and additional data for use in analysis.

Major Conclusions: Taking a step back to view the grounded theory as a holistic tapestry allows five major conclusions to be recognized. The first major conclusion is that the process of CTE and science integration is about wholesale transformation and adaptation. In terms of the grounded theory it is a process of evolutionizing. Evolution might be thought of as an ongoing process which results in the creation of new life forms and phenomenon capable of coping with current and future environments. In the case of the grounded theory the term evolutionizing encapsulates the idea that the CTE and science integrating programs of study were newly adapted forms of CTE programs of study.

Changes in the DNA of the CTE and science integrating programs of study have resulted in the creation of transformed and adapted programs of study. This echoes previous research findings which found that in-depth CTE and science content integration requires CTE instructors to enact substantive changes at the programmatic, course, and lesson level (Conroy & Walker, 2000; Stephenson, Warnick, & Tarpley, 2008). Concluding that CTE and science content integration is about wholesale transformation and adaption is also linked to research completed by Stone, Alfeld, Pearson, Lewis, and Jensen (2006). Stone et al. (2006) found that in order for CTE teachers to more successfully integrate mathematics into their program they needed to develop a different mindset about their programs of study, their content, and themselves as instructors.

It is recommended that research be carried out to create a deeper understanding of how CTE programs of study transform and adapt over time. It would be valuable to create information regarding how transformation and adaptation can be facilitated within CTE programs of study. It would also be valuable to research barriers to CTE program transformation and adaption.

A second major conclusion is that the process of CTE and science integration is a complex phenomenon which is affected by many factors. Given its complexity, it is likely that the process of CTE and science integration requires detailed planning and an ability to organize a flexible progression of activities. This idea mirrors previous findings which have highlighted a need for detailed planning and a flexible orientation to support the integration of literacy and the implementation of multidisciplinary teaching strategies (Mestre, 2005; Readence, Bean, & Baldwin, 1998). Therefore, it may also be concluded that, CTE teachers who intend to enact a process of CTE and science integration should recognize, anticipate, and immerse themselves in planning and organizing while remaining flexible enough to adapt to changing needs.

It is recommended that further research be conducted to specifically exam the planning and organizing processes CTE teachers find most effective for enacting CTE and science content integration within their programs of study. The outcomes of such research should be directed at creating a CTE and science content integration planning guide. Overall, the planning guide should target the practical and useful aspects of planning and organizing the process of CTE and science content integration.

The third major conclusion drawn from the grounded theory is that connections are an important element with the process of CTE and science content integration. This conclusion complements conclusions made by others which revealed that CTE teachers perceived a need to connect with other professionals when integrating CTE and science content (Adelman 1989; Myers & Washburn, 2008; Park & Osborne, 2007; Warnick & Thompson, 2007). Still other researchers found that connections to experiences and the content to be integrated were critical elements of the process of integration (Edwards, 2004; Enderlin & Osborne, 1992; Sinatra, 2000; Warnick & Thompson, 2007; Washburn & Myers, 2010; Wenger, 1998). It is recommended that research be carried out to examine the affect that connections have on the process of CTE and science content integration. Specifically, research should explore how focusing on connections as a metacognitive concept may assist CTE teachers throughout the process of CTE and science content integration.

The fourth major conclusion that arises from the grounded theory is that authentic learning opportunities and problem solving are essential considerations for CTE teachers engaging in the process of CTE and science content integration. This conclusion finds support in previous literature which praises the utilization of problem solving methods of instruction and the use of realistic learning activities (Bruning, Schraw, Norby, & Ronning, 2004; Castellano, Stringfield, & Stone, 2003; Slavin, Lake, & Groff, 2009). In addition, the conclusion that authentic learning opportunities and problem solving are crucial facets within the process of CTE and science integration is supported by previous findings (Edwards, 2004; Fletcher & Zirkle, 2009; Knobloch, 2003; Shelley-Tolbert, Conroy, & Dailey, 2000; Stearn & Stearns, 2006). In parallel with Washburn and Myers (2010), it is recommended that further research be carried out to examine the utilization of authentic tasks and problem solving within CTE and science integrating programs of study.

A fifth major conclusion that can be drawn from a wide angle view of the grounded theory is that the findings of the current study are related to previous research regarding CTE and science content integration. The grounded theory illustrates that perceptions are an important element in the process of CTE and science content integration. This matches previous findings which illustrate how the perceptions of CTE teachers, administrators, and science teachers impact the CTE and science integration process (Conroy & Walker, 2000; Connors & Elliot, 1994; Johnson, 1996; Layfield, Minor, & Waldvogel, 2001; Thompson, 1996; Warnick & Thompson, 2007; Washburn & Myers, 2010; Whent & Leising, 1988).

It is clear that the grounded theory constructed from the data has links to previous research. Such links serve to add to the credibility, transferability, and dependability of the study. The remaining conclusions and their connections to previous research findings is discussed in detail throughout the rest of the discussion chapter five.

Core Category of Evolutionizing

The grounded theory constructed from the data consists of the core category of evolutionizing, and three other subsidiary categories: (a) connecting, (b) enacting, and (c) futuring. The core category within the grounded theory of evolutionizing consisted of four selective codes: (a) reflection, (b) perceptions, (c) content, and (d) purpose. The core category within a grounded theory research study represents the central theme around which the data coalesces and forms. Bryant and Charmaz (2007), indicate that the core category should be adherent to the common reality of the phenomenon being investigated.

The data and findings of this study reveal that the central theme expressed by the CTE teachers was evolutionizing. All of the CTE teachers expressed that the process of CTE and science content integration is at its heart, a process of evolutionizing the program. For the CTE teachers the process of CTE and science content integration took on a holistic nature and the respondents noted a need to develop and transform the program as a whole entity to avoid creating knowledge and content connection gaps. That sentiment echoes the findings of previous work by Eaton and Bruening (1996), who found that adapting programs without a holistic perspective was a factor highlighted by teachers as creating programmatic challenges and gaps within CTE programs of study.

Conclusions: Evolutionizing Reflection. The core category itself is only made meaningful by explicating the subsuming categories and selective codes which compose the various other facets of the grounded theory (Glaser & Strauss, 1967). The findings reveal that the CTE teachers pointed to reflection as an important evolutionizing factor within the process of CTE and science content integration. For the CTE teachers, reflection was both a tool of action and a practice to facilitate the process of CTE and science content integration. The evolutionizing experiences the CTE teachers had with reflection coalesced around three axial codes: (a) motivating; (b) self-understanding; and (c) personal and collective.

The findings illustrate that the CTE teachers received or generated motivation to begin and continue work on the process of CTE and science content integration through reflections. The findings also illustrate that the motivating reflections revolved around ideas about how the process of CTE and science integration would or currently was evolutionizing the CTE program of study. This finding is related to ideas forwarded by Schön (1991), who stated that reflection assists us in our awareness of ourselves as agents so that we are motivated to direct and change our experiences. Taking the idea further: “A reflection in a mirror is an exact replica of what is in front of it, however, reflection in, professional practice gives back not what is, but what might become; an improvement of the original. In that way, reflection provides motivational aspects for professional practice” (Schön, 1991 p. 37). Reflection is not simply about acknowledging the past, it is also a lens through which we see the future and it motivates us to pass through transformational processes (Dewey, 1933).

The findings reveal that reflections regarding self-understanding were relevant within the process of CTE and science content integration for the CTE teachers. The reflections that the CTE teachers spoke about within the self-understanding vein of reflection were almost exclusively about: (a) self-understandings of their science knowledge and what help they would need to adapt it; and (b) self-understandings of their teaching styles and how they would fit within CTE and science content integrated instruction.

The findings regarding the nature and content of the self-understanding reflections that the CTE teachers engaged in are congruent with the ideas put forth in the reflection literature. Claxton (1999), states that reflection it is not simply about acknowledging who we are and what may have gone wrong, but who we need to become and what needs to transform in order to progress. Further, it is the learning to learn and the unpacking of understanding and constructing a response that powers reflection as a process of coming to know when, how, and what to do (Claxton, 1999).

The findings regarding self-understanding reflections are also supported by the literature with respect to how the teachers viewed the functions of the reflections themselves. Implementing a new subject that can be considered a curricular innovation means that teachers have to be introduced to the new subject domain, have to understand the elements of the innovation, have to adopt the innovation, and have to acquire the new knowledge, skills, and routines needed (Schulman 1987; Van den Akker 1999).

Implications: Evolutionizing Reflection. The CTE teachers revealed that personal and collective reflections shared with others were motivating and self-understanding elements in the process of CTE and science content integration. This implies that motivation and self-understanding in and of themselves are facets in the process of CTE and science content integration from the perspective of CTE teachers. Further, this finding implies that within the process of CTE and science content integration, personal and collective reflective processes and reflections can be utilized as a tool to support CTE teacher's motivations and self-understandings. Another implication of the findings is that the endogenous and shared reflective experiences of the CTE teachers can be viewed as a structure within and as an aid to facilitate the process of CTE and science content integration.

Recommendations: Evolutionizing Reflection. It is recommended that practitioners and those engaged in guiding the process of CTE and science content integration create opportunities to sensitize teachers to reflection and reflective practices. Often, teachers do not recognize opportunities for reflection or simply do not take time to engage in reflection even though it is recognized as a powerful tool for improving professional practice (Manen, 2002). Further, it is recommended that the process of CTE and science content integration begin with reflective exercises to sensitize collaborators to reflection and establish explicit pathways to reflection.

A third recommendation for practice is to plan for specific opportunities for reflection to support continued motivation and self-understanding throughout the day-to-day process of CTE and science content integration. Specifically planning for and utilizing opportunities to support reflection is also highlighted in the findings of Schon (1991), who indicates that reflective practices facilitate motivation and self-understanding by brining pathways towards improvement into better focus. Additional support for the recommendations for practice arise from Dweck and Molden, (2005) who state that self-examination by teachers is a part and a key element of reflective practice. Self-examination involves assessing one's beliefs and values and engaging in discussions, which lead to self-understanding, self-improvement and should equate into being a better teacher.

With respect to research focused on the process of CTE and science content integration, it is recommended different approaches to reflection be investigated to determine the extent of the effect reflection may have on the overall process. It is also recommended that research be enacted that investigates the efficacy that varying forms of reflective practices have on the outcomes of the process of CTE and science content integration. One specific approach would be to research the effect that daily reflections have on the process of CTE and science content integration.

Conclusions: Evolutionizing Perceptions. The findings reveal that the CTE teachers pointed to perceptions as an important evolutionizing factor within the process of CTE and science content integration. The CTE teachers revealed that the concept of perceptions was influential to the process of CTE and science content integration in two ways. First, the concept of perceptions was critical to the CTE teachers because of external perceptions held by school faculty and staff. In particular the CTE teachers addressed the need to change the perceptions of their superintendents, principals, and school guidance counselors. The second way the concept of perceptions was critical within the process of CTE and science content integration was through perceptions which were internal to the CTE teachers themselves. Primarily internal perceptions were centered around changes in how the CTE teachers themselves perceived their CTE programs of study.

The findings reveal that for most of the CTE teachers, the process of CTE and science content integration involved active attempts to evolve the perceptions of superintendents, principals, and guidance counselors towards their CTE programs of study and CTE and science content integration. The active efforts to evolve the perceptions of school leaders and guidance counselors towards CTE programs of study and CTE and science integration bore fruit in the form of: (a) positive transformed perceptions; (b) helpful ideas; and (c) supportive collaborators. The findings also reveal that the CTE teachers viewed the perceptions of leaders and guidance counselors as an actively evolving and ongoing process. In addition, the findings demonstrate that the CTE teachers regarded the evolved perceptions of school leaders and guidance counselors toward their CTE programs of study and CTE and science content integration as delicate and in need of consistent support.

The findings reveal that perceptions the CTE teachers' held before engaging in the process of CTE and science content integration evolved through the enactment of the process. The findings illustrate that the perceptions held by the CTE teachers that evolved were related to: (a) who might participate in their CTE program of study and what the program could help students to become; (b) what CTE and academic integration is; and (c) the value of work experience in CTE and science integrated teaching. Most of the CTE teachers indicated that the process of CTE and science content integration adapted their perceptions of the potential constituency and outcomes of their program of study. Specifically, the CTE teachers perceived their CTE program would attract more students who had greater levels of academic ability. This finding is parallel to the findings of others that have reported that CTE teachers perceived that offering science credit for CTE courses would increase enrollment, benefit students, and enhance the program image (Conroy & Walker, 2000; Johnson, 1996). The CTE teachers also indicated that a factor in the process of CTE and science integration was the adaptation of how much assistance they perceived their program could provide to aid non-college bound students in becoming college (community college, technical college, trade school, or 4-year college) bound students. Sai stated,

> I think this process (integrating science) will bring more college ready kids into the program and that they will help the other students make connections to college. I also think integrating science will help all the kids with their academics so that they have a better chance of getting into the college they want to go to.

The finding that recognizes the potential impact CTE teachers may have on assisting their students to becoming college bound echoes findings by other researchers. Previous findings indicate that CTE teachers perceived CTE and science integration as offering opportunities to support the rigorous academic learning of students within a contextualized context (Castellano, Stringfield, Stone, 2003; Stasz, Kaganoff, & Eden, 1994; Thompson, 1996; Warnick & Thompson, 2007).

The findings related to the evolving perceptions also indicate that the CTE teachers' perceptions regarding CTE and academic integration evolved while they were engaged in the process of CTE and science content integration. The findings illustrate that most of the CTE teachers originally perceived the process of CTE and academic integration as a way to force more academic seat time on students and limit the CTE content that they had the opportunity to engage with. This finding is congruent with previous research which indicated that many agriculture teachers were reluctant to change traditional agriculture programs because they believed integrating too much science into the curriculum might threaten the program (Blaschweid & Thompson, 2002). Further, this finding echoes similar findings which indicate that CTE teachers are reluctant to integrate academics because they perceive it may diminish the overall quality of the CTE program (Parr, Edwards, & Leising, 2006; Stearn & Stearns, 2006; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006). However, enacting the process of CTE and science integration transformed the perceptions of the CTE teachers towards CTE and academic integration. As a result of their experiences the CTE teachers perceived CTE and science integration as the utilization of CTE as a context for teaching and supporting students' CTE and science (academic) learning. Kakashi stated,

> When I saw this academic integration thing coming…I thought…well that's going to be Ag content that I will have to give up. But that isn't how it's worked out…if anything I think I have been able to increase me overall Ag content by reorganizing what I did in the past.

The findings also reveal that CTE teachers expressed their work experiences within their fields of study (e.g., automotive technician, horticulturist, and nurse) were an element within the CTE and science content integration process. Most of the CTE teachers indicated that their perception of the value of their work experiences increased during the process of CTE and science content integration. The CTE teachers revealed that they began to recognize their "real world work experiences" as the basic foundation for figuring out the process of CTE and science content integration.

Implications: Evolutionizing Perceptions. The CTE teachers revealed that evolutions in perceptions were elements in the process of CTE and science content integration. The findings related to perceptions have relevant implications for CTE educators, CTE directors, and other CTE stakeholders as they demonstrate that overall, perceptions of CTE are lagging behind the progress being made in CTE legislation, practice, teacher perservice education, and research. The Carl D. Perkins Career & Technical Education Act (2006) deliberately spells out that CTE programs of study are to engage in processes designed to address CTE and academic connections. In fact the term CTE is now defined in legislation as follows:

> Organized educational activities that offer a sequence of courses that provides individuals with coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions; provides technical skills proficiency, an industry-recognized credential, a certificate, or an associate degree; and may include prerequisite courses that meet the requirements of this subparagraph; and include competency-based applied learning that contributes to the academic knowledge, higher-order

> reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of an industry, including entrepreneurship, of an individual (Carl D. Perkins Career & Technical Education Act, 2006, p. 1)

The implications of the perceptions of the CTE teachers and those of their school leaders and guidance counselors is that the old fashion view of vocational education still permeates the educational system and is part of the existence of CTE. In a very real sense this implies that CTE needs a robust rebranding process to change the out-of-date perceptions that people still carry regarding what CTE is and what is may become.

Another implication pertaining to evolutionizing perceptions is that existing literature and best practices associated with CTE and science content integration need to be disseminated in a more robust fashion. Research has demonstrated the efficacy of integrating CTE and science content and CTE and academic content (Chiasson & Burnett, 2001; Enderlin & Osborne, 1992; Park & Osborne, 2007; Parr, Edwards, & Leising, 2004; Ricketts, Duncan, & Peake, 2006; Roegge & Russell, 1990; Stone et al., 2005; Whent & Leising, 1988). The findings imply that perhaps there is a disconnect between the findings and practices of researchers and policy makers and the day to day lived experiences of CTE teachers, school administrators, and school guidance counselors.

Another implication that arises from the findings associated with evolutionizing perceptions is related to the importance of work experiences for CTE teachers. The CTE teachers in the study expressed that their work experiences were substantial assets both with respect to understanding the integration process and when working with science teachers. This implies that the work experiences that CTE teachers bring to the classroom have value added elements that go beyond benefits to student outcomes and curriculum development. The implication that work experiences provide a platform for confidence to the CTE teachers when working with other teachers implies that the experiences garner some form of value.

Recommendations: Evolutionizing Perceptions. It is recommended that researchers, CTE organizations, and CTE directors create and disseminate resources that illustrate the efficacy of CTE and science integration and the best practices for CTE and science content integration. CTE teachers, school administrators, and other CTE stakeholders need more information and resources to assist them in evolving the perceptions of others. This recommendation is similar to recommendations forwarded by Blaschweid & Thompson (2002), which can be summarized as stating assistance must be given to develop programs that integrate science into CTE, knowledge must be gathered and disseminated regarding the best practices of exemplary CTE and science integrating programs of study.

A second recommendation for practice related to the evolutionizing perspectives findings is to assist CTE educators to focus on their work experiences as a source of confidence for working with academic content. Not only starting with the CTE content, as others have recommended (Parr, Edwards, & Leising, 2006; and Stone et al., 2005), but narrowing in on the CTE teachers' experiences in the field as the place to start. Focusing in on the areas the CTE teachers are most confident in will assist them in building their confidence to integrate science and will also assist them in constructing connections between the science content and aspects of the CTE content that they know the best. In addition, the success of the implementation of a new curricular innovation depends on the active involvement of teachers in the curriculum design process, their feeling of ownership of this curriculum, and the further preparation by these teachers (Hill & Cohen, 2005).

With respect to research, it is recommended that research be carried out that explores how CTE and science content integration may change the population of students CTE programs attract or if CTE and science integration only changes the perceptions of the CTE teachers regarding the participating populations. In addition, more research needs to be carried out to define how the perceptions of CTE teachers, school administrators, and guidance counselors are affected by CTE and science content integration workshops and recourse materials.

As the number and effects of fast-track and alternative teacher certification routes grow, more quality research will be needed to understand the possible differences between traditionally and alternative certified CTE teachers (Fletcher & Zirkle, 2009). Based on the findings from the evolutionizing perceptions component of the grounded theory it is recommended that research be enacted to explore the effect of work experiences on CTE and science content integration. In addition, it is recommended that research be carried out to examine the differences in how CTE teachers perceive the value of work experiences and course work with respect to CTE and science content integration.

Conclusions: Evolutionizing Content. The study concluded that CTE teachers describe content as an important evolutionizing element within the process of CTE and science content integration. The evolutionizing experiences the CTE teachers had with the concept of content coalesced around two axial codes: (a) program of study, and (b) student experiences. The CTE teachers highlighted the idea that there is a substantive difference between adding science and integrating science, because the latter requires a complete transformation of the content.

The findings illustrate that for CTE teachers the process of CTE and science content integration is a time consuming complex operation that requires a deep revision of the existing programmatic content. The CTE teachers identified that the process of CTE and science integration required transforming the learning objectives and goals utilized within the program of study. Further, CTE teachers expressed that adapting the learning objectives within the process of CTE and science content integration was a difficult and time consuming undertaking. This finding is related to other findings in the literature which state that CTE teachers have found that the processes of CTE and science and CTE and math integration require a significant amount of time and effort (Blaschweid & Thompson, 2002; Brister & Swortzel, 2007; Conroy & Walker, 2000; Myers & Washburn, 2008; Stone et al., 2005; Warnick & Thompson, 2007).

The findings reveal that the process of CTE and science content integration, from the perspective of CTE teachers, transformed elements at the level of program of study. The CTE teachers expressed that, driven by the process of CTE and science content integration, evolutions in the content cultivated shifts at the programmatic level. Saske's culinary arts program exemplifies this finding. In the past, Saske had utilized partnerships with restaurants and food markets, however, the process of CTE and science content integration facilitated the creation of a partnership with a food science laboratory. The process of CTE and science content integration and evolutions in the content that arose from the process altered the programmatic partnerships Saske focused on. Additionally, CTE teachers expressed that as the content was transformed corresponding evolutions in the work-based learning and resource management aspects of the CTE program also occurred. Gara stated,

> When we were reworking the content of the program…really the learning objectives…we were really integrating science...and then I noticed that it was going to necessitate changes in our work-based learning program.

Further, almost all of the CTE teachers acknowledged that the CTE and science integration process effected and was affected by changing resource needs. In almost all cases, CTE teachers indicated that their budget became more difficult to reconcile because of the need for science related equipment and supplies. Saske stated,

> Integrating science and CTE does require some additional resources. We are using the CTE content to drive the science content choices, but we still need certain equipment and borrowing it all the time is a pain.

Wrestling with the equipment and resource needs associated with CTE and science integration has surfaced in the CTE and science content integration literature previously. In fact, early research regarding CTE and science content integration illustrated that perceived equipment needs and resource allocation were concerns for CTE and science teachers alike (Castellano, Stringfield, & Stone, 2003; Connors & Elliot, 1994; Enderlin & Osborne, 1992; Thompson, 1996). More current research reveals that the equipment and resource needs required to support CTE and science content integration are still an inhibiting or limiting factor in the CTE and science content integration process (National Research Center for Career and Technical Education, 2010; Warnick & Thompson, 2007; Washburn, & Myers, 2010).

The findings demonstrate that evolutionizing student experiences was a component of the process of CTE and science content integration. The CTE teachers expressed that they purposefully created opportunities for students to have new varieties of experiences at the classroom and programmatic levels. The CTE teachers also indicated that within the process of CTE and science content integration student experiences were evolutionized by infusing more flexibility for students. The CTE teachers revealed that CTE and science content integrating lessons and activities were more flexible because they addressed a greater number of potentially preferred learning modalities and learning strategies. In addition, the findings illustrate that the process of CTE and science content integration transformed student experiences by creating more opportunities to employ problem solving and discovery learning as a way to learn and reinforce the CTE and science integrating content.

Implications: Evolutionizing Content. The process of CTE and science content integration creates opportunities for CTE teachers to review and examine the content of their CTE program of study. The process of CTE and science content integration is a deep and involved process for CTE programs of study. For the CTE programs, integration is not a cosmetic change; it is a complex transformation of the program infrastructure. For CTE teachers, the process of CTE and science content integration was made real through adapting and adding to the learning objectives the CTE programs of study employed for student learning experiences. Additionally, the findings illustrate that CTE teachers highlighted transforming the learning objectives as being a difficult challenge within the process of CTE and science content integration.

For CTE teachers it seems as if the process of CTE and science content integration cultivates the creation of a new identity for the CTE program of study. In turn, the new identity the programs develop provide greater variety of learning experiences for students. This finding is supported by findings within science education literature which illustrate that creating interdisciplinary science programs is often experienced by science teachers as a process of constructing completely new identities for their programs of study (Dunbar, 2002; Kerr, 2006).

Resource allocation and utilization has been and continues to be a perceived as challenge within the process of CTE and science content integration. Although it has been identified as a challenge for science integrating CTE programs of study, no research has been carried out to assess the nature and degree of the challenges (Washburn & Myers, 2010). Even though the vein of inquiry investigating the process of CTE and science content integration is not new, perhaps broad gaps in the research illustrate that it is still struggling to find its form (Edwards, 2004).

The process of CTE and science content integration may assist CTE teachers to begin or extend the utilization of more flexible and student centered instructional techniques and strategies. In addition, the integration process may support CTE teachers' utilization of problem solving and inquiry oriented instructional techniques. Kabuto stated,

> Integrating CTE and science and the whole process pushed my instruction to be more like problem solving. I use inquiries to put the students in position to fix challenges which require them to learn two or three things as they go along and finally fix the problem. Also I let them use resources like their phone to look up information that will help solve the problem…I try to be flexible.

While this finding in and of itself is not supported in the literature regarding CTE and science content integration, it is tangential related to findings from other veins of inquiry. Guzey (2010), found that science teachers that engage in curriculum mapping and adaptations were more likely to extend their use of inquiry teaching methods and to create instructional experiences that facilitated student learning through problem solving. Other research that is tangentially related reveals that higher quality instruction makes available a variety of pathways to learning in order to accommodate different abilities and learning styles and tends to focus on reasoning and problem solving rather than recalling facts (Fink, 2000; Kerr, 2006; Myers & Washburn, 2008; Weimer, 2003).

Recommendations: Evolutionizing Content. It is recommended that CTE teachers who are planning to engage in the process of CTE and science integration prepare themselves for a time consuming and detail oriented progression of events. It is also recommended that as CTE teachers and their collaborators enact a process of CTE and science content integration they keep in mind changes and adaptions at the programmatic level. In particular, details regarding the utilization and allocation of resources should be attended to within the process of CTE and science content integration.

It is recommended that research be conducted regarding the utilization and allocation of resources within CTE and science content integrating programs of study. More information is needed regarding the nature and degree of challenges associated with resources in CTE and science integrating programs of study (Warnick & Thompson, 2007; Washburn & Myers, 2010). A related recommendation for research is to explore and describe the time and efforts CTE teachers direct at engaging in a process of CTE and science content integration. For example, important research might focus on the strategies CTE teachers utilize to include collaborators or to reduce the overall workload associated with the process of CTE and science content integration.

It is recommended that research be conducted that explores the effect that the process of integrating CTE and science content has on the instructional strategies and techniques utilized by CTE teachers. For example, research may focus on the process of integration and the employment of inquiry teaching methods. A parallel recommendation for research is to carry out an inquiry directed at exploring and describing the methods of instructional planning carried out by CTE teachers in CTE and science content integrating programs of study.

It is also recommended that research be enacted to create information about the broader programmatic changes that arise within CTE and science content integrating programs of study as a direct result of the integration process. For example, research could assess whether the broader programmatic changes that CTE and science integrating programs experience positive or negative. Additionally, research could explore and describe the impact that planning for programmatic level adaptations has on the efficacy of the CTE and science integration process.

Conclusions: Evolutionizing Purpose. The findings reveal that the CTE teachers experienced evolutions in the career oriented purpose of their CTE programs of study. Neji stated, “we are focusing on college and careers, even careers that require four year college”. The findings illustrate that the career goals of most of the programs evolved to focus more on careers which require formal postsecondary experiences. The findings also illustrate that the process of CTE and science content integration was oriented towards including knowledge and skills required for field specific careers. This finding is supported by other recent research which reported that CTE teachers were utilizing career tasks as a way define what science content should be integrated within their CTE programs of study (Stearn & Stearns,2006). The findings also illustrate that an element within the process of CTE and science content integration was the inclusion of problem solving and critical thinking as explicit student outcomes of the CTE programs of study.

Implications: Evolutionizing Purpose. One implication for the key conclusions related to evolutionizing purpose is that the process of CTE and science integration seems to have been influenced first by the purposes associated with field specific careers rather than the explicit content of the CTE program of study. Another implication of the evolutionizing purpose findings is that the CTE teachers perceived that integrating academics provided them with greater influence over students' postsecondary decisions. An additional implication of the related findings is that the CTE teachers perceive that the outcomes of the process of CTE and science content integration as creating more pathways to more professional opportunities or niches.

Recommendations: Evolutionizing Purpose. It is recommended that research be carried out to explore and describe the extent to which career competencies and programmatic goals and objectives influence the process of CTE and science content integration as separate and confounding variables. It is also recommended that research be enacted to explore and describe the impact that Perkins IV has had on the perceptions of CTE teachers regarding CTE and science content integrating programs of study and postsecondary educational options. It is further recommended that research be directed at addressing questions regarding the process of CTE and science content integration and the utilization of the problem solving and critical thinking instructional techniques. The final recommendation is supported by other calls in the CTE and science content integration literature to explore and describe the relationships between CTE and science integration, critical thinking, problem solving, and student centered learning environments (Edwards, 2004; Fletcher and Zirkle, 2010; Washburn & Myer, 2019).

Subsidiary Category of Connecting

The grounded theory constructed from the data consists of the core category of evolutionizing, and three other subsidiary categories: (a) connecting, (b) enacting, and (c) futuring. The subsidiary category within the grounded theory of connecting consisted of three selective codes: (a) experiences, (b) people, and (c) content. Bryant and Charmaz (2007), indicate that subsidiary categories should have strong connections to the core category which best describe the reality being investigated.

Conclusions: Connecting People. The second category within the grounded theory is encapsulated in the term connecting. CTE teachers expressed the concept of connecting was important in a number of ways and at a variety of levels of complexity. The category of connecting is composed of three selective codes: (a) connecting people; (b) connecting content; and (c) connecting experiences. The central theme of this category is supported by the findings of Adelman (1989), who found that the process of CTE and academic integration involved constructing connections between people, content, and experiences while simultaneously utilizing those connections to create high quality learning experiences for students.

The findings illustrate that connecting to people was a critical component of the CTE and science integration process. For the CTE teachers, connecting to people was part of the actual fabric of the process itself and not just an outcome of the process of

CTE and science content integration. Previous research has also found that connecting to other people is a critical aspect within the process of CTE and science content integration (Adelman, 1989; Blaschweid, Thompson, & Cole, 2000; Myers & Washburn, 2008). Itachi stated, “connecting with other people to work on integrating was critical to our success”.

The findings reveal that CTE teachers expressed that knowing how to work with other people was an important element in the process of CTE and science content integration. The CTE teachers felt that “staying on top” of the integration process, monitoring relationships, and managing logistics were critical elements of the connections they had with others within the process of CTE and science content integration. The CTE teachers reported that if process of CTE and science content integration were to “get off course” or become “stagnant” the other people involved would feel like their time was being wasted and they would discontinue their participation. These ideas are consistent with previous research regarding educational initiatives which found that teacher collaborators quickly became frustrated and abandoned work on projects that were not well organized and did not produce any substantive outcomes (Elmore, 1995; Vacca, 2002).

The findings demonstrate the perceptions of CTE teachers regarding their leadership skills, gained through work and CTSO advisement, were a prominent element within the process of CTE and science content integration. Of particular importance to the CTE teachers was their understanding that they were the central figures within the process of CTE and science content integration but they were not “the boss” of the process. Another way to state this might be that the CTE teachers recognized the process of CTE and science content integration called for leading with rather than a leading over. Meaning that for the CTE teachers the CTE and science integration process was an egalitarian collaboration rather than a top-down hierarchical autocracy.

The findings also demonstrate that the process of CTE and science content integration was influenced by the concept of stakeholders. The findings illustrate that the process of CTE and science content integration connected the collaborators not only to the integration process but to the CTE programs of study as a whole. The CTE teachers expressed that as a result of the collaborators developing stronger connections to the CTE program of study, they were transformed from integration process collaborators into CTE program of study stakeholders. Temari stated,

> Working with the science teachers was good for the Ag program. They are very supportive now. They even have said that they have a stake in how the program does and that is a really nice outcome. We always need support...I think they feel connected.

The findings also illustrate that most of the CTE teachers took steps to recognize the value the collaborative stakeholders brought to their CTE programs of study. Further, most of the CTE teachers engaged in efforts to publically recognize their collaborators as CTE program stakeholders and invited them to social gatherings and banquets.

Implications: Connecting People. The connections that CTE teachers have are critical within the process of CTE and science content integration. The ability of CTE teachers to connect to collaborators and provide logistical organization and leadership are also consequential elements within the process of CTE and science content integration. With respect to logistical organization, quality planning and consistent progress within the process of CTE and science integration are keys to avoiding the loss of collaborators.

The findings illustrate that CTE teachers viewed their work experiences and their experiences as CTSO advisors as helpful in developing leadership skills. That implies that the work and/or CTSO advising experiences of the CTE teachers provided either purposeful or inherent opportunities to practice and develop leadership skills. This conclusion is supported by other research which has reported that part of the value of CTSO advising for CTE teachers is the perceived enhancement of leadership skills and abilities (Thompson, Thompson, & Orr, 2003).

A third implication regarding the findings associated with the axial code connecting people is related to the concept of stakeholders. The findings reveal that the CTE teachers identified their collaborators in the process of CTE and science content integration as stakeholders in their CTE program of study. Within the process of CTE and science content integration, the CTE teachers' collaborators are likely to become more invested in the CTE program of study.

Recommendations: Connecting People. With respect to practice, it is recommended that professional development experiences be developed to assist CTE teachers in better understanding best practices in planning and prioritizing activities within the process of CTE and science content integration. It is also recommend that professional development be created to address leadership within the process of CTE and science content integration.

It is recommended resource materials regarding best practices in stakeholder recognition and inclusion be developed and disseminated for use by CTE teachers engaging in the process of CTE and science content integration.

With respect to research, it is recommended that research be carried out to explore and describe methods for planning and prioritizing the efforts of CTE and science content integration collaborative groups. For example, it is recommended that research be conducted to determine the effect that different group sizes and compositions have on the outcomes of the process of CTE and science content integration. Edwards (2004) forwarded a similar recommendation for research based on his conclusion that the research base regarding the process of CTE and academic integration is largely undeveloped and in need of development. Regarding the process of CTE and science content integration, it is recommended that research be conducted to explore and describe the perspectives of non-CTE teacher collaborators and stakeholders.

Conclusions: Connecting Content. The findings illustrate that connecting content was an element within the process of CTE and science content integration. The selective code of connecting content was composed of three axial codes: (a) CTE and science; (b) levels; and (c) organization. The findings illustrate the process of CTE and science content integration was driven by creating explicit connections and links between CTE content and science content. More specifically, the process of CTE and science content is facilitated when CTE content was used as a foundation for constructing appropriate connections between CTE programs of study and science content. Similar findings are reflected in previous research which found that CTE and academic integration was best operationalized by first beginning with the CTE content (Adelman, 1989; Conroy & Walker, 2000; Johnson, 1996; Parr, Edwards, & Leising, 2006; Stone et al., 2006; Young, Edwards, & Leising, 2009).

The findings demonstrate that within the CTE and science integration process, even though the CTE teachers and their collaborators began with the CTE content, it was often the science teachers that found connections in the content. The CTE teachers found that the science teachers were “niche finders,” meaning they found inherent connections between the CTE and science content. Similarly, Stone et al. (2006) found that the math teachers were major contributors to high quality integration of CTE and math content within CTE programs of study. It seems likely that the level of specialized knowledge the academic teachers bring to the content is a factor in their ability to assist in driving the integration process forward. The findings also demonstrate that the process of CTE and science content integration had effect on the content and learning experiences that the science teachers utilized in their science instruction. The science teachers utilized some of the content connections between CTE and science to engage students in authentic learning opportunities.

The findings reveal that the concept of levels was an important element within connecting content. The findings demonstrate that the CTE teachers recognized a possible spectrum of integration levels from completely seamless to “pull-out” situations in which students would leave the CTE classroom and go to a science classroom. The CTE teachers expressed that they preferred to have the CTE and science integrating content be as seamlessly connected as possible. Further, the CTE teachers indicated that if connections between the CTE and science content were “too artificial” or “fake,” then the process of integration was made more difficult and the resulting outcomes were less preferable. Kabuto stated,

> Don’t try to cram more science in to meet some magical point. If something doesn’t fit it doesn’t fit. Integrate the science that is there…less is more. If you take advantage of what is there and refine that you will probably find more spots to integrate science into.

In a similar vein, the findings reveal that CTE teachers monitored the overall amount of science content integration that was occurring in their CTE programs of study. Most of the CTE teachers reported that the priority of the CTE program was still oriented towards preparing students for a variety of careers that may or may not require postsecondary formal educational experiences. The findings illustrate that striking a balance between the CTE content and the CTE and science integrating content is an important element of the process of CTE and science content integration. This echoes the findings of previous research which advises CTE and science integrating programs to seek an appropriate measure of CTE content and CTE and science integrated content (Ricketts, Duncan, & Peake, 2006; Warnick & Thompson, 2007). Further, most of the CTE teachers reported that part of the balance within the CTE and science integrating content addressed the engagement of students in learning experiences which could form building blocks for more sophisticated science understandings within their science courses of study.

A third aspect within the selective code connecting content is related to the idea of organization. The findings illustrate that the process of CTE and science content integration was affected by the organization of the CTE programs of study. The CTE teachers expressed that organized CTE content was a critical factor in the process of CTE and science content integration. Further, CTE teachers expressed that if the CTE content was not well organized or the organization of the CTE content was not well illustrated, then the integration process would be very difficult if not impossible. Shino stated,

> The content and lessons for the CTE program need to be organized and then there needs to be detailed outlines of the program courses. Without organizing documents the integration process would be like throwing darts at a dart board.

Implications: Connecting Content. The connections between the CTE and science content form a critical element within the process of CTE and science content integration. The first implication is that from the perspective of CTE teachers, the process of CTE and science content integration is facilitated by creating explicit connections between the CTE and science content. The second implication is that the assistance of science teachers is critical to identifying the niches within the CTE programs of study which afford substantive connections to science. The third implication is that the process of CTE and science content integration should aim for seamless integration of CTE and science content while seeking an appropriate balance between CTE and CTE and science integrating content. The fourth implication is that CTE and science integrating instruction can be used to build the success that students have with science and other academics subjects. And the fifth implication is that the more organized the CTE content and lessons are, the more efficient and efficacious the process of CTE and science content integration will be.

Recommendations: Connecting Content. With respect to practice, it is recommended that resource materials and professional development be created to provide examples of CTE and science integrated content with appropriate and seamless connections. It is recommended that resources and workshops regarding how the process of CTE and science content integration can be utilized within a differentiated instruction framework to provide academic successes for all students. It is also recommended that that professional development be created to assist science teachers in incorporating CTE and science integrating content within their courses of study.

With respect to research, it is recommended that research be carried out to explore and describe the process of defining the explicit connections that exist between various CTE specializations and fields of science. Research should be enacted that describes the extent that science teachers incorporate the content outcomes of the process of CTE and science content integration within their professional practice and courses of study. It is recommended that research be carried out to examine the effect that connections between CTE and science integrating content, and science course content have on the academic self-efficacy, academic commitment, and postsecondary attendance of CTE participants. It is also recommended that research be undertaken to explore and describe the effect that level of program organization has on the outcomes of the process of CTE and science content integration.

Conclusions: Connecting Experiences. The findings illustrate that the selective code of connecting experiences was an element within the process of CTE and science content integration. The findings also illustrate that the selective code of connecting experiences was composed of two axial codes: (a) designing; and (b) success. With respect to the axial code designing, the findings illustrate that within the process of CTE and science content integration, the CTE teachers emphasized engaging students in experiences that explicitly connected CTE and science content. For example, the organic farm field trip that Naruto utilized was an experience that explicitly linked the CTE content and the science content that was being integrated within an authentic or real-world context (i.e., organic farm). With respect to the axial code success, the findings illustrate that within the process of CTE and science content integration, CTE teachers were concerned with assisting students to be successful in their academic endeavors. The findings reveal that CTE teachers utilized the process of CTE and science content integration to create opportunities for students to have success with CTE and academic content that might lead to more successes in other academic areas as well.

Implications and Recommendations: Connecting Experiences. Within the CTE and science content integrating process, CTE teachers attempted to construct experiences that: (a) highlighted the connections between CTE and science by explicitly demonstrating the connections between the CTE and science content in authentic contexts; and (b) assisted students in building onto academic success by connecting successes students had with CTE and science integrating content to science course content.

With respect to practice, it is recommended that resource materials be constructed that provide information about successes with CTE and science integrating content that can assist students in creating more academic success. With respect to research, it is recommended that research be carried out to explore and describe the types of experiences CTE programs of study utilize to demonstrate the connections between the CTE and science content that is part of the integration process. It is also recommended that research be enacted to explore and describe the perceptions that students have regarding the effects of CTE and science content integration on their academic success.

Subsidiary Category of Enacting

The grounded theory constructed from the data consists of the core category of evolutionizing, and three other subsidiary categories: (a) connecting; (b) enacting; and (c) futuring. The subsidiary category within the grounded theory of enacting consisted of two selective codes: (a) problem solving, and (b) planning. While the core category of the study represents the central theme around which the data coalesces the subsidiary categories also represent major themes around which substantial portions of the data coalesce (Bryant & Charmaz, 2007).

Conclusions: Enacting. The findings reveal that CTE teachers perceived enacting planning and enacting problem solving to be components of the process of CTE and science content integration. The findings reveal that CTE teachers perceived the process of CTE and science content integration was a challenge. More specifically, the findings illustrate that the most challenging part of the process was related to workload. Further, the findings reveal that the CTE teachers put forth an extensive effort to create lessons that engaged the process of CTE and science content integration. This finding supports previous research which has found the constructing lessons within the process of CTE and science content integration to be a challenge for CTE teachers (National Research Center for Career and Technical Education, 2010; Thompson, 1996; Washburn & Myers, 2010; Welton, Harbstreit, & Borchers, 1994).

The findings also reveal that within the process of CTE and science content integration the CTE teachers were challenged by attempts to determine the best sequences for instruction. More specifically, the CTE teachers were challenged by determining whether the practical oriented CTE or the more theoretical oriented science related aspects should be taught first. Most of the CTE teachers reported beginning instruction with the CTE oriented practical aspects of instruction and utilizing those aspects as a “hook” with which they could “reel-in” the students. This finding is supported by science education research which illustrates that student achievement is likely to be improved by first engaging science concepts and challenges from a practical or authentic perspective (Germann, 1989; Kerr, 2006).

The findings illustrate that within the process of CTE and science content integration the CTE teachers were challenged by determining how best to enact the actual teaching of CTE and science integrated content. Further, the findings demonstrate that the CTE teachers expressed that they were challenged by determining which methods of instruction would provide the best fit with the CTE and science integrated content. The findings also demonstrate that the CTE teachers did not construct any common techniques for developing ideas regarding which instructional methods to employ with the CTE and science integrated content. This finding is congruent with work completed by Park and Osborne (2007), which reveals that CTE teachers struggled to match methods of instruction to literacy strategies within CTE courses of study. In addition, this finding is supported by research which indicates that matching appropriate methods of instruction to interdisciplinary content is a challenge for secondary teachers (Blumberg, 2009; Chun, 2010).

The findings reveal that the process of CTE and science content integration involved the enactment of problem solving by the CTE teachers. The CTE teachers described the enactment of problem solving within the process of CTE and science content integration in two main ways: (a) preventive, and (b) group processing/ strategizing. The findings illustrate that within the process of CTE and science content integration the CTE teachers engaged in preventive problem solving. The findings reveal that preventive problem solving was a product of the connections and understandings constructed during the process of CTE and science content integration. This means that the CTE teachers had to engage in the integration process before they could see the problems and challenges that may arise from enactment of the CTE and science integrating instruction.

The concept that teachers need to engage in processes of planning or adapting instruction in order to uncover the challenges that that they may encounter in bringing the instruction to life is supported in the literature. Mestre (2005), found that through engaging teachers in adapting the content and methods of their instruction, teachers were better able to identify and address challenges they may face within live classrooms. This idea was is also supported by the work of Mayer (2002), who linked problem finding abilities to the increased meaningfulness that teachers ascribed to the modified instructional methods and content the teachers had worked on.

The findings also illustrate that the enactment of problem solving within the process of CTE and science content integration was affected by group processing/ strategizing. Most of the CTE teachers expressed that when problems arose they would often direct them to the attention of a group of collaborators. Almost all of the CTE teachers found that collaborative problem solving assisted them in constructing a better understanding of the process of CTE and science content integration, particularly with respect to the needs of students with IEPs. Other researchers have also found that collaborative approaches for addressing the challenges associated with students with IEPs have been successful (Manen, 2002; Palmer, 2003).

Implications: Enacting. There are two central implications that arise based on the findings and key conclusions encapsulating the category of enacting. The first implication is that planning for the actual CTE and science content integrating instruction is time consuming and involves a substantial array of details. CTE teachers must determine exactly what to teach and exactly how to teach it. Part of the aforementioned challenge, however, is the recognition that trial and error may be an important element in refining what is taught and how it is taught. Therefore, a minor implication is that part of the planning time should account for the time CTE teachers will need to make adjustments to the content and methods of their CTE and science integrating instruction. Similarly, Stone, Alfeld, Pearson, Lewis, and Jensen (2006), found that part of the CTE and Math integration process should account for the time teachers need for readapting the content and instructional approaches after their initial utilization of CTE and math integrated lessons.

The second central implication is that CTE teachers found it useful to address challenges that arose within the process of CTE and science content integration through reflection and group processing/strategizing. A component of this implication is that, challenges with students with IEPs are likely to arise within the process of CTE and science content integration. This implication is supported by findings forwarded by

Kessell, Wingenbach, & Lawver (2009), which indicate that CTE teachers are challenged by a lack of knowledge regarding IEPs and how best to work with students with IEP's.

Recommendations: Enacting. With respect to practice, it is recommended that CTE and science integrating curriculum guides be created and shared with practicing CTE teachers and CTE teacher educators. The creation and dissemination of such curriculum guides provide CTE teachers with more time and space to work on the specifics of CTE and science content integration lessons, as well as, other important programmatic elements. With respect to practice, it is also recommended that special education teachers be included as members of CTE and science content integrating collaborative teams. Including special education specialists will increase the likelihood that CTE teachers will implement higher quality CTE and science integrating instructional plans that provide greater support for students with IEPs (Kessell, Wingenbach, & Lawver, 2009; Pense, 2008).

With respect to research, it is recommend that research be carried out to explore and describe how CTE teachers make decisions regarding what content to include in CTE and science integrating instruction. Further, similar research should explore and describe how teachers determine how they will teach CTE and science integrating content. It is recommended that research be enacted to explore and describe the affects that CTE and science integrating instructional experiences have on students with IEPs. It is also recommended that research be carried out that assesses the impact that special education teachers have on the process of CTE and science content integration.

Subsidiary Category of Futuring

The grounded theory constructed from the data consists of the core category of evolutionizing, and three other subsidiary categories: (a) connecting; (b) enacting; and (c) futuring. The subsidiary category within the grounded theory of futuring consisted of two selective codes: (a) utility, and (b) professionalizing. It is critical that the subsidiary categories represent ideas and concepts around which a significant portion of the data coalesces and that they are essential components of the data (Bryant & Charmaz, 2007).

Conclusions: Futuring. The CTE teachers engaged in the process of CTE and science content integration revealed that for them the process was oriented towards the future. The findings reveal that the CTE teachers perceived opportunities to construct the future of their programs of study within the integration process. Further, the CTE teachers expressed that the process of CTE and science content integration was also a way to address the future that would surround their programs of study. Gara stated,

> The future is hard to predict in an exact way, but integrating science is part of putting pieces in place and the Ag program in position to meet the demands that school and the work environment will have in the future.

The findings illustrate that, for the CTE teachers, the process of CTE and science content integration consisted of elements of futuring the utility of their programs in their roles within their schools and communities. More specifically, the CTE teachers reported that wanting to increase the utility of their CTE programs in the future was an element in the CTE and science content integration process. The CTE teachers expressed that they believed that the utility of the role their CTE program of study fulfills could be made greater in the future through enacting the process of CTE and science content integration.

The findings also demonstrate that the CTE teachers reported that the process of CTE and science content integration provided utility for addressing future education and career requirements. This finding is linked to previous research that indicates that CTE teachers and school administrators viewed CTE and academic integration as provided greater levels of utility for students and schools (Blaschweid & Thompson, 2000; Conroy & Walker, 2000).

The findings reveal that the process of CTE and science content integration was impacted by the idea of professionalizing students and student experiences. Most of the CTE teachers expressed that preparing students for their futures as professionals was a facet within the process of CTE and science content integration. In particular, the CTE teachers highlighted futuring the interdisciplinary professionalizing experiences of students. This finding echoes previous research that has demonstrated that CTE teachers view CTE and science integration as offering high quality interdisciplinary learning opportunities (Stearn & Stearns, 2006; Warnick & Thompson, 2007).

The findings illustrate that professionalizing within the process of CTE and science content integration also included an element of including general work competencies. The findings demonstrate that that the CTE teachers reported addressing general work oriented competencies, e.g., problem solving, and collaboration skills, while they were engaged in the integration process. The findings also illustrate that the CTE teachers expressed that the process of CTE and science content integration, which explicitly and implicitly plans for the future, is in itself a professionalizing activity.

Implications: Futuring. The first implication to arise from the futuring findings is that the process of CTE and science content integration is a future oriented process. Further, the process of CTE and science integration is affected by the CTE teachers taking into account the future of students' educational and career needs. This is exemplified by a statement by Naruto,

> I was always…asking how am I going to affect the future? How can this integration process really set the program up for the future and prepare students for their future? CTE and academic (science) integration is about the future.

Another implication of the related findings is that CTE teachers are concerned with engaging in processes that are likely to increase the utility their program provides to their students, schools, and communities. Within the CTE teachers' concerns regarding the utility of their programs was the idea that the process of CTE and science content integration was likely to increase the utility their programs of study afforded to stakeholders. A third implication of the findings related to the category of futuring is that the CTE teachers recognized the process of CTE and science content integration as professionalizing themselves and their program of study.

Recommendations: Futuring. It is recommended that providers of professional development and others engaging CTE teachers to assist them in understanding and enacting the process of CTE and science integration focus on the process as a future oriented process. More specifically, it is recommended that the process of CTE and science content integration focus on how it relates to the future particularly with respect to: (a) student education and career requirements, and (b) program utility. With respect to practice, it is also recommended that the process of

CTE and science content integration be framed as a professionalizing opportunity for both CTE teachers and their programs of study.

With respect to research, it is recommended that research be enacted to better understand the effect that concept of program utility has on the process of CTE and science content integration. In particular, research should be conducted to determine the utility CTE and science content integration provides to: (a) CTE teachers, (b) students, (c) schools/school districts, and (d) communities. In addition, it is recommended that research be carried out to determine how the CTE and science content integration process may create opportunities for CTE teachers to engage in other program adaptations.

Summary

Qualitative research is generally more focused on the elucidation of meaning rather than causal explanation (Glaser, 2005). In addition, qualitative researchers generally support the view that all observation is theory laden and that understandings and perceptions of the world are shaped by prior experiences and assumptions (Charmaz, 2006). While theories can provide understanding of phenomena or the basis for action with respect to them, they are inherently influenced by the creator's perspective (Patton, 2002). Grounded theories are simplifications which clarify and explain phenomena at varying levels of complexity and abstraction (Strauss & Corbin, 1990). However, grounded theories are more than only frameworks. Grounded theories are illuminating accounts that provide insights and in depth understandings of phenomena of interest.

Grounded theory researchers generally acknowledge insights and concepts taken from existing findings that relate to their findings. However, grounded theory researchers draw on the related findings selectively and eclectically, rather than deliberately seeking to connect their outcomes to a particular set of findings (Glaser, 2005). Grounded theories are most often considered to be general and ideal representations of abstract concepts and the connections between them (Patton, 2002). However, grounded theories can also be seen as explications of the processes and mechanisms that result in a particular occurrence in a given context (Strauss & Corbin, 1997).

In grounded theory research, the researcher must translate the conceptual model of the grounded theory into the story line that will be read by others (Creswell, 2005). Ideally, the research report is a rich, tightly woven account that approximates the reality it represents (Strauss & Corbin, 1997). In addition, According to views of Glaser and Strauss (1967), a grounded theory is not a perfected product but an every-developing entity or process. This means that, a grounded theory may be adapted continuously based on further research or by reexamining the connections represented within the grounded theory itself. Glaser and Strauss (1967), also claim that one of the requisite properties of grounded theory is that it is sufficiently general to be applicable in a number of diverse contexts within the substantive area of inquiry. Therefore, grounded theories must be specific enough to accurately define or describe the context of interest while being sufficiently abstract enough to facilitate utilization in related contexts.

The present study was an explication of the experiences and perceptions of CTE teachers' engaged in the process of integrating CTE and science content. It may be useful to recall that presently there exists a dearth of findings which elucidate the process of CTE and science content integration. More specifically, there are no findings which explore and describe the process of CTE and science content integration from the perspective of CTE teachers. The following is a summary of the grounded theory and its implications which facilitates the transposing of the findings to related contexts.

The central theme that arose from the expressions of the CTE teachers is evolutionizing. The teachers revealed that the process of CTE and science content integration was an episode of evolutionizing. As individuals the CTE teachers described the process of CTE and science content integration by using terms such as transformation, metamorphosis, modification, and developing progression. However, the abstraction of evolutionizing is a more apropos depiction of the meaning of the process of CTE and science content integration to the CTE teachers and their CTE programs of study. Primarily, because of possibilities that the process of CTE and science content integration creates for the CTE teachers and their programs of study.

One reason for this is the evolution is a continuous process of becoming something new. Evolution is never complete and, from the perspective of the CTE teachers, neither is the process of CTE and science content integration. Another reason the theme of evolutionizing is such a good fit is that it recognizes the completeness of the changes to the CTE teachers and their CTE programs of study. In evolution, the mutation of a single gene (genotype) has the potential to create profound changes in the expression of the physical form and function (phenotype) of an organism’s genes. The process of CTE and science content integration changes the genes of CTE programs of study and it has the potential to create profound transformations within CTE teachers and their CTE programs of study.

A third reason for the core category being identified as evolutionizing is that it encapsulates the complexity and foundational depth of the process of CTE and science content integration. For example, while a caterpillar may transform into a monarch butterfly evolution in the species may result in changes in the food they eat, the end point of their migration, the length of time they spend as a pupae, and the level of toxicity in their wings. Similarly, evolutionizing through the process of CTE and science content integration doesn't only transform the written curriculum it changes teaching strategies, the realized program outcomes, the constituency of the program stakeholders, and lived experiences of the students. Ideas such as transformation and modification do not capture the essence or depth of the process of CTE and science content integration. In addition, they do not imply the continuous and ongoing nature of the process of CTE and science content integration the way the core theme of evolutionizing does.

What does it mean that the process of CTE and science content integration is evolutionizing? For CTE teachers the process of CTE and science content integration is complex and occurs on many different levels from specific to general and from concrete to abstract. It is likely that the process of integration will lead CTE teachers and their programs of study to outcomes they did not expect or foresee. It is critical that CTE teachers recognize the challenges and opportunities which the process of CTE and science content integration cultivates so that they can raise the viability of their efforts.

The process of CTE and science content integration was not recognized by the

CTE teachers as a typical top down reform oriented band aid to address the day-to-day challenges of educating students. Rather, the CTE teachers recognized the process of CTE and science content integration as a substantive change which had effects on a myriad of facets surrounding themselves and their CTE programs of study. Further, much of the work and organization necessary to enact the process of CTE and science content integration was in the hands of the CTE teachers. Therefore, it is likely that organizational and leadership skills would facilitate such a deep and impactful process. More specifically, greater levels of organization would enable CTE teachers to recognize and capitalize on opportunities that arose through the process of integration.

Typically, within grounded theory methods, the core category that is developed is also reflected in or at least connected to the other categories which formed the grounded theory. The grounded theory illustrates that the process of CTE and science content integration facilitated evolutionizing the connections to the CTE programs of study. Within the category of connecting, evolutionizing had impacts on designing student experiences. It is likely that organizing and planning would be facilitated by asking teachers to reflect on the evolving connections that might arise or be promoted throughout the process of CTE and science content integration. Perhaps teachers should deliberately engage in the practice of reflectively evolving the connections between: (a) students and experiences, (b) the CTE program and stakeholders, and (c) content and program organization. It is likely that such targeted reflections would create more opportunities to envision and incorporate evolving connections within the process of CTE and science content integration. Similarly, by reflecting with a future oriented frame of reference it would be possible to conceive of evolutionizing possibilities for the CTE teachers and the CTE programs of study.

The constructed grounded theory does not provide a listing of ordered steps for enacting the process of CTE and science content integration. However, the grounded theory illustrated in Figure 4 is not an end to the research process. The grounded theory illustrated in Figure 4 represents outcome of the first iteration in an ongoing inquiry into the nature of the process of CTE and science content integration. In fact, two of the main intentions of grounded theory methods are to frame a place to begin further investigations and to provide a guide for designing substantive research questions. The grounded theory illustrated in Figure 4 elucidates phenomena and factors that were elements within the process of CTE and science content integration.

The grounded theory summarizes the CTE and science content integration story of the CTE teachers; their logistical concerns; their reflections; and their actions. This research has laid the foundation for subsequent work and provided a solid base from which others my launch their inquiries. Others engaging in the process of CTE and science content integration will do well to envision it as a process of evolutionizing.

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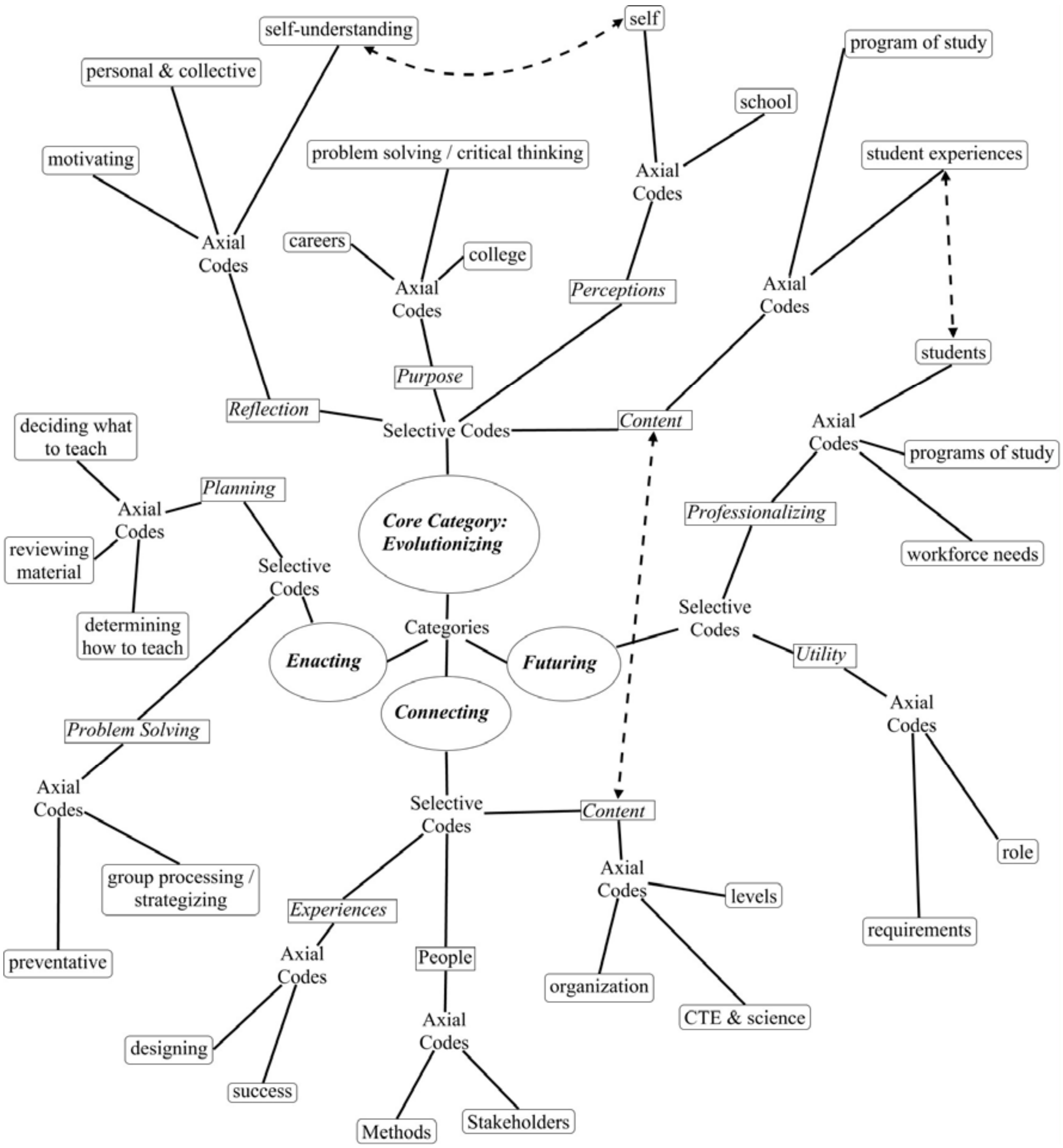
APPENDIX A
GROUNDED THEORY



APPENDIX B
INTERVIEW INITIAL QUESTION GUIDE

Today, I would like to provide you with the opportunity to describe your perceptions regarding the integration of science in career and technical education programs of study.

1) What is important about career and technical education?
   a. Career development
   b. Student interests
   c. Postsecondary connections
   d. Student organizations
   e. Community development

2) Prior to teaching, what kind of experiences did you have related to your area of expertise?
   a. Education / Apprenticeship
   b. Work / Own business
   c. Hobby / Avocation

3) Prior to teaching, what kind of experiences did you have related to science or applied science?
   a. Education / Apprenticeship
   b. Work / Own business
   c. Hobby / Avocation

4) How did the process of integrating science into the (insert program name) program of study begin?
   a. Influential factors
   b. Critical events

5) What kinds of experiences have you had while engaged in the integration of science into the (insert program name) program of study?
    a. Professional
        i. Formal
        ii. Informal
    b. Personal

6) When you think about integrating CTE and science what comes to mind?

APPENDIX C
OPEN CODES, AXIAL CODES, SELECTIVE CODES, & CATEGORIES

motivating self-understanding personal & collective self school program of study student careers college problem solving / critical thinking	reflection perceptions content purpose	evolutionizing
designing success methods stakeholders Organization CTE & science levels	experiences people content	connecting
role requirements programs of study workforce needs students	utility professionalizing	futuring
preventative group processing / strategizing deciding what to teach determining how to teach reviewing material	problem solving planning	enacting