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A Relationship between Course-level Implementation of First Principles of Instruction and Cognitive Engagement: A Multilevel Analysis

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ABSTRACT

Cognitive engagement is an indicator of how students engage in their learning process in classroom context, and the levels of cognitive engagement are conceptualized by the use of cognitive and metacognitive strategies. As the levels of cognitive engagement are thought to be a result of interactions between students and learning contexts, previous studies have explored how certain practices within a course promote student cognitive engagement, but placed less emphasis on the integration of instructional design principles. Given the theoretical and practical importance of First Principles of Instruction, this dissertation answers the question of whether the degree to which the First Principles are implemented in courses makes a difference in students' cognitive engagement when taking into account the mediating role of individual goals, another key predictor of cognitive engagement. A multilevel mediation analysis demonstrates that the influences of course-level implementation of First Principles are transmitted to cognitive engagement through individual intrinsic goal orientation. The implementation of First Principles affects students' deep cognitive strategy use directly as well as indirectly through intrinsic goal orientation. The effect of the First Principles on surface strategy use and self-regulated strategy use appears to be mediated by intrinsic goal orientations. The dissertation concludes that students in a course with greater implementation of First Principles are interested in learning and mastery of academic materials, and ultimately are likely to become engaged in learning in cognitive and self-regulated fashion.

Key words: **First Principles of Instruction, Cognitive Engagement, Cognitive Strategy, Self-regulated Strategy, Goal Orientation, Multilevel Mediation Model.**

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Chapter 1 Introduction

A growing body of research suggests that learning environments should be structured to encourage student engagement (Nelson Laird et al., 2008). The term *student engagement* is used "to represent constructs such as quality of effort and involvement in productive learning activities" (Kuh, 2009, p. 6). In higher education literature, student engagement has been studied as one of the predictors of desired learning outcomes such as academic performance (Carini, Kuh, & Klien, 2006), intellectual skills (Pike & Kuh, 2005), attrition (Gilardi & Guglielmetti, 2011), and persistence (Kuh et al., 2008). The basic assumptions of those studies are that qualitative and quantitative differences in student engagement determine the quality of the students' university experiences and learning outcomes. Empirical studies consistently supported that student engagement is positively correlated with various learning outcomes. Overall, it is suggested that highly engaged students spend more time and participate more actively in academic activities, leading to higher levels of learning than those who are not highly engaged.

As it is argued that different students invest different levels of engagement in academic work and the same students invest different levels of engagement in different academic contexts (Astin, 1999). Thus, researchers presume student engagement is malleable as a result of the interaction between students and their learning context (Fredricks et al., 2004). In other words, the quality of student engagement can be enhanced by the learning environment. Thus, Astin (1984; 1991) argued that the effectiveness of a learning environment is related to the capacity of the environment to increase student engagement.

Conjecture pointing to the role of student engagement plays in mediating the relationships between a learning environment and learning outcomes has led to a growing interest in designing learning environments that can increase the university students' quality of effort and involvement in learning. Therefore, researchers have attempted to explore how learning environments influence student engagement and determine whether student outcomes are indeed enhanced by improving the learning environment. An approach viewing the concept of engagement as a mediator between students and the environment can help researchers and practitioners better understand the complexity of student's experiences and ultimately become better at designing targeted interventions that can enhance learning (Fredricks et al., 2004). Thus, a focus of interest in student learning research is in better addressing the relationship between learning environment and student engagement, and further the complex causal mechanisms among learning environment, student engagement and learning outcomes.

Another focus of student engagement research is to define particular forms of student engagement addressing the multiple dimensions of engagement (e.g., academic, peer, and faculty) and develop instruments that measure these constructs. Student engagement, in this context, is a broad multi-dimensional concept related to the entire university experience. With the multifaceted nature of engagement, there have been a variety of labels, definitions and measures of engagement in the research literature (Fredricks et al., 2004). For example, Astin (1999) defined student engagement as academic activities (e.g., time allocation, pedagogical experience, and learning experience), engagement with faculty (e.g., working on a professor's research project and hours per week spent talking with faculty), engagement with student peer groups (e.g., discussing course content with other students, working on group projects and tutoring other students), and engagement in work (e.g., working full-time or part-time). Astin (1999) argued that research should investigate the connections between particular forms of engagement and particular learning outcomes. Particular forms of engagement can be identified according to specific outcomes of interest and learning context (Axelson & Flick, 2011; Fredricks et al., 2004).

This study particularly focuses on cognitive engagement, which has been used to describe the student learning process in regard to academic materials and instruction itself in classroom context (Corno & Mandinach, 1983; Lyke & Young, 2006). Cognitive engagement in this literature suggests that some resources and learning processes are more effective than others in engaging learners in acquisition or construction of knowledge. Students employ different processing strategies during learning and thus expend cognitive resources in different ways. The levels of cognitive engagement are directly related to the quality of learning process and ultimately learning outcomes (Corno & Mandinach, 1983).

Cognitive engagement

The definitions of cognitive engagement vary in the literature. In general, however, cognitive engagement is defined as involving meaningful and thoughtful approaches to learning tasks (Paris & Paris, 2001). Cognitive engagement has been conceptualized as a combination of students' use of cognitive processing strategies and metacognitive strategies employed to monitor their own cognitive processing. Thus, it is assumed that successful students use both effective cognitive and metacognitive learning strategies (DeBacker & Crowson, 2006; Greene & Miller, 1996; Meece et al., 1982; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991;

Pintrich & Schrauben, 1992; Walker et al., 2006; Wolters, 2004). Since the levels of cognitive engagement vary from rote memorization to metacognitive strategy use, a distinction between surface levels of engagement and deep levels of engagement has been established (Dupeyrat & Mariné, 2005; Greene & Miller, 1993; Marton & Säljö, 1976; Pintrich & De Groot, 1990).

In the cognitive engagement literature, surface levels of cognitive strategies, deep levels of cognitive strategies and metacognitive strategies have been investigated individually. In general, surface engagement is indicated by the use of rote memorization and rehearsal strategies while deep engagement is indicated by a combination of deeper levels of cognitive strategies such as elaboration, organization and critical thinking, and metacognitive learning strategies (Dupeyrat & Mariné, 2005; Lyke & Young, 2006; Nie & Lau, 2010; Pintrich & Garcia, 1991; Pintrich & Schrauben, 1992). Research suggests that students who employ deeper levels of cognitive strategies and self-regulated strategies are likely to be more fully engaged with their learning than are students who employ surface levels of cognitive strategies.

There has been a long debate over whether students' learning strategy uses are consistent or varying over time and across contexts (e.g., Eley, 1992; Nijhuis, Segers, & Gijselaers, 2005; Wilson & Fowler, 2005; Vermetten et al., 2002). Empirical studies have shown that the cognitive engagement can be, at least in part, modified by individual or contextual difference (e.g., Greene & Miller, 1996; Jang et al., 2010). Therefore, identifying factors that explain the variability of students' cognitive engagement has become a major research focus. Some have sought these factors within the students. Thus, students' endorsement of goals has received much attention as an influential factor in relation to cognitive engagement (Dupeyrat & Mariné, 2005;

Greene & Miller, 1996; Lyke & Young, 2006; Meece et al., 1988, 2003; Pintrich et al., 1994; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Walker et al, 2006; Wolters et al., 1996, 2004). Others have sought the factors within the learning environment, suggesting that various aspects of the course structure and the teaching style are related to the levels of cognitive engagement. For example, studies have been done exploring factors related to students' perceptions of teaching quality (Entwislte & Tait, 1990; Prosser & Trigwell, 1992; Ramsden, 1992; Trigwell & Prosser, 1991; Nijhuis et al, 2007, 2008), characteristics of tasks and learning activities (Kyndt et al., 2011; Pintrich et al., 1994), teachers' behaviors during instruction (Jang, Reeve, & Deci, 2010; Pintrich et al., 1994), classroom goal structures (Lyke & Young, 2006; Wolters, 2004), the integration of student oriented learning, action learning, problem-based learning, and constructivist learning (Ahlfeldt, Mehta, & Sellnow, 2005; Meece et al., 1988; Nie & Lau, 2010; Nijhuis, Segers, & Gijselaers, 2005; Rotgans & Schmidt, 2011; Wilson & Fowler, 2005), and academic disciplines (Hativa & Birenbaum, 2000; Nelson Laird et al., 2008; Vermunt, 2005; Wolters & Pintrich, 1998).

The studies linking individual goal orientations to cognitive engagement have shown a consistent result that learning goals were related to deeper levels of engagement, whereas performance goals were related to shallow levels of engagement. However, the studies focusing on instructional environment have suggested that to some extent, instructional design approaches that have been integrated into instruction to prompt deep level cognitive engagement have not always produced expected levels of engagement. Thus the literature has been inconclusive (Nijhuis, Segers, & Gijselaers, 2005; Rotgans & Schmidt, 2011; Wilson & Fowler, 2005). Nijhuis, Segers, and Gijselaers (2008) suggested that the inconclusive nature of this research may be a result of weakly implemented designs in the studied learning environments that may not have been rigorous enough to prompt changes in student engagement in learning.

Instructional design researchers argue that engaging instruction does not happen without careful application of instructional design principles (Merrill, 2002; Reigeluth & Carr-Chellman, 2009). In other words, effective instructional design principles can be integrated into instruction to encourage student engagement in learning and help students acquire specified knowledge or skills (Ormrod, 2004). Therefore, a related area of interest might be the relationship among integrations of instructional design principles into the learning environments and student cognitive engagement. This area has not yet been rigorously investigated.

Engaging learning environment and instructional design principles

An *instructional design principle* is defined as "a relationship that is always true under appropriate conditions regardless of a specific instructional activity (practice) or a set of practices (program) which implement this principle" (Merrill, 2002, p. 43). Instructional design principles are empirically proven to consistently influence desired instructional outcomes: effective, efficient, and engaging instruction (Merrill, 2002; Reigeluth, 1999). Therefore, as a result of the implementation of instructional design principles in instruction, it may be assumed that the levels of student engagement would be increased.

Merrill spent over four-decades synthesizing and identifying fundamental principles that are included in most instructional design theories and models, and that are necessary for designing effective, efficient, and engaging instruction. In 2002, Merrill first proposed a set of basic principles of instructional design called First Principles of Instruction. These first principles were based on existing instructional design theories and models, most of which prescribed different approaches to instructional design yet were based on the same underlying principles.

First Principles of Instruction (Merrill, 2009) suggested that learning is promoted 1) when learners are engaged in task-centered, real-world problems; 2) when existing knowledge is activated as a foundation for new knowledge; 3) when new knowledge is demonstrated to the learner; 4) when new knowledge is applied by the learner; and 5) new knowledge is integrated into the learner’s context. According to Merrill, these principles can be implemented in a variety of ways through a variety of different instructional practices.

Merrill (2008) posits that “instruction is a deliberate attempt to structure a learning environment so that students will acquire specified knowledge or skill. The purpose of instruction is to facilitate learning. Facilitate means that the learning is more efficient, effective, and engaging than learning that might occur without this intervention” (p. 270). Merrill further contends that if a learning environment does not incorporate the appropriate instructional principles required for the acquisition of the desired knowledge or skills, the instruction may be problematic in its effectiveness, efficiency, or ability to engage students (Merrill, 2008; van Merrirëboer et al., 2002).

The First Principles of Instruction, therefore, provide a clear framework and prescription to design engaging instruction. According to Merrill, instruction that integrates these principles should promote student engagement. However, few empirical studies have been conducted to verify this claim.

Frick and his colleagues conducted a series of studies to link First Principles of Instruction and university course quality (2008, 2009, 2010). They argued that exiting course evaluation instruments hardly indicate how to improve teaching; therefore a theory-driven course evaluation instrument needs to be developed and validated. Frick and et al. (2008) first developed an instrument to measure teaching and learning quality (TALQ) in university courses. The instrument includes the measure of the integration of Merrill's principles as the quality of instruction scale and the measure of various indicators of learning quality. These measures of quality include student satisfaction, overall course quality, students' perceived learning gain, and level of mastering of course objectives. Then they conducted validation studies by investigating various relationships of student ratings of instructor use of these principles with the indicators of learning quality. Overall, in courses where students rated that instructors integrated more First Principles into the course, higher levels of student satisfaction, course quality, perceived learning gain, and mastery of course objectives were reported. They also established a link between the First Principle measure and student learning engagement. In their studies, student engagement was measured by the academic learning time scale measuring the amount of time and effort students spent on learning tasks (ρ=.682, $p<.0005$; Frick et al., 2009). The results showed that the degrees to which First Principles were integrated in the courses were positively related to students' reported amounts of learning time and effort. Although in these studies student engagement was conceptualized as an amount of time and effort, the concept of student engagement in learning also included qualitative aspects of engagement such as the effort to comprehend knowledge and master skills. Therefore, more studies on the relationship between the implementation of First Principles and the level of cognitive engagement as a qualitative indicator of student engagement are required.

Problem statement

The levels of cognitive engagement are useful indicators of how students are engaged in their learning. Successfully engaged learners are likely to be more strategic and self-regulated to learn new knowledge and skills (Fredricks et al, 2004; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Pintrich & Schrauben, 1992). Literature on cognitive engagement attempts to better understand how the learning environment is related to different levels and types of cognitive engagement, and how cognitive engagement influences students' learning outcomes. Unpacking these relationships may help to establish a link between students' learning outcomes and learning context. As it is argued that student cognitive engagement depends on learning environment, various structures within the course promote student cognitive engagement have been explored in conjunction with a concern for the improvement of instruction. Although there is supportive evidence for the association between learning environmental design and cognitive engagement, several questions still remain. First, there is a lack of knowledge regarding the relationship between the integration of instructional design principles into the learning environments and the levels of student cognitive engagement. Instructional design principles can prescribe how instruction should be designed to facilitate deeper levels of student engagement in learning. The First Principles of Instruction provide a clear framework for designing engaging instruction. Few studies have been conducted to verify the effect of the First Principles of Instruction on student engagement in learning. Although there is evidence linking the First Principles and quantitative aspects of student engagement in terms of the amount of time a student spends, additional research is required to better understand the relationship between qualitative aspects of engagement and the integrations of these principles. Furthermore, this study is guided by Merrill's claim that student engagement in instruction is a function of the degree to which the First Principles are implemented (Merrill, 2002; 2009) and it has been empirically shown that the extent to which the First Principles are implemented in courses varies across courses (Frick et al., 2010). Therefore, a main focus of interest in the study is to test whether the extent to which his principles are integrated into courses predicts students' levels of cognitive engagement.

An additional question concerns the role of personal goals in the relationships between the integration of First Principles and cognitive engagement. When predicting cognitive engagement, most prior studies have examined either personal factors or classroom environmental factors, thus separate links between personal factors and cognitive engagement (DeBacker&Crowson, 2006; Dupeyrat&Mariné, 2005; Greene&Miller, 1996; Pintrich&De Groot, 1990; Pintrich&Garcia, 1991; Walker et al., 2006; Zusho et al., 2003) or classroom environmental factors and cognitive engagement (Ahlfeldt et al., 2005; Jang et al., 2010; Nie&Lau, 2010) have been established. In addition, many motivational studies highlight the links between students' goal orientations and the learning environment, arguing that students' adoption of goals is also context dependent (e.g., Church et al., 2001; Meece et al., 2003). Given the links among leaning contexts, goal orientations, and cognitive engagement that have been separately established together, it seems reasonable to hypothesize a mediating relationship that learning environment exerts its indirect influence on cognitive engagement through individual motivational orientations. In fact, there have been many calls for research to test both simultaneously (e.g., Ames, 1992; Pintirich & Schrauben, 1992; Pintrich et al., 2003). An investigation of a mediating relationship would provide a more accurate picture of the contribution of learning environmental design elements in explaining the variance in students' cognitive engagement. This study, therefore, also concerns the relationship between the students' perceived levels of the integration of instructional design principles and the levels of their cognitive engagement, taking into account the effect of students' goal orientation as a personal factor. This makes the independent contributions of students' personal factors and learning environmental factors clearer.

Meanwhile, reviewing previous studies on cognitive engagement reveals an important methodological issue concerning the nature and measurement of learning environments. Different measurements of learning environments have been used such as redesigned learning environment itself as a treatment, expert or instructor ratings of classroom, or students' perceptions of instructional environment. Prior studies have shown that student perceptions of learning environmental were associated with student cognitive engagement, not objectively assessed learning environment. It is argued that students' perception is a valid measure when studying the effects of learning environmental design because students perceive differently the influential design elements from what is expected to be effective in designing the learning environment (Ames, 1992; Koszalka et al. 2002). In order to assess the integration of First Principles of Instruction in a course, therefore, this dissertation focuses on students' perceptions of how well a course implemented the First Principles based on their classroom experiences.

Research Questions

The primary purpose of this study is to examine the relationships between students' perceptions of the degree to which First Principles of Instruction are implemented in university courses and the level of student engagement in learning. In addition, this study seeks to investigate whether the relationships are mediated by students' goal orientations.

This study investigates whether course-level instructional design practices influence student engagement with multiple courses. Therefore, the study employs a multilevel modeling approach. The multilevel modeling method is an appropriate analytical technique when multiple courses are involved in the study, and students were nested within courses (Raudenbush & Byrk, 2002). It allows for partitioning the proportion of variance on cognitive engagement at the student- and course-level and for examining hierarchical relationships that course-level predictors influence student-level outcomes.

Twenty-nine undergraduate courses from various academic majors in a Korean university were involved in the current study. It is therefore important to provide a brief description of the general characteristics of Korean universities and cultural perspectives of Korean students and how these perspectives may affect responses to the instruments used in this study and the researchers' interpretations of the results. Korean universities have adopted many ideas from US universities (Lee, 1989, as cited in Shin, 2012). Most elements of the university system such as department system, academic courses, and academic organization, and teaching and learning strategies are similar to US universities (Shin, 2012). There are however cultural differences in teaching and learning contexts between Western universities and Asian universities. With Confucian heritage culture, in general, it is claimed that Asian students view teachers as knowledge authorities who have responsibility for content delivery and who are not to be questioned (e.g., Holliday, 1994; Pratt et al., 1999). It is also reported that Asian students perceive that learning is memorization of knowledge provided by teachers (e.g., Kennedy 2002, McKay and Kember 1997). Thus, in contrast to views on Western contexts, Asian classroom contexts are perceived as more authoritarian, expository, and focused on preparation for examinations. Thus students tend to use more surface cognitive strategies (Biggs, 1991; 1998). This study is not a cultural comparative study of cognitive engagement; however this dissertation will provide a discussion of Korean student cognitive engagement according to various student variables and academic majors as compared to the results reported in Western context.

With an interest in student engagement in learning and course-level implementation of First Principles of Instruction are implemented, this study is designed to address the following major research questions:

- R1: Does student cognitive engagement vary across courses?
- R2: Is there a significant relationship between students' perceptions of the degree to which First Principles are implemented in courses and student cognitive engagement?
- R3: Is the relationship between students' perceptions of the degree to which First Principles are implemented in courses and student cognitive engagement mediated by student goal orientation?

Significance of the study

A main focus of this study is to understand how the integration of instructional design principles into university courses and the levels of student cognitive engagement in these courses are related. Furthermore, this study attempts to better address a causal mechanism by which the integration of instructional design principles influences cognitive engagement through individual goal orientations.

Theoretically, this study will provide novel evidence linking Merrill's First Principles of Instruction to cognitive engagement. In spite of the importance of the First Principles in designing engaging instruction, few studies have validated the relationship between the principles and various learning outcomes. In addition, the study will provide further support for the mediating role of goals in the relationship between learning environmental factors and cognitive engagement. There have been many calls for research testing personal and learning environmental factors simultaneously when predicting cognitive engagement; however, most previous studies have directly linked either personal factors or learning environmental factors to cognitive engagement. Thus, this study allows capturing of the complexity of learning contexts, students, and cognitive engagement.

When studying learning contexts, multiple courses are often sampled in which students are nested, and both courses and students are used as unit of analysis. Despite the obvious nested nature of the data involved in most learning context studies, the majority of existing studies did not consider such data structure. This may cause statistically invalid results by not taking into account course effects. This study employed a multilevel modeling technique as an analytical method. This allows partitioning within- and between–course effects on cognitive engagement and clarifying how course-level practices and student-level characteristics influence on the cognitive engagement outcomes.

In terms of practical significance of this study, if the First Principles are identified to be effective in designing engaging instruction as Merrill claims, instructional designers or university instructors will have a better idea of how to design and evaluate university courses. For example, in university contexts, course evaluations by students are often the only source of feedback to instructors on the quality of instruction (Bangert, 2006; d'Apollonia & Abrami, 1997). Course evaluations are often criticized that the items are less related to actual student learning (e.g., engagement and achievement) and most do not provide the information on how to improve teaching (Frick et al., 2008, 2009, 2010). First Principles could be used as a set of principles of how a course should be structured in a way to more engage students in the course.

Summary

Cognitive engagement has been used as an indicator of students' meaningful and thoughtful approaches to their learning in classroom context. As it is argued that students approach their learning in different ways depending on their purpose or reasons of learning or the demands of what is required of them in a learning context, previous research has focused on identifying the factors that promote students' cognitive engagement. This study particularly employs First Principles of Instruction as a framework for designing engaging learning environment and attempts to explore the relationship among integrations of instructional design principles into the learning environments and student cognitive engagement.

In chapter 2, the relevant literature will be synthesized and provide a detailed rationale for this study in detail. A research design will also be suggested to examine hypothesized relationships between the integration of instructional design principles and cognitive engagement.

Chapter 2 Review of Literature

The purpose of this study is to examine the relationship between students' perceptions of course in terms of the integration of First Principles of Instruction and the levels of cognitive engagement. This study is grounded on the assumption that students' engagement in learning would be promoted by effective learning environment design. Chapter 1 describes a conceptualization of cognitive engagement, and identifies a knowledge gap in the literature linking learning environment and cognitive engagement from an instructional design perspective.

Chapter 2 will now provide a comprehensive review of cognitive engagement literature. Since the construct of cognitive engagement is described by underlying components of the construct in a variety of ways, different conceptualizations of cognitive engagement are synthesized. Second, a rationale for a link between instructional design principles and cognitive engagement is provided.

This review of literature attempts to cover all theoretical and empirical studies on the construct of cognitive engagement as well as its underlying components. In addition, there are two major perspectives of student engagement research: student approaches to learning perspective and self-regulated learning perspective. Since they share much of the basic assumptions, empirical studies from the both perspectives are reviewed when exploring the factors affecting student engagement in learning. It will be discussed in the next section in-depth.

At the end of the chapter a synthesis of the literature will be provided that supports the research design and methods that will be used to further our understanding of the relationships among the integration of instructional design principles, cognitive engagement and goal orientations. The review of literature begins with definitions of cognitive engagement.

Cognitive engagement

Defining students' engagement in learning

In 1983, Corno and Mandinach first used the term *cognitive engagement* to describe the extent to which students deliberately regulate their own learning. They defined cognitive engagement in terms of self-regulated learning. That is, "students who are active in the acquisition and transformation of academic material during instruction" (p. 243) are considered to be self-regulating or highly engaged in their learning (Corno & Mandinach, 1983). Since this first usage, the term cognitive engagement has been widely used in the literature in student learning. However, the definitions vary.

In recent scholarship, cognitive engagement is typically described based on two common indicators: students' use of basic cognitive strategies such as rehearsal, elaboration, organization, and critical thinking; and self-regulatory strategies such as planning, monitoring, regulating (DeBacker & Crowson, 2006; Greene & Miller, 1996; Meece et al., 1982; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Pintrich & Schrauben, 1992; Walker et al., 2006; Wolters, 2004). In light of this, cognitive engagement has been operationalized in the literature by one of these indicators or as a combined set of the indicators.

Students' use of basic cognitive strategies has been considered to be one form of cognitive engagement (e.g., Dupeyrat & Mariné, 2005; Lyke & Young, 2006).

Some define cognitive engagement as the cognitive strategies a student employs, and such scholars distinguish it as shallow or surface engagement when referring to students' use of rehearsal strategies and deep or meaningful engagement when referring to the use of elaboration and organization strategies. In short, it is presumed that more engaged students use deeper cognitive strategies in their learning.

However, the current view of student engagement in learning reflects a self-regulated learning perspective (Paris & Paris, 2001; Pintrich, 2004). With the self-regulated learning perspective, students are assumed to be actively engaged in their learning activities. That is, students who are deeply engaged monitor their learning progress, reflect their use of learning strategies, and modify the strategies in their learning process (Schunk, 1996; Pintrich, 2004). From this point of view, one body of literature includes students' use of self-regulatory activities as an important indicator of deep levels of engagement in learning (DeBacker & Crowson, 2006; Greene & Miller, 1996; Meece et al., 1982; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Pintrich & Schrauben, 1992; Walker et al., 2006; Wolters, 2004). Thus, cognitive engagement in this context is described as the use of cognitive and self-regulated learning strategies. For example, Meece et al. (1988) defined active cognitive engagement by students' reported use of cognitive strategies such as relating new information to existing knowledge and self-regulated learning strategies such as monitoring comprehension, regulating attention and effort. On the other hand, superficial engagement was defined as the use of help seeking and effort-avoidant strategies.

A group of researchers taking a *self-regulated learning perspective* such as Pintrich and his colleagues (Pintrich & De Groot, 1990; Pintrich & Garcia, 1991;

Pintrich & Schrauben, 1992) often used the term cognitive engagement and self-regulated learning interchangeably in their studies. They conceptualize learning strategies as having two components based on Weinstein's learning process model (Weinstein & Mayer, 1986): general cognitive strategies for learning and self-regulatory strategies. Weinstein and Mayer (1986) describe learning strategies as "behaviors and thoughts that a learner engages during learning and that are intended to influence the learner's encoding process. Thus, the goal of any particular learning strategy may be to affect the learner's motivational or affective state, or the way in which the learner selects, acquires, organizes, or integrates new knowledge" (p. 315). Weinstein and Mayer identified major categories of learning strategies related to comprehending learning materials: cognitive strategies in terms of rehearsal, elaboration, and organizational strategies; and self-regulatory strategies in terms of comprehension monitoring strategies.

In addition to rehearsal, elaboration, and organizational strategies discussed by Weinstein and Mayer (1986), Pintrich and his colleague (Garcia & Pintrich, 1992) added critical thinking strategies as another indicator of cognitive strategies. Critical thinking strategies refer to "the extent to which students try to apply prior knowledge to new situations and solve problems, to analyze and evaluate information in a thoughtful manner" (Pintrich, 2004, p. 393). They believed that effective learning strategy involves applying knowledge as well as acquiring and comprehending texts. Thus, scholars regard cognitive engagement as the use of four types of cognitive strategies such as rehearsal, elaboration, organization and critical thinking, as well as the use of self-regulated strategies.

Other researchers (Guthrie et al., 1996; Newmann, Wehlage, & Lamborn, 1992 1992; Richardson & Newby, 2006) include motivational components in their conceptualization of cognitive engagement. For example, Richardson and Newby (2006) define cognitive engagement as the integration and utilization of students' motivations and strategies. Newmann et al. (1992) define student engagement in academic work as “psychological investment in and effort directed toward learning, understanding, or mastering knowledge, skills or crafts that academic work is intended to promote” (p. 21). Cognitive engagement was inferred from the extent to which students demonstrate active interest, effort, and concentration through behaviors and activities such as the amount of time spent on academic work, the intensity of students concentration, the enthusiasm and interest expressed, and the degree of care shown in completing the work.

In addition, there is another group of scholars who take the view of *student approaches to learning* to describe student engagement in learning (Biggs, 1993; Eley, 1992; Entwistle, 1991; Entwisltle & Tait, 1990; Kember et al., 1997; Trigewell & Prosser, 1991; Wilson & Fowler, 2005). In this perspective, *approach* refers to students' learning strategies, and also to students' intentions adopted in their learning processes (Biggs, 1993; Entwistle, 1991).

Comparing *student approaches to learning* and *self-regulated learning perspective*, Pintrich (2004) states that both perspectives are widely taken by researchers of student learning, but there are some similarities and differences between the two perspectives. Both share the assumptions that learning is a constructive process of students, and that the process mediates between the characteristics of individuals and learning outcomes as well as between the characteristics of learning environment and learning outcomes. However, Pintrich asserts that a major difference between the two is the role of motivation in learning. The *student approaches to learning perspective* posits a one-to-one correspondence between motivation and cognitive strategies; thus, extrinsic goals are linked to surface learning and intrinsic goals are linked to deep learning. According to Pintrich, however, “this type of merger of goals and strategies into approaches to learning does not recognize the possibility that students can flexibly combine different goals and strategies in different ways in different context” (p. 388). Appleton et al. (2006) also argued that “motivation and engagement are separated but not orthogonal” (p.428). That is, one can be motivated and still not actively engage in a task. Therefore, the motivational and cognitive components are distinguished under the self-regulated learning perspective. Although motivational and cognitive components work together for a learning task, the distinction allows for “more dynamic, sophisticated, and multivariate analyses of the links between students’ motivation and cognition in the college classroom” (Pintrich & Garcia, 1991, p. 378). Thus, one body of studies (e.g., Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Pintrich & Schrauben, 1992) views motivational components as precursors of “how students come to use different cognitive strategies and become self-regulating learner” (Pintrich & De Groot, p. 37) and attempts to clarify the relationships between various motivational components and the levels of cognitive engagement.

In summary, researchers seem to agree that successfully motivated learners adopt more effective cognitive strategies and monitor their cognitive strategy use to learn new knowledge and skills. However, it is useful to separate motivational components and cognitive components in the conceptualization of cognitive engagement in student learning research. Therefore, cognitive engagement is defined in this study as the cognitive learning strategies and the self-regulated learning strategies that students employ. The indicators of cognitive engagement involve rehearsal, elaboration, organization, critical thinking, and self-regulated learning strategies.

Distinction between deep and surface level of cognitive engagement

In general, the levels of cognitive engagement have been operationalized by four scales of basic cognitive strategies (rehearsal, elaboration, organization, and critical thinking strategies) and a single scale of self-regulated strategy (Pintrich, 2004). These scales of cognitive engagement have been investigated together or individually in the literature. In some studies, researchers only distinguish basic cognitive strategies and self-regulated strategies (e.g., Pintirich et al., 1994; Pintrich & De Groot, 1990; Wolters et al., 1996; Wolters, 2004). The researchers operationalize the cognitive strategies as a combination of rehearsal and elaboration strategies (Pintirich et al., 1994; Wolters et al., 1996) or a combination of rehearsal, elaboration and organization strategies (Pintrich & De Groot, 1990; Wolters, 2004). Still in other studies, those subscales were examined separately (e.g., Zusho & Pintrich, 2003).

Another group of researchers established the concept of deep and surface engagement since cognitive engagement ranges from simple memorization that is not thought to be effective to the use of self-regulated learning strategies which is considered the highest form of meaningful learning in university classroom contexts (Fredricks et al., 2004). Marton and Säljö (1976) initially identified deep and surface levels of engagement. Used in parallel to deep and surface levels of engagement are the distinctions between active versus superficial engagement (e.g., Meece et al., 1988), and shallow versus meaningful learning strategy use (e.g. Greene & Miller, 1993). These studies suggested that students who employ deep or meaningful cognitive strategies are likely to be more engaged with academic tasks than the students who employ surface or shallow strategies.

In the literature on cognitive engagement, surface level engagement was typically indicated by the rehearsal or memorization strategy use; however many different combinations of cognitive strategies and self-regulated strategies were used to indicate deeper levels of engagement. For example, Greene and Miller (1993) combined self-regulated learning strategies with deep levels of strategies into a single variable and investigated shallow and meaningful engagement as separate outcomes. Pintrich and Garcia (1991) examined surface engagement measured by the items associated with rehearsal strategies, deep engagement measured by the items of elaboration and organization strategies, and the items of self-regulation individually.

There are few empirical studies which attempt to empirically validate their conceptualization of cognitive and self-regulated strategy use or of surface and deep levels of engagement. Pintrich and De Groot (1990) conducted factor analysis in the middle school context and confirm two-factor structures of cognitive engagement: cognitive strategy use and self-regulation. The cognitive strategy use scale consisted of the items measuring rehearsal, elaboration, and organization strategies, and the self-regulation consisted of the items self-regulatory and effort management strategies. Another factor analysis of adult students conducted by Dupeyrat and Mariné (2005) showed a distinction between deeper levels of strategy use which were associated with elaboration and organization strategies use as well as shallow levels of strategy use which were associated with rehearsal strategies. Nie and Lau (2010) conducted a confirmatory factor analysis in a secondary school context to test two-factor structures of surface strategy scale measured by the items of rehearsal strategies, and the deep strategy scale measured by the items of elaboration and critical thinking strategies. The model was a good fit. Table 1 shows how the scales of cognitive engagement have been conceptualized across numerous studies in the literature.

Table 1 Conceptualizations of Cognitive Engagement

Author	Levels/types of cognitive engagement	Instrument
Pintrich & De Groot, 1990; Pintrich et al.,1994;Wolters et al., 1996	· cognitive strategies (combined scale of rehearsal and elaboration) · self-regulatory strategies	Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1991)
Pintrich & Garcia, 1991; Pintrich & Schrauben, 1991	· surface cognitive strategies (scale of rehearsal) · deep cognitive strategies (combined scale of elaboration and organization) · self-regulatory strategies	MSLQ
Zusho et al., 2003	· surface cognitive strategies (scale of rehearsal) · deep cognitive strategies (separate scale of elaboration and organization) · self-regulatory strategies	MSLQ
Dupeyrat & Marine, 2005	· shallow cognitive strategies (scale of rehearsal) · deep cognitive strategies (combined scale of elaboration and organization)	MSLQ
Nie & Lau, 2010	· surface cognitive strategies (scale of rehearsal) · deep cognitive strategies (combined scale of elaboration and critical thinking)	MSLQ
Eley, 1992; Kember et al., 1997; Wilson&Fowler, 2005; Nijhuis et al., 2005, 2007, 2008	· surface approaches to learning · deep approaches to learning	Study Process Questionnaire (SPQ; Biggs, 1986)
Meece et al., 1988; 2003	· active cognitive engagement by students' reported use of meta-cognitive and self-regulation strategies a · superficial engagement by students' reported use of help-seeking, and effort avoidance strategies	Science Activity Questionnaire (SAQ; Meece et al., 1988))
Debacker & Crowson, 2006; Greene & Miller, 1996; Walker et al., 2006	· shallow engagement (scale of rote memorization, underlining and other shallow study strategies) · meaningful engagement (combined scale of meaningful cognitive processing and self-regulatory activities)	Motivation and Strategy Use Survey (Greene&Miller, 1993)

Measuring cognitive engagement

Cognitive engagement is not an observable construct; therefore, it is assessed from observing students' behavior or from students' self-reports. Researchers have developed several measures of cognitive engagement. These instruments typically measure self-regulatory strategy use and cognitive strategy use (Fredricks et al., 2004). The goal of these instruments is to measure the differences in how students learn.

As either the *approach to learning perspective* or the *self-regulated learning perspective* has been taken by scholars, two instruments have also been generally used in the literature on student engagement: the Study Process Questionnaire (SPQ; Biggs, 1987) has been applied to the approach to learning perspective while the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, and McKeachie, 1991) has been applied to the self-regulated learning perspective. Both instruments were designed for use in university course contexts. The major difference between the two perspectives is reflected on the instruments.

The Study Process Questionnaire (Biggs, 1987) includes 42 items on three main learning strategies: deep learning, surface learning and achieving learning strategies. Deep learning scales consist of intrinsic motivation and cognitive strategies associated with understanding, discussing, and reflecting; surface learning scales consist of extrinsic motivation as well as cognitive strategies for focusing on details and accurately reproducing information; and, finally, achieving learning scales consist of performance motivation and regulatory learning strategies for efficiently organizing time and effort.

The Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991) is an 81-item self-report instrument consisting of 6 motivation subscales and 9 learning strategies scales which were developed to assess motivational orientations and learning strategies in a specific university course. These 15 scales have been used in combination or separately in literature as shown in Table 1.

The main difference between the SPQ and the MSLQ may be in terms of the operationalization of learning strategy subscales. The MSLQ allows for assessing the five learning strategies separately from any motivational components. Accordingly, research can adapt each subscale of the MSLQ based on the research purpose and the conceptualization of the construct. In contrast, the surface and deep learning strategy of the SPQ combines motivation and strategies for learning as well as cognitive strategies (Pintrich, 2004). The benefit of the MSLQ is to allow the researcher to unpack each indicator of motivation, cognitive strategy, and self-regulatory strategy when compared to the SPQ. Pintrich (2004) argues that by using the MSLQ it is possible to investigate more dynamic and sophisticated analysis of the relationships between students' motivation, cognitive strategies, and self-regulatory strategies. Furthermore, the MSLQ was grounded on the assumption that students' motivational and learning strategy orientations depend on the nature of learning environment, thus it was designed to be used at the course level and it has been most frequently used to assess the impacts of different aspects of instruction on motivational and cognitive components of learning (Duncan & McKeachie, 2005).

Therefore, in this study, the following will be adopted from the MSLQ: the scale of rehearsal strategy to indicate surface levels of engagement; the scale of elaboration, organizational and critical thinking strategy to indicate deep level of engagement, and the scale of self-regulatory strategies.

Factors affecting students' cognitive engagement

There has been a long debate over whether students' cognitive engagement is consistent or varying over time and across contexts. Some researchers argue that there is a certain consistency in students' adoption of learning strategies (e.g. Entwistle, 1991; Vermetten et al., 2002); others argue that students choose learning strategies according to their motivational orientations or learning environmental factors (e.g. Greene & Miller, 1996; Jang, Reeve, and Deci, 2010).

There is empirical evidence that shows a limitation to the variability in students' use of learning strategies. Vermetten et al. (2002) conducted an experimental study to compare students' use of learning strategies between a traditional course and a student-oriented course in a university context. The student-oriented course incorporated group work or activating instructions that are expected to evoke more meaningful learning. The same group of students in the Law department participated in both traditional and student-oriented courses during two consecutive years. The authors expected that students' use of deep and surface learning strategy would vary according to the different learning environment. However, there was no difference in the use of learning strategies between the traditional and student-oriented course. They concluded that the reforms made to student-oriented instructional practices hardly had any impact on learning strategies. This finding may indicate that the learners demonstrate stable learning strategies across different learning context.

Some scholars (Nijhuis, Segers, & Gijselaers, 2005; Wilson & Fowler, 2005) assume that students have a predisposition to deep or surface learning and investigated whether a general tendency in students' learning strategy use would be influenced by a specific learning context. For example, Wilson and Fowler (2005) examined students' differences in their approach to learning in two concurrent courses: a traditional course assumed to foster surface learning and a redesigned course prompting deep learning. In the beginning of the semester during the course of their study, they classified 50 undergraduate students to either surface or deep approach to learning and their approach to learning was measured again in the last week of the semester. The findings illustrate that the students in the typical deep learning group did not show any difference in their strategy use across the two courses; on the other hand, the students in the typical surface learning group reported higher levels of deep learning strategy use in the redesigned course. The authors concluded that typical deep learners are relatively consistent in their use of learning strategies; however typical surface learners are more influenced by their learning environment.

Alternatively, a number of studies have found that students' adoption of learning strategies varies as a function of individual and contextual differences. Eley (1992) attempted to examine whether students show variability in their engageement across contexts. One hundred and fifty two undergraduate students enrolled in four concurrent course units were surveyed on their use of learning strategies and perceptions of the learning environment. The changes in individual learning strategy use were scored based on the magnitude of the changes. The scores showed that about 95% of students reported they adopted different learning strategies across courses, but the magnitude of the changes was not great. In addition, students' perceptions of their learning context also differed between courses. Eley (1992) concluded that students use different learning strategies in different learning contexts; and that the variability in learning differences is related to the perceptions of the learning environment.

It is argued that although students have a general predisposition to deep or surface learning strategy use, this learning strategy use can be, at least in part, modified by individual or learning environmental factors (Ramsden, 1984). This requires researchers to identify the factors explaining the variability of students' cognitive engagement. Some have sought these factors within the students; others have sought them within the learning environment.

Student motivational factors

One motivational factor that has received much attention in cognitive engagement research is goal orientation. Goal orientations reflect "students' rationale or reasons for engaging in a task" (Pintirich & Schrauben, 1992, p. 156); and thereby result in different types or levels of students engagement. The relationship between students' levels of cognitive engagement and various sets of students' goal orientations has been well established. These studies compared two contrasting orientations of students' goals which refer to the reasons or purposes students have for engaging in academic tasks (Maehr, 1989): learning versus performance-oriented goals (e.g., Greene & Miller, 1996); mastery versus performance goals (e.g., DeBacker & Crowson, 2006; Wolters, 2004); mastery versus work-avoidance goals (e.g., Dupeyrat & Mariné, 2005); task-mastery versus ego or social goals (e.g., Meece et al., 1988); and intrinsic versus extrinsic goals (e.g., Walker et al., 2006).

Researchers argue that although these sets of goal orientations are labeled differently, they indicate essentially the same constructs (Pintrich et al., 2003; Pintrich & De Groot, 1990; Wolters et al., 1996). Basically, learning-oriented, mastery-oriented, or intrinsically-oriented goals represent the goal of developing competencies and of learning and mastering academic tasks. On the other hand, performance-oriented or extrinsically-oriented goals represent the goal of students demonstrating their performance in comparison with others. These different goal orientations lead to different selections of cognitive and self-regulated learning strategies.

Research has shown a consistent, positive relationship between learning-oriented, mastery-oriented, or intrinsic motivations and the deeper levels of engagement, whereas performance goal orientation or extrinsic motivations predict surface or shallow levels of engagement among university students (Dupeyrat & Mariné, 2005; Greene & Miller, 1996; Lyke & Young, 2006; Walker et al, 2006) as well as younger students. (Meece et al., 1988, 2003; Pintrich et al., 1994; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Wolters et al., 1996, 2004). For example, Green and Miller (1996) used path analysis to investigate the relationships between undergraduate students' goal orientations, perceived ability and cognitive engagement. The result indicated that perceived ability and learning goal orientations influenced meaningful cognitive engagement, whereas performance goals were related to shallow cognitive engagement. In addition, meaningful cognitive engagement was positively related to student achievement, while shallow cognitive engagement was negatively related to students' achievement. Lyke and Young (2006) compared the mean score of deep cognitive strategy use among three groups by the levels of intrinsic and extrinsic orientation (low/moderate/high) with 322 undergraduate students. The ANOVA result revealed that students differed significantly in their use of cognitive strategies according to their levels of orientations. Students who have higher levels of intrinsic orientation were more likely to use deep cognitive strategies; whereas the students with the lowest levels of extrinsic orientation were less likely to use surface strategies than the students with moderate or high levels of extrinsic orientations.

Learning environmental factors

Since a certain amount of students' adoption of cognitive strategies is thought to be reactive to the task, the classroom environment, or the context, cognitive engagement researchers are concerned with identifying the characteristics of effective learning environment that lead to students' deeper levels of cognitive engagement.

Empirical studies have shown that students' engagement in learning can be altered by various elements in the learning environment design such as factors related students' perceptions of teaching quality (Entwislte & Tait, 1990; Prosser & Trigwell, 1992; Ramsden, 1992; Trigwell & Prosser, 1991; Nijhuis et al, 2007, 2008), characteristics of tasks and learning activities (Kyndt et al., 2011; Pintrich et al., 1994), teachers' behaviors during instruction (Jang, Reeve, & Deci, 2010; Pintrich et al., 1994), classroom goal structures (Lyke & Young, 2006; Wolters, 2004), the integration of student oriented learning, action learning, problem-based learning, and constructivist learning (Ahlfeldt, Mehta, & Sellnow, 2005; Meece et al., 1988; Nie & Lau, 2010; Nijhuis, Segers, & Gijselaers, 2005; Rotgans & Schmidt, 2011; Wilson & Fowler, 2005), and academic disciplines (Hativa&Birenbaum, 2000; Laird et al., 2008; Vermunt, 2005; Wolters&Pintrich, 1998).

Perceptions of teaching. A group of researchers has established in exploratory ways key elements of the learning environment which make significant differences in students' deeper levels of engagement. The researchers relied on students' ratings of teaching quality using course evaluation questionnaires that measure the dimensions of teaching such as good teaching, freedom in learning, clear goals, appropriate assessment and workload, and relevant content. Using these measures, researchers explored what aspects of teaching are relate to students' engagement in learning (Entwislte & Tait, 1990; Prosser & Trigwell, 1992; Ramsden, 1992; Trigwell & Prosser, 1991; Nijhuis et al, 2007, 2008). Entwistle and Tait (1990) conducted two studies. First, a correlational study was conducted with 431 first-year students enrolled in engineering courses to explore the relationships between approaches to learning, evaluation of teaching, and students' course experiences. The factor analysis of the course evaluation items separated into the two different dimensions: the items related to student evaluation of course structure and delivery; and the items related to students' perceptions of their course experience. In the study, only an association between students' course experiences and approaches to learning was found. Among subscales of course experience, individuals' perceptions of relevant content were associated with deep approaches, while the perceptions of demanding workload were associated with surface approaches. However, contrary to their expectation, evaluation of the courses (as a general view of teaching quality students held) was not associated with deep approaches to learning. Questioning whether the course evaluation is valid to measure students' perceptions of teaching, the authors, in the second study, asked 271 students about their preference of the teaching and approaches to learning. The results showed that students who adopt deep approaches to learning preferred a learning environment in which understanding was encouraged, while students who adopt surface approaches preferred a learning environment in which rote learning was promoted. Based on the findings, Entwistle and Tait (1990) inferred that the perceptions of good teaching may vary among students from what course evaluation measures expected; thus, the differences could weaken the link between course evaluation and student approaches to learning. The authors suggested that caution should be taken when linking course evaluations and students' engagement.

Regarding students' perceptions of teaching, furthermore, the quality of instructor measured by the questions such as "teaching staff motivated me to do my best", the extent of freedom in learning, and the clarity of goals have shown to be important aspects of teaching which affect students' deep engagement in leaning (Trigwell & Prosser, 1991; Nijhuis et al., 2007; Vermetten et al, 2002).

Academic tasks/learning activities. The design of academic tasks and learning activities is a central element of learning environments, and students' perceptions of the tasks and activities influence how they engage in their learning (Ames, 1992). As was discussed in the previous section, the workload, accompanying feelings of pressure or stress in terms of tasks and learning activities (Kember, 2004), is one of the factors affecting students' different levels of engagement. There are several studies specifying further the aspect of academic tasks or learning activities. Kyndt et al. (2011) conducted a study concerning the influence of students' perceptions of workload and task complexity on their approaches to learning. One hundred and twenty eight second-year undergraduate students in educational sciences were asked to engage in four conditions of learning tasks designed according to the extent of workload and task complexity (high workload and high task complexity; high workload and low task complexity; low workload and high task complexity; low workload and low task complexity) and were surveyed at the end of each assignment. Factor analysis confirms a factor of workload and three factors of task complexity:

familiarity, solutions, and lack of information. In each condition, the authors conducted regression analysis with those factors as predictors. The study found that a lack of information was positively related to surface approaches to learning under all conditions, and a lack of information was also negatively related to deep approaches in high workload and high task complexity conditions as well as low workload and low task complexity conditions. Familiarity of tasks was a predictor of deep approaches with high workload and high complexity, whereas in conditions with low workload and low complexity, familiarity was a predictor of surface approaches. Workload was positively related to deep approaches only in conditions with low workload and high task complexity. Pintrich et al. (1994) also focused on the aspects of academic tasks. They investigated three classroom perception scales (productive academic work, cooperative work, and teacher effectiveness) with 100 middle school students from 14 classrooms. The researchers analyzed correlations between individual perceptions with students' cognitive and self-regulatory strategy use and between the classroom-level aggregated perceptions with the strategy use. Both individual- and classroom-level aggregated perceptions were related to students' cognitive and self-regulatory strategy use. The correlational analysis showed that those students who perceived their work as productive and cooperative; their teacher as more effective reported higher levels of cognitive strategies and the use of self-regulated learning strategies.

Teacher's instructional style. When students are involved in classroom learning, there are some aspects of the teacher's behavior that play a role in students' learning processes. The studies focusing on students' evaluation of teaching showed that students' perceptions of teacher effectiveness or quality of teaching staff were related to deep approaches to learning or the use of deeper cognitive strategies and self-regulatory strategies (Trigwell & Prosser, 1991; Nijhuis et al., 2007; Pintirich et al., 1994). In the aforementioned study by Pintrich et al. (1994), teacher effectiveness was measured by the items regarding teacher's behaviors in a clear and interesting manner, good classroom management, and fair grading procedure. The study showed that the teacher effectiveness was positively related to students' cognitive and self-regulated strategy use.

Jang, Reeve, and Deci (2010) investigated the effect of engagement-promoting behaviors of teachers such as autonomy support and course structure on students' engagement. Engagement was measured in two ways: by students' self-reporting and collective engagement rated by observers of the class. Teachers' engagement-promoting behaviors were also rated by trained observers. Two sets of hierarchical regression analyses were performed to examine whether students' individual and collective engagement can be predicted by the teacher-provided autonomy and structure. First, teacher-provided autonomy support and course structure were significant predictors of the collective engagement ($b=.36, .38$, $p<.05$, respectively); second, teacher-provided autonomy support was a predictor of the self-reported engagement ($b=.19$, $p<.05$). Course structure did not predict the self-reported engagement. Using objective ratings of classroom context, the study focused on between-classes effect and reported that 14 % of the variance in students' engagement was accounted for by classroom contextual differences, while the remaining 86% of the variance in students' engagement was explained by individual differences within a class.

Classroom goal structure. Perceived classroom goal structure has been studied as a significant classroom contextual factor which leads to differences in students' cognitive engagement. In the literature, it is assumed that students may adjust their cognitive strategies in accordance with their perceptions of how the classroom environment is structured toward different goals; and depending on what the learning environment requires (Lyke & Young, 2006). Researchers have investigated students' perception of the performance versus task (or mastery) structures of their classroom and its impact on students' use of cognitive and self-regulatory strategies (Ames & Archer, 1988; Lyke & Young, 2006; Wolters, 2004). Based on a sample of 322 undergraduate students, Lyke and Young (2006) analyzed the correlations between students' goal orientation and the levels of cognitive engagement, between the goal orientation and classroom goal structure, and between classroom structure and the levels of cognitive engagement. Each relationship was individually examined. The results showed that students who had higher levels of intrinsic motivation reported a greater use of deep cognitive strategies, students who had higher levels of intrinsic motivation perceived their classroom more task-structured, and when the classroom was perceived as task-structured, students' use of deep strategies were increased. Taken these findings together, they concluded that intrinsic motivation may act as a mediator of the positive relationship between classroom structure and the deep level of cognitive engagement. That is, intrinsically motivated students in task-oriented classrooms are most likely to engage in their learning at a deeper level. Wolters (2004) conducted a study to investigate whether classroom goal structure as a contextual factor and personal goal orientations account for students' cognitive engagement. The 525 junior high school students from 38 mathematics classes were surveyed on their perceived classroom goal structure, personal goal orientation, and their use of cognitive and metacognitive learning strategies. Wolters (2004) conducted a series of hierarchical regression analyses. First, he analyzed the relationship between classroom goal structure and personal goal orientation. Results from the analysis indicated that students' perception of the mastery-oriented structure of the classroom was a predictor of individual adoption of mastery goal ($\beta=.49$, $p<.01$) and performance goal orientation ($\beta=.10$, $p<.01$); further students' perception of the performance-oriented classroom was a predictor of individual adoption of performance goal orientation ($\beta=.34$, $p<.01$).Then, the relationships between classroom goal structure, personal goal orientation, and cognitive engagement were analyzed. Wolters (2004) first entered mastery and performance-oriented classroom goal structures as predictors of cognitive engagement. Results from this analysis indicated that both mastery-oriented classroom structure and performance-oriented structure positively predicted students' use of cognitive strategies ($\beta=.41$ and .11, $p<.01$) and metacognitive strategies ($\beta=.38$ and .12, $p<.01$). Lastly, both classroom goal structures and individual goal orientations were added in the analysis. The final model showed that a mastery-oriented classroom structure and mastery goal orientation predicted students' use of cognitive strategies ($\beta=.22$ and .47, $p<.01$) and metacognitive strategies ($\beta=.16$ and .47, $p<.01$). This study established separate links between classroom goal structure and cognitive engagement and between classroom goal structure and personal goal orientation.

Redesign of learning environment. The effects of learning environmental factors on students' engagement are often discussed in the context of course re-design or improvement of traditional instructor-led course through integrating approaches such as action learning (Wilson & Fowler, 2005), problem-based learning (Ahlfeldt, Mehta, & Sellnow, 2005; Nijhuis, Segers, & Gijselaers, 2005; Rotgans & Schmidt, 2011), and constructivist learning (Nie & Lau, 2010). Wilson and Fowler (2005) classified approximately fifty university students as typical deep or typical surface learners based on a baseline measurement in the beginning of the course. The learning environment included two concurrent courses: a conventional course (lectures and tutorial) and an action learning based course (which including project work and group work). The authors measured the students' learning strategy uses again in the end of the course and compared the differences observed in typical deep or typical surface students' learning strategy use across the two courses. Wilson and Fowler found that in the action learning course, the students in the typical surface learning groups reported increased use of deep learning strategies; however, the students in the typical deep learning group were not influenced by both learning environments in their use of learning strategies. Ahlfeldt et al. (2005) conducted a correlational study with 1,831 undergraduate students from 56 classes to examine the relationship between the levels of problem-based learning methods that instructors reported and students' self reported learning engagement. The results showed that the reported engagement was higher in the classrooms where more PBL methods were implemented. Nie and Lau (2010) conducted a study to investigate how different instructional methods were related to students' surface and deep cognitive strategy use. The instructional methods compared in this study were didactic and constructivist instruction. Didactic instruction emphasized drill and practice of basic skills and knowledge relying mainly on textbook, while constructivist instruction frequently used classroom discussion and extended writing, and teachers emphasize in-depth understanding and application of students' learning to everyday life. Three thousand 9th grade students from 108 classrooms participated in the study. The author analyzed whether the class-mean perceptions of didactic and constructivist instruction were related to individual students' use of cognitive strategies using hierarchical linear regression. The results showed a relationship between didactic instruction and surface strategy use ($r=.113$, $p<.05$), and between constructivist instruction and deep strategy use ($r=.102$, $p<.05$). Those studies support the claim that re-designed courses have an impact on students' increased engagement or the use of deeper cognitive strategies.

Some studies fail to establish a link between re-designed courses and students' deeper levels of engagement. Vermetten et al. (2002) used an experimental study to examined the effect of student-oriented courses aimed at prompting students' deeper levels of engagement compared to traditional courses. It was assumed that in the student-oriented courses, students would engage in their learning at deeper levels, but the results indicated that the students in the experimental group showed little differences in learning strategies from the student in the comparison group. The authors concluded that students demonstrate stable learning strategies across different learning environments. In a study by Nijhuis et al. (2005), students' deep and surface learning strategy use were compared in two different formats of the same university business course: an assignment-based course in which clear instructions in the assignment were provided; and a problem-based course in which ill-structured authentic problems were given to the students. They examined the changes in students' use of learning strategy from pre- and post- measures. Although the authors expected that students' use of deep learning strategies would be promoted in the problem-based format, contrary to their expectations, students in the problem-based environment showed a significant decrease in deep learning and increased in surface learning. Rotgans and Schmidt (2011) examined to what extent autonomy in problem-based learning results in cognitive engagement with a study including 208 university students. They assumed that five phases of problem-based learning activities such as the problem definition, initial self-study, initial findings sharing, self-study, and the presentation and elaboration phase allowed students different levels of autonomy; then, the feeling of being autonomous would be related to the different levels of cognitive engagement. For example, the authors expected at an initial self-study phase that students would be allowed a higher level of autonomy, and then they would engage at deeper levels. However, there was no significant difference in students' engagement associated with the differing levels of autonomy. These studies attempt to reveal the effects of the instructional design components on students' deeper levels of learning strategies used. It seems that the evidence does not effectively support the hypothesis of the authors.

Academic disciplines. Academic disciplines have been a major concern in this research area. It is assumed that the nature of disciplines requires different approaches to teaching, which in turn, may lead to different ways of learning. But there has been little research done focusing on the effects of disciplinary differences on students' cognitive engagement.

Vermunt (2005) conducted a study to clarify the associations between academic discipline and students' approaches to learning with a sample of 1,279 university students. Seven academic disciplines were included: Law, Information Science, Economics, Econometry, Sociology, Psychology, and Arts. Regression analysis with age, gender, prior education as personal predictors and with discipline as a contextual predictor showed that differences in students' learning strategy use were associated with different academic disciplines, indicating that Arts and Psychology students used deeper cognitive strategies, while Economy and Law students used more reproduction directed learning strategies. Lonka and Lindblom-Ylanne (1996) examined the disciplinary differences between students of psychology and medicine. The students in the medicine department were more externally regulated and showed reproduction-directed learning. In middle school contexts, Wolters and Pintrich (1998) examined whether students' levels of motivation and cognition vary across domains and if the relations between the motivational and cognitive components of self-regulated learning change as a function of the three domains. There were 545 middle school students from six mathematics courses, six English courses, and five social studies courses who participated in the study. ANOVA results indicated that there were significant differences in student cognitive and self-regulatory strategy use between subjects. Students reported greater cognitive strategy use in social studies than in mathematics or English. The use of self-regulated strategies was similar across all subject areas.

The nature of the knowledge in different disciplines might lead to differences in students' use of cognitive and self-regulatory learning strategies. However, few studies have examined the differences in students' use of learning strategies between different academic majors.

The studies reviewed above showed supportive evidences for the association between learning environmental design and cognitive engagement. However several concerns remain. The next section attempts to clarify that concerns.

Lacking a link between instructional design principles and cognitive engagement. Cognitive engagement literature has focused on how the elements of learning environmental design influence students' levels of cognitive engagement. Many types of instructional practices were employed to prompt deep cognitive strategy use. Table 2 shows a summary of the learning environmental variables that were covered in the literature.

Table 2 Summary of learning environmental variables explored in cognitive engagement literature

Environmental variables		Source
Perception of teaching	· good teaching · clear goal · appropriate assessment · appropriate workload · independent learning	Eley, 1992; Entwistle&Ramsden, 1983; Entwislte&Tait, 1990; Nijhuis et al., 2007, 2008
Academic tasks/learning activities	· interesting academic work and cooperative work	Pintrich et al., 1994
	· task complexity and perceived workload	Kyndt et al., 2011
	· small group and whole class activities	Meece et al., 1988
Teachers' instructional style	· autonomy support and course structure	Jang et al., ,2010
	· teacher effectiveness	Pintrich et al., 1994
Classroom-goal structure	· classroom goal structure (task vs. performance)	Lyke&Young, 2006; Wolters, 2004
Re-design of learning environment	· constructivist and didactic instruction	Nie&Lau, 2010;
	· problem based learning	Nijhuis et al, 2005; Rotgans&Schmidt, 2011
	· levels of problem-based learning	Ahlfeldt et al., 2005
	· conventional and action learning design	Wilson&Fowler,2005
	· project-based course	Kember et al., 1997
Discipline		Hativa&Birenbaum, 2000; Laird et al., 2008; Lonka&Lindblom-Ylanne, 1996; Vermunt, 2005; Wolters&Pintrich, 1998

Some of these practices appear to be effective, while others do not. Particularly, engaging learning environment designs that incorporate problem-based learning, student-oriented learning, or action learning did not appear to be effective in promoting students' deep levels of learning. In assessing these results, Vermetten et al. (2002) argue that it could be because the learning environment design was not effective enough, although researchers attempt to design more engaging learning environments. Nijhuis et al. (2008) also note that "another explanation could be that the changes in the learning environment were not strong enough to induce changes in learning strategies" (p. 122). In fact, some of these studies based on experimental design did not assess how well intended instructional elements were implemented in actual instructional situations, and the studies failed to produce expected levels of cognitive engagement (e.g., Nijhuis et al., 2005; Rotgans & Schmidt, 2011; Wilson & Fowler, 2005) . Instructional design researchers pointed out that engaging instruction does not happen without careful application of instructional design principles which are proven to consistently facilitate effective, efficient, and engaged learning. For example, Merrill (2008) claims that "there are known instructional strategies. If an instructional experience or environment does not include the instructional strategies required for the acquisition of the desired knowledge and skill, then effective, efficient, and engaging learning of desired outcome will not occur" (p. 267). Therefore, when linking instructional design elements and students' engagement, a related area of interest might be the extent to which the instructional design principles are integrated into learning environments, and its relationship with student cognitive engagement factors. This area has not yet been rigorously investigated.

Students' perception as a contextual variable. Reviewing previous studies reveals an important methodological issue concerning the nature and measurement of the learning environment (Ames, 1992, Entwistle, 1991; Nie & Lau, 2010; Pintrich et al., 1994; Rmasden, 1992; Wolters, 2004). Different measures of the learning environment reviewed in the literature are shown in Table 3.

Table 3 Classroom context measures

Author	Classroom context measure	Type of inquiry
Nijhuis et al., 2005; Rotgans&Schmidt, 2011; Wilson&Fowler, 2005; Vermetten, 2002	Redesigned classroom environment as an intervention	Analysis of variances between groups or pre- and post scores of engagement
Jang et al., 2010	Observer ratings of teachers' behaviors	Between-class effect using HLM
Ahlfeldt et al., 2005	Instructor reported levels of problem-based learning	Correlation between levels of PBL and student engagement
Lyke&Young, 2006; Nijhuis et al, 2007; Trigwell&Prosser, 1991	Individual perceptions of classroom environment	Correlation between individual perceptions and engagement indicators
Pintrich et al., 1994	Class-level aggregated perceptions of classroom environment	Correlation between classroom mean perceptions and engagement indicators
Nie&Lau, 2010; Wolters, 2004	Class-level aggregated perceptions of classroom environment	Between-class effect using HLM

As is made evident this review, there exist several experimental studies on the variability of cognitive engagement. Researchers designed learning environments to improve traditional university courses and compared the engagement between traditional and redesigned courses or between pre- and post-measurements of student engagement in the redesigned courses. However, as mentioned earlier, these studies failed to support their hypotheses that intended instructional design would promote students' deeper level engagement (Nijhuis et al., 2005; Rotgans & Schmidt, 2011; Wilson & Fowler, 2005; Vermetten, 2002).

Many other studies relied on the measurements of subjective or perceived classroom characteristics by students (Lyke & Young, 2006; Nie & Lau, 2010; Nijhuis, Segers, & Gijselaers, 2007; Pintrich et al., 1994; Trigwell & Prosser, 1991; Wolters, 2004). Ames (1992) emphasized students' perception as a measure of learning environment. She argues that although all students are exposed to the common classroom environment, students perceive the classroom environment differently based on their individual characteristics such as goal orientations. Consequently, it is important to note that a learning environment does not directly influence student learning; rather, it is indirectly affected through the ways students perceive the learning environment. Koszalka et al. (2002) also argued that the investigation of students' perception is important in studying the effects of learning environmental design because students have different perceptions on the influential design elements compared to instructional designers' expectations in designing the learning environment. Empirical evidence showed that individual students perceived their course context differently, and the differences in the perception of a course accounted for some portions of the variability in students' learning strategy use (e.g., Nijhuis, Segers, & Gijselaers, 2008; Pintrich et al., 1994; Prosser & Trigwell, 1999). This type of inquiry linking individual perceptions to cognitive engagement cannot isolate the effect of classroom contexts from those attributable to individual student differences.

Meanwhile, other studies are concerned with between-course or between-instructor variations when investigating the effects of instructional practices, since instructional practices are inherent in a course or an instructor. The studies focused on the class-level effects on individual students' cognitive engagement using the aggregated students' perceptions of the class level as a measure of contextual variable (Meece et al., 2003; Nie & Lau, 2010; Wolters, 2004). The average students' perception of the class level can be considered as "a more objective indicator of the actual academic environment" (Entwistle & Tait, 1990, p. 190). This type of inquiry tests the assumption that at least some of the variance in the cognitive engagement is attributed to classroom differences (Raudenbush & Bryk, 2002). However, the study linking classroom context and cognitive engagement is limited.

This study is guided by Merrill's claim that student engagement of a particular method of instruction is a function of the degree to which the basic principles of instruction he suggested are implemented (Merrill, 2002; 2009). In order to test whether his claim is valid, between-class design is employed in this study to test the relationship between the extent to which his principles are integrated into courses and students' levels of cognitive engagement.

Direct and indirect effects of learning environments. The primary purpose of this study is to investigate the relationship between learning environmental factors and the level of students' cognitive engagement. When investigating this relationship, most prior studies have focused on a direct link between the learning environmental factors and cognitive engagement. Thus, links were established separately between students' goal orientation as a personal factor and cognitive engagement, and between classroom contextual factors and cognitive engagement. In addition, a group of scholars concerns that students' motivational components such as individual goal adoption is also learning context dependent; thus, the links between students' motivational components and the learning environment were highlighted (e.g., Pintrich et al.'s review, 2003). Taken the links that have been separately established together, it seems reasonable to hypothesize a mediating relationship that learning environment exerts its indirect influence on cognitive engagement through motivational factors. In fact, researchers suggest testing both personal and learning environmental factors simultaneously (e.g., Ames, 1992; Pintrich & Schrauben, 1992; Pintrich et al., 2003), however little work has done.

The evidences for these relationships are outlined in Table 4.

Table4 Evidences linking goal orientations, environmental factors, and cognitive engagement

	Source
Link between goal orientations and cognitive engagement	DeBacker&Crowson, 2006; Dupeyrat&Mariné, 2005; Greene&Miller, 1996; Pintrich&De Groot, 1990; Pintrich&Garcia, 1991; Walker et al., 2006; Zusho et al., 2003
Link between learning environmental factors and cognitive engagement	Ahlfeldt et al., 2005; Jang et al., 2010; Nie&Lau, 2010
Link learning environmental factors and goal orientation	Church et al., 2001; Pintirich et al.'s review, 2003
Link between learning environmental factors and cognitive engagement through goal orientation	Wolters, 2006; Yildrim, 2012

The aforementioned Wolters'(2004) study did not test mediating effects of personal goal orientations; however, a series of analyses allows the mediating relationship to be inferred. This study established a direct relationship between classroom goal structure and cognitive engagement as well as a direct relationship between personal goal orientation and classroom goal structure. When entering personal goal orientations and classroom goal structure as predictors, the strength of the relationship between mastery-oriented structure and cognitive engagement was substantially reduced and the relationship between performance-oriented structure and cognitive engagement was no longer significant. This evidence meets the conditions for a mediation model suggested by Baron and Kenny (1986). A mediation model can be posited when the relationship between an independent variable (i.e., classroom goal structure) and a dependent variable (i.e., cognitive engagement measures) is significant, when the relationship between mediating variables (i.e., personal goal orientations) and dependent variables is significant, and when the direct relationship between independent variable and dependent variable is reduced by the mediator.

An investigation of mediating relationships would provide a more accurate picture of the contribution of learning environmental factors in explaining the variance in students' cognitive engagement. Therefore, this study concerns the direct and indirect relationship between the integration of instructional design principles and the levels of cognitive engagement taking into account the effect of students' goal orientation. This investigation will show the independent contributions of students' personal factors and learning environmental factors.

Korean studies on cognitive engagement

Korean researchers have also focused on student engagement in learning and the factors affecting the level of engagement. In Korean literature, students' engagement in learning has also been described in a variety of ways. Jung (2010) describes engaged students as those who immerse in learning and are actively involved in activities related to learning. Similarly, Cha et al. (2010) define student engagement as active and voluntary involved in learning activities. In online course contexts, students' engagement was described by the extent of the interactions between student and student, and between student and instructor (e.g., Shin, 2002;

Lee, 2006). There also exists a body of studies focusing on cognitive and metacognitive strategy use as indicators of student engagement measured by MSLQ as it is operationalized in this study (e.g., Cheon, 2003; Kim & Kim, 2011; Kim et al., 2011).

A relationship between students' engagement and academic achievement was an important area of student learning research in both K-12 and university contexts. It was shown that students' use of cognitive strategies were significantly related to undergraduate students' achievement measured through indicators such as their GPA (Cheon, 2003; Kim et al., 2011) as well as middle school students' achievement (Roh, 2009). A meta analysis by Kim et al. (2002) on the effects of learning strategies in K-12 contexts showed that the 44 articles under review reported that the overall effect size of cognitive strategies and metacognitive strategies were large (.61 and .71, respectively). In addition, a study conducted by Roh (2009) tested a mediational relationship among teaching practices, learning strategies, and academic achievement with middle school students and founded that students' perceptions of teaching practices had both direct and indirect influence on their academic achievement through the use of learning strategies such as cognitive strategies and metacognitive strategies.

The factors that are related to cognitive engagement were explored in the realms of students, instruction, and academic tasks. The following appeared to be associated with students' use of cognitive and metacognitive strategies: the relatedness (Kim & Do, 2009), learning style (Cheon, 2004), academic emotions (Kim & Kim, 2011), goal orientations (Han, 2004), and self-efficacy (Jung, 2012; Park, 2007) as personal factors; and students' perceptions of task value (Jung, 2012), the perceptions of teaching strategies (Roh, 2009), student-oriented instructional practices (Park, 2011), authentic instruction (Park, 2004), and teachers' autonomy support (Jung, 2012; Kim & Kim, 2011; Park, 2011) as classroom contextual factors.

Student engagement in learning and its relationship with learning environments have received much attention in Korean literature with increased interest in supporting college students' learning (Lee & Lee, 2012); however, evidence demonstrating the relationship between the integration of instructional design principles and engagement is still missing from the literature.

Merrill's First Principles of Instruction

First Principles of Instruction

According to Reigeluth (1999), there are two kinds of instructional methods: basic methods and variable methods. The basic methods are the methods to consistently promote learning and the variable methods are the alternative method to implement the basic method in the specific instructional practices. According to Merrill, Reigeluth's basic method as the principle of instruction is "a relationship that is always true under appropriate conditions, regardless of a specific instructional activity (practice) or a set of practices (program) which implement this principle" (Merrill, 2002, p. 43). Merrill (2009) also argued that, "in spite of the diversity represented by the various instructional theories and models, the underlying principles for all of those theories are fundamentally the same" (p. 55).

He devoted himself to identifying, elaborating, and validating the underlying principles which are included in most instructional design theories and models, and expected to consistently promote student learning during instruction. Merrill reviewed extensive literature on instructional design theories and models and, finally, proposed the First Principles of Instruction, in 1999. The instructional design theories and models that he reviewed include multiple approaches to understanding (Gardner, 1999), collaborative problem solving (Nelson, 1999), constructivist learning environments (Jonassen, 1999; van Merriënboer, 1997), learning by doing (Schank, 1999), and so on.

First Principles of Instruction suggests five principles to consistently promote student learning: task- or problem-centered, activation, demonstration, application, and integration. Merrill also proposes these principles as a cycle of instructional phases. That is, instruction should be based on authentic, real-world problems or tasks, and should be designed to engage students in a cycle of four principles activate students' previous knowledge, demonstrate new knowledge to the students, encourage students to apply and reflect new knowledge in relation to their lives. The cycle of four principles also embed a cycle of structure, guidance, coaching, and reflection within the cycle (Merrill, 2009).

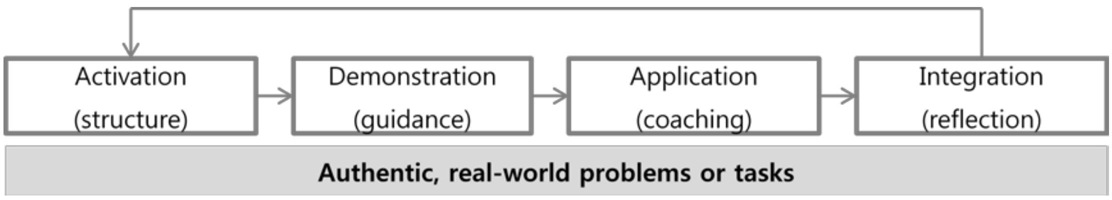

Figure 1 Merrill's (2009) First Principles of Instruction

The task-centered principle suggests that instruction should be designed based on a task-centered instructional approach. During the instruction, learners should engage in the context of authentic, real-world problems or tasks. With the task-centered principle, Merrill emphasizes that increasingly complex tasks from less difficult or complex to more difficult or complex tasks should be presented.

The activation principle suggests that instruction should begin with activation of the learners' relevant prior knowledge or experiences as a foundation of new knowledge. In the activation phase, it is important that learners have the opportunity to recall, describe, and share their existing knowledge. In order to enhance the activation process, activation also involves providing a structure of the knowledge being presented to help learners organize new knowledge.

The demonstration principle suggests that instruction should provide a demonstration of the knowledge and skills to be learned. It suggests that specific cases that show how the information applies to a situation need to be presented by teachers. In the demonstration phase, students are encouraged to actively engage in interaction with one another, rather than passively observe the demonstration. Learner guidance helps learners to relate detailed demonstration or explanation to the generalizable knowledge

The application principle suggests that instruction should provide learners with the opportunity to apply their newly acquired knowledge and skills into a new situation. During application, feedback and coaching can enhance the students' learning from application.

The integration principle suggests that instruction should encourage learners to integrate new knowledge into their everyday life. Effective integration can be implemented by having the students reflect-on, discuss, or defend newly acquired knowledge or skills.

Merrill also argued that these principles can be implemented in a variety of ways by different practices of instruction, and the extent to which the principles are implemented in a course determines effectiveness, efficiency and student engagement. That is, if a learning environment does not incorporate the appropriate instructional principles required for the acquisition of the desired knowledge or skills, it may cause learning problems in effectiveness, efficiency or engaging students (Merrill, 2008; van Merrirëboer et al., 2002). Merrill suggests that research should be conducted to validate these principles in various teaching and learning context.

Studies on First Principles of Instruction

There have been several attempts to empirically investigate the relationships among the First Principles of Instruction and the effectiveness, efficiency, and engaging instruction.

Copper, Bentley, and Schroder (2009) attempted to evaluate the reliability and validity of Merrill's principles. They selected six award-winning online courses by recognized award-granting organizations and compared the courses with the rubric of Merrill's First Principles and six other evaluation rubrics of online courses that focused primarily on instructional strategies and methods. First, interrater reliability among five raters was calculated for each course and the correlation of the reliability ranged from .568 to .847. In addition, the scores rated by those rubrics were compared. Based on the comparison, the authors concluded that the use of Merrill's First Principles is linked to high-quality instruction. Most of the award-winning online courses were problem-centered, but there were a variety of levels of each principle: activation, demonstration, application, and integration.

For the emphasis given to active learning in an undergraduate science course, Gardner (2011) adapted Merrill's First Principles of Instruction to implement active learning strategies in a web-based module in an introductory biology course. There were three levels of learning outcomes between two groups of students: students in the module using First Principles of Instruction and students in the module using a traditional web-based approach were compared. Three levels of learning outcomes were measured in terms of the questions, at the remember, understand, and problem solving levels. When the author compared the effect size of the difference between pre- and post-test score between groups, the results showed that both groups improved the remember level scores, from pretest to posttest and the effect size of the First Principles group was larger. There was no significant difference between groups at the understand level. At the problem solving level, students in the First Principles group had a larger effect size, and this improvement from pre- to post-test for the First Principles group was significant. These results indicate that the implementation of the First Principles can improve learning at remembering and problem solving. The author suggested that designing instruction that uses First Principles increases students' ability to solve problems and remember essential information; however, the improvement was not significant when compared to those who were in the module using a traditional approach.

Frick et al. (2008) used Merrill's principles as course evaluation framework in terms of the integration of instructional design. They developed a course evaluation instrument to measure teaching and learning quality (TALQ) in university course. The instrument includes the measure of the integration of Merrill's principles as the quality of instruction scale and the measure of various indicators of learning quality.

These measures of quality include student satisfaction, overall course quality, students' perceived learning gain, level of mastering of course objectives, and academic learning time. Using the instrument, they conducted a series of studies to investigate the relationships of student ratings of instructor use of these principles with the indicators of learning quality. Frick et al. (2009) surveyed 156 undergraduate and graduate students using the instrument. Correlational analysis showed that First Principles being used in a course was associated with all scales of quality instruction, students' satisfaction and their perception of learning a lot (Spearman's ρ ranged from .341 to .867). Furthermore, Mapping and Analyzing Patterns and Structures Across Time (MAPSAT) results indicated that students were three to five times more likely to agree or strongly agree that they learned a lot, and were satisfied with courses when they also agreed that First Principles of Instruction were used, and were frequently engaged successfully. Students were nine times more likely to report mastery course objectives when both First Principles and Academic Learning Time (ALT) were reported to have occurred, compared with their absence. Another study conducted by Frick et al. (2010) with 464 undergraduate students from 12 courses showed similar results. In addition, in this study, they further investigated the relationship between student rating of Merrill's First Principles and instructor ratings of student mastery of course objectives as a learning outcome. The result showed that students were five times more likely to achieve high levels of mastery course objectives, when both First Principles and ALT were reported to have occurred. Overall, the conclusion of those studies is that Merrill's First Principles of Instruction are associated with quality of instruction in terms of students' satisfaction, course evaluation, learning gains, and engagement. Previous studies also confirmed that the degrees to which these principles are integrated differ across the courses.

Merrill's principles were recently published; therefore, there are a limited number of studies exploring the relationships of the principles with quality of instruction. Although empirical evidence shows that the principles contribute to design effective and engaging instruction and ultimately improve student learning, more evidence is needed to support the validity of the First Principles of Instruction. The current study particularly focuses student engagement in learning as a desired outcome of the integration of the principles. This concern was raised by the studies conducted by Frick et al. (2008, 2009, 2010). They established a link between the class-level integration of First Principles and student engagement. In their study, student engagement was measured with academic learning time scale consisting of the items to measure the amount of time and effort students spent on learning tasks (e.g., I spent a lot of time doing tasks, projects and /or assignments; I put a great deal of effort into this course). In the study, student engagement was conceptualized as amount of time and effort; however an important question concerns the relationship between the principles and student meaningful learning, since the concept of student engagement in learning also included qualitative aspects of engagement. Therefore more studies on the relationship between the implementation of First Principles and the level of cognitive engagement as a qualitative indicator of student engagement are required.

Summary

The purpose of this study is to examine the relationship between the degree to which First Principles of Instruction are implemented in courses in a Korean university and the level of student cognitive engagement.

Cognitive engagement as an indicator of how student are engaged in learning has been conceptualized as a combination of a students' use of cognitive strategies such as rehearsal, elaboration, organization and critical thinking, and metacognitive strategies. Since cognitive engagement vary from the use of rote memorization to the use of self-regulated metacognitive strategy, surface levels of engagement and deep levels of engagement are generally distinguished in the literature.

Literature has shown that although there is a certain consistency in students' adoption of cognitive and metacognitive strategies, the strategy use can be modified by student personal and learning environmental factors. Thus, links between the levels of cognitive engagement and a variety of factors have been explored. However, little is known about the relationship between integration of instructional design principles into the learning environments and the levels of student cognitive engagement.

The First Principles of Instruction Merrill suggested is a useful framework for designing engaging instruction, but few studies were conducted for empirical validation of the principles. Therefore, this study attempts to examine how the First Principles integrated within the classroom are related to the levels of cognitive engagement.

Chapter 3 Method

Research design

This study is designed to investigate the relationships between the degree to which the First Principles of instruction (Merrill, 2002, 2009) are implemented and three indicators of students' cognitive engagement (Surface, Deep, and Self-regulatory learning strategy use) in university courses.

This investigation was designed as a cross-sectional survey study. Cross-sectional survey is an appropriate design when researcher examines students' opinions, practices, or attitude, and collects data at one point in time (Cresswell, 2008). The current study focused on students' experiences in and perceptions on the courses. A paper and pencil survey instrument was administered at the end of semester to gain overall students' reflections on their course and learning activities.

Hierarchical Linear Model (HLM) was chosen for the data analysis technique. HLM requires the following assumptions about the nature of the data (Hofmann, Griffin, & Gavin, 2000, p. 489):

1. Lower-level units such as individual students are nested within identifiable higher-level units such as classes or schools.
2. The lower-level units are influenced by characteristics of the higher-level units.
3. The outcome variable is measured at the lowest level of interest.
4. The outcome variable varies both within the lower-level units and between the higher-level units.

In the current study, students were nested within classrooms and both classrooms and students are the units of analysis. These data are multilevel in nature; thus, hierarchical relationships occur.

Population and Sample

The target population of the study was undergraduate students enrolled in courses offered by a university in Korea. The university is a large University with approximately 10,000 undergraduate students. This study was also interested in whether there are differences among various academic disciplines in the relationships between the degree to which the First Principles are implemented and the three indicators of students' cognitive engagement. Therefore, the stratified sampling procedure was used to consider academic disciplines. Stratified sampling is a type of probability sampling. This sampling technique allows researchers to divide the population based on some specific characteristic (e.g., disciplines) and to sample from each subgroup of the population (Cresswell, 2008). Thus, research can include the specific characteristics of interest in the sample. In this study, participants were sampled within each academic discipline: Language and Humanities, Business, Social Science, Natural Science, Engineering, and Education Departments.

In a multilevel model, a large number of groups appear more important than a large number of individuals per group. A rule of thumb to determine sample size in a two-level multilevel design is at least 30 groups, with at least 30 participants per group in order to have sufficient power (.90) when investigating cross-level relationships (Kreft, 1996). Mass and Hox (2005) also suggest that a group size of 30 is considered to be normal in educational research. In this case 29 courses consisting of 30 or more subjects per course were sampled. According to Hoffmann et al. (2000), the large number of subjects in each group can reduce the requirements of the number of groups to maintain same level of power.

The researcher discussed the study's purpose with the faculty, sought their permission to recruit students, and scheduled to visit each course. In the classroom, students were informed that they are invited in the study, but participation was voluntary and anonymous without being associated with personal identification information. Informed consent was obtained from each participant prior to the administration of the surveys. The data collection process began at the end of spring semester after IRB approval was obtained.

Research variables and measures

The variables include a set of demographics, a measure of First Principles implementation, and students' cognitive engagement subscales. In addition, students' intrinsic and extrinsic goal orientations are included as mediating variables. Table 5 shows an overview of variables.

Cognitive engagement measure. The cognitive and self-regulatory strategy uses were measured by the recent version of Motivated Strategies for Learning Questionnaire (MSLQ: Pintrich et al. 1991). Originally, the MSLQ is an 81-item self-report instrument consisting of 6 motivation subscales and 9 learning strategies scales. The MSLQ was grounded in the assumption that students' motivational and learning strategy orientations depends on the nature of learning environment- that is, motivation and learning strategy use are not the characteristics of the student, but rather contextually bound to course and instruction (Duncan & McKeachie, 2005;

Garcia & Pintrich, 1995). Thus, the MSLQ was designed to be used at the course-level and has been extensively used to assess the effects of different aspects of instruction on motivational and cognitive components of learning with college students as well as with other populations (Duncan & McKeachie, 2005).

Table 5 Research variables

Variables (name)	Description (scale)
Student-level	
Surface cognitive strategy use (Surface)	A composite of 4 items on rehearsal strategies adopted from MSLQ (7-point scale from 1=not at all true of me to 7=very true of me)
Deep cognitive strategy use (Deep)	A composite of 15 items elaboration, organization, and critical thinking strategies adopted from MSLQ (7-point scale from 1=not at all true of me to 7=very true of me)
Self-regulatory strategy use (Self-regulated)	A composite of 12 items on self-regulatory strategies adopted from MSLQ (7-point scale from 1=not at all true of me to 7=very true of me)
Extrinsic goal orientation (Extrinsic)	A composite of 5 items on students' extrinsic goal orientation adopted from MSLQ (7-point scale from 1=not at all true of me to 7=very true of me)
Intrinsic goal orientation (Intrinsic)	A composite of 5 items on students' intrinsic goal orientation adopted from MSLQ (7-point scale from 1=not at all true of me to 7=very true of me)
Gender (Gender)	Male and Female (0=male, 1=female)
Academic rank (Rank)	Freshman, Junior, Sophomore, and Senior (1=freshman, 2=junior, 3=sophomore, 4=senior)
Course type (Course_type)	Core and Elective (0=core, 1=elective)
Course-level	
Aggregated perceptions on the implementation of First Principles (Class-level FP)	A mean score on the perceptions on the implementation of First Principles (class mean score)
Academic major (Major)	Humanities, Business/Economics, Social science, Natural Science, Engineering, Education Department (each major coded as 1 as a separate variable)

Each construct of MSLQ was theoretically-driven, and the validity of MSLQ has been established by factor analyses and a number of correlational studies of college student learning. Between 2000 and 2005, more than 50 empirical studies were replicated and established empirical links with various learning outcomes. The reported reliabilities of the MSLQ scales ranged from α=.64 (organizational strategy) to α=.80 (critical thinking). The MSLQ scales were designed to be modular, and thus can be used in combination or separately (Duncan & McKeachie, 2005).

The cognitive and self-regulatory strategy scales of MSLQ are based on a social-cognitive model of learning and information processing (Pintrich et al., 1993). The scales measure how a learner uses basic and complex cognitive strategies to process information, and uses self-regulatory strategies to control and regulate their cognition (Duncan & McKeachie, 2005). The basic cognitive strategy subscale involves rehearsal strategies (e.g., simple recall of information) and the complex cognitive strategy subscale involves elaboration (e.g., paraphrasing, summarizing), organization (e.g., outlining, using charts and graphs) and critical thinking strategies (e.g., connecting new information to prior knowledge, critically evaluating ideas). Self-regulatory strategy scale measures students' use of planning, monitoring, and regulating strategies.

The cognitive and self-regulatory strategy scales have been used separately or in combination in the literature. Empirical investigation shows many different factor structures of cognitive and self-regulatory strategy or of surface and deep levels of engagement. Pintrich and De Groot (1990) conducted factor analysis in the middle school context and confirmed two-factor structures of cognitive engagement: cognitive strategy use and self-regulation. The cognitive strategy use scale consisted of the items measuring rehearsal, elaboration, and organization strategies, and the self-regulation consisted of the items self-regulatory and effort management strategies.

Another factor analysis of adult students conducted by Dupeyrat and Mariné (2005) showed a distinction between deeper levels of strategy use which were associated with elaboration and organization strategy use and shallow levels of strategy use which were associated with rehearsal strategy. Nie and Lau (2010) conducted a confirmatory factor analysis in secondary school context to test two-factor structures of surface strategy scale measured by three items of rehearsal strategies, and deep strategy scale measured by elaboration and critical thinking strategies. The model was a successful fit.

As surface level engagement has been typically indicated by the rehearsal strategy and deep level engagement has been indicated by a combination of elaboration and organization or of elaboration and critical thinking strategy, this study adopts rehearsal strategy (4 items) as surface levels of engagement indicator; elaboration strategy (6 items), organizational strategy (4 items), and critical thinking strategy (5 items) as deep level of engagement indicators; and self-regulatory strategy (12 items). The items use a seven point Likert-scale from “not at all true of me” to “very true of me”. This theoretical structure was tested by a Confirmatory Factor Analysis and the results are shown in chapter 4.

Goal orientation measure. Intrinsic and extrinsic goal orientation scales were also measured with four items each adopted from the MSLQ. Like other MSLQ scales, intrinsic and extrinsic goal orientation scales have been validated for use with undergraduate students and widely adopted in numerous empirical works. The reported reliabilities of the goal orientation scales were α=.74 (intrinsic orientation) and α=.62 (extrinsic orientation). The items use a seven-point Likert-scale.

First Principle measure. The degrees to which Merrill's First Principles of Instruction in the course were measured by the items taken from Teaching and Learning Quality instrument (TALQ) developed by Frick et al. (2008). TALQ includes 20 items that measure students' perceptions of the implementation of Merrill's five principles: authentic problems (4 items), activation (4 items), demonstration (5 items), application (3 items), and integration (4 items). Construct validity was reviewed by both university instructors and instructional design experts in the development process. A series of studies conducted by Frick and his colleagues (2008, 2009, 2010) also showed that it is a valid measure by consistently reporting its relationships with a variety of student learning outcomes including student engagement which are theoretically hypothesized. Further evidence provided by Frick et al. (2010) confirmed the single factor structure with this measure. The reported reliability of the scale was α=.88.

As a validation process of First Principle measure in this study, an Exploratory Factor Analysis was conducted, and the results will be presented in chapter 4.

Translation of instrument. Since the current study was conducted in a Korean university context, it was necessary to translate the measures into Korean. When translating an instrument, caution should be taken to resolve translation errors and to assure that the meaning of the phenomena being measured between cultures is accurately translated; ignoring either may cause poor results (Dixon, 2004). There are four translation techniques suggested by Brislin et al. (1973): back-translation; bilingual techniques; committee approach; and pretest. Researchers have often used one or more these techniques. Although there is little or no systematic guideline or consensus among researchers of instrument translation techniques, a back-translation is highly recommended by cross-cultural researchers (e.g., Brislin, 1970).

Considering the strengths and weaknesses of each method provided in Dixon's (2004) review of translation methods as well as available resources, the current study employed a back-translation with bilingual test technique. According to Dixon, the technique helps to achieve semantic and conceptual equivalence between original and translated instruments. First, the English version of original instrument was translated into Korean by the researcher, and the equivalence between two instruments was reviewed by an expert English-Korean translator and a Korean researcher in the instructional design field. Then, the Korean version was translated back into English by another instructional design researcher, and two versions were compared again in their semantic equivalence. Finally, two Korean-American students from a course were recruited to test both instruments. Each instrument was given to each student and they were asked to answer all items of the instrument. Discrepancies in responses were detected, and regarding the discrepant responses, the meaning of each item between the students was discussed. The translations were then slightly modified to be sure that the instruments were valid in Korea. Feedback from the students in terms of clarity and relevance were also reflected in the final revision.

Procedures

The researcher scheduled a time to visit each course to administer the survey instrument. Two separate packets were prepared for students: the consent form and the survey instrument. The survey instrument was combined into one anonymous paper and pencil survey including students' background information. No personal identification information was included in the survey instrument.

Students were informed that they were invited to participate in the study, but that participation was voluntary, anonymous, and would not affect any course outcome. Students were further informed that no personal data related to their identification would be collected, and they could skip any questions or stop at any time if they felt uncomfortable, when answering the questions. The researcher gave each student a copy of the consent form before administering the survey.

After the consent forms were collected, the survey instrument was administered. While the survey was being administered, the researcher was out of the classroom. Students were guided to submit the survey on the desk in front of the classroom when they had finished, then they could leave the class. A set of consent forms and survey instruments were put into each envelope, and course information was marked. The instructors and TA's were not allowed to access the survey instrument or see individual data.

Analytical methods

This study investigated how classroom characteristics influence student engagement; therefore, Hierarchical Linear Model (HLM) was chosen for the data analysis. HLM provides "a conceptual and statistical mechanism for investigating and drawing conclusion regarding relationships that cross levels of analysis" (Hofmann, Griffin, and Gavin, 2000, p. 467). Hierarchical linear modeling has been increasingly used in educational studies because it allows for taking into account the nested nature of data and avoiding aggregation bias (Raudenbush & Byrk, 2002).

In educational research, when dealing with two levels of data, research can generally take the approach of assigning higher-level variables to each individual, so that each individual of a group receives the same score on the higher-level variables (e.g., Pintrich et al., 1994). Then traditional ordinary least square (OLS) regression analysis is applied (Hofmann et al., 2000). Hofmann et al., however, pointed out that with hierarchical data, this approach is likely to violate the basic assumptions of OLS regression that the random errors are independent. With the nested nature of data, the random errors of individuals in the same group are likely to be more similar than those of individuals in different groups. Thus, the assumptions of independence would be violated. In addition, the assignment of group-level variables to the individual results in the use of statistical tests that are based on the number of individuals, not on the number of groups. Therefore, standard errors associated with the tests of the group-level variables may be underestimated.

Hierarchical linear modeling provides a more statistically appropriate approach. Using HLM, researchers can separately estimate the variance in outcome both at the lower-level and at the higher-level, and test the significance of the variance components. It allows the researcher to assess the relative power of variables at each level.

In the current study, HLM was chosen to investigate cross-level effects of the integration of First Principles at the course-level on students' cognitive engagement measured at the individual level. The proportion of variance on students' cognitive engagement is partitioned at the student- and course-level and the effects of student- and course-level variables are accounted for.

In addition, a multilevel mediation model was explored to investigate a mediating relationships between the degree to which First Principles are implemented in courses (level 2 predictor) and student cognitive engagement (level 1 outcome) through student goal orientations (level 1 mediator). Figure 2 depicts the 2-1-1 mediation model.

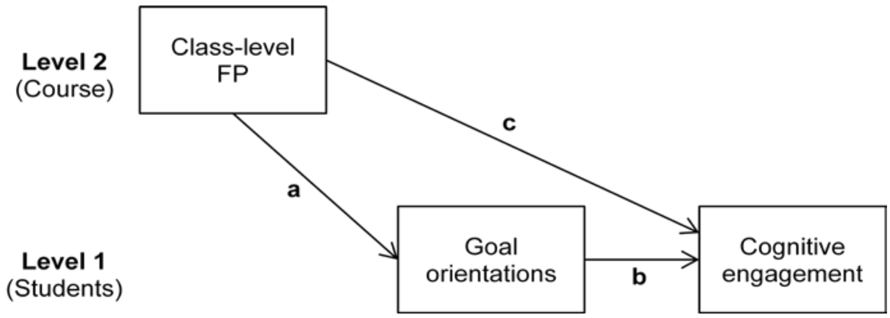

Figure 2 Hypothesized multilevel mediation model

As described in Chapter 2, Baron and Kenny (1986) introduced an analytical technique for testing mediation and the technique is the most commonly used for single level mediational analysis (Frazier et al., 2004). The procedure of mediational analysis involves three tests: first, the outcome variable is regressed on the predictor; second, the mediator is regressed on the predictor; and third, outcome variable is regressed on both the mediator and the predictor (see single-level equations in Table 6). In order to establish mediation, the relationships between the outcome and the predictor, between the mediator and the predictor, and between the mediator and the outcome must be significant.

Baron and Kenny's procedures have been reformulated in multilevel settings (e.g., Krull & Mackinnon, 2001; Zhang et al., 2009) as shown in Table 6.

Table 6 Multilevel Equations for Mediational Analysis from Krull & Mackinnon (2001, p. 258)

	Analysis Type: Single-Level	Analysis Type: Multilevel
	1→1→1	
Equation 1	$Y_{ij} = \beta_0 + \beta_c X_{ij} + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + \beta_c X_{ij} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$
Equation 2	$Y_{ij} = \beta_0 + \beta_{c'} X_{ij} + \beta_b M_{ij} + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + \beta_{c'} X_{ij} + \beta_b M_{ij} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$
Equation 3	$M_{ij} = \beta_0 + \beta_a X_{ij} + r_{ij}$	Level 1: $M_{ij} = \beta_{0j} + \beta_a X_{ij} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$
	2→1→1	
Equation 1	$Y_{ij} = \beta_0 + \beta_c X_j + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + \gamma_c X_j + u_{0j}$
Equation 2	$Y_{ij} = \beta_0 + \beta_{c'} X_j + \beta_b M_{ij} + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + \beta_b M_{ij} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{c'} X_j + u_{0j}$
Equation 3	$M_{ij} = \beta_0 + \beta_a X_j + r_{ij}$	Level 1: $M_{ij} = \beta_{0j} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + \gamma_a X_j + u_{0j}$
	2→2→1	
Equation 1	$Y_{ij} = \beta_0 + \beta_c X_j + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + \gamma_c X_j + u_{0j}$
Equation 2	$Y_{ij} = \beta_0 + \beta_{c'} X_j + \beta_b M_j + r_{ij}$	Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$
		Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{c'} X_j + \gamma_b M_{ij} + u_{0j}$
Equation 3	$M_j = \beta_0 + \beta_a X_j + r_j$	

The first step in testing the 2-1-1 mediation effect is to establish a relationship between level 2 predictor (class-level FP) and level 1 outcome (cognitive engagement). The second step is to establish a relationship between level 2 predictor (class-level FP) and level 1 mediator (individual goal orientation). The final step is to show the effect of level 2 predictor (class-level FP) on level 1 outcome (cognitive engagement) after adding level 1 mediator (individual goal orientation).

Like single level mediation analysis, the mediation effect can be represented using the product-of-coefficients (path *a* x path *b* in figure 2) and the significance of the mediation effect can be tested using a Sobel z statistic, the square root of $b^2 sa^2$ +

$a^2sb^2+sa^2sb^2$ (Zhang, 2009), in which *a* and *b* are regression coefficients and *sa* and *sb* are standard errors.

The analysis techniques used in the study are summarized in Table 7.

Table 7 Overview of Analysis Plan

Analysis	Purpose
Factor analysis	Validate cognitive engagement and First Principle measures
Reliability	Understand reliability of each variable to support further analysis
Descriptive analysis	Understand distributions of sample and items to support further analysis
Correlational analysis	Understand overall relationships among variables
HLM	Examine research questions 1,2 R1: Does student cognitive engagement vary across courses? R2: Is there a significant relationship between students' perceptions of the degree to which First Principles are implemented in courses and student cognitive engagement?
Multilevel mediation model	Examine research question 3 R3: Is the relationship between students' perceptions of the degree to which First Principles are implemented in courses and student cognitive engagement mediated by student goal orientation?

Before proceeding to conduct HLM analyses, factor analyses were first conducted for both cognitive engagement and First Principle measure to ensure the validity of each measure with the sample of this study. Internal consistency of each variable was determined by Cronbach's alpha reliability. Descriptive statistics such as mean, standards deviation and frequency distribution were analyzed to describe main features of the collected data, and correlations were analyzed to overall relationships among variables.

To answer each research question, a series of HLM analyses was conducted. First, as this study hypothesizes that cognitive engagement would be predicted by class-level predictor, research question 1 investigates the amount of between-group variance in cognitive engagement with a null model that does not include any predictor. The null model allowed for assessing variability among courses. Second, research question 2 investigates whether class-level FP accounts for the between-course variance in cognitive engagement. HLM models were analyzed for each cognitive engagement indicator as outcome variables to account for the effects of student variables and academic majors and ultimately to yield unique contribution of class-level FP. HLM does not provide R^2, pseudo-R^2 was presented to assess how much outcome variance is explained by the model's predictors (Singer & Willett, 2003). R^2 was computed by comparing the variance components to those of the null model. The final set of analyses was conducted to test research question 3, cross-level mediation that students' goal orientations mediate the effects of class-level FP on cognitive engagement. Using the procedure outlined in Table 6, three relationships were tested: (i) between class-level FP (level 2 predictor) and cognitive engagement (level 1 outcome); (ii) between class-level FP (level 2 predictor) and individual goal orientation (level 1 mediator); and (iii) between class-level FP (level 2 predictor), cognitive engagement (level 1 outcome), and students' goal orientation (level 1 mediator).

The results of each analysis will be reported in the Chapter 4.

Summary

This study explores the relationship between students' perceptions of course in terms of the integration of First Principles of Instruction and the level of cognitive engagement in a university. This study uses a cross-sectional survey design to gain students' reflections on their courses and learning activities. Research subjects were undergraduate students in a university who are enrolled in the school of Humanities, Social Science, Natural Science, and Engineering.

The variables for this study are measured by the TALQ and MSLQ. Data were collected by a paper and pencil survey instrument and analyzed using HLM to examine the relationships among the variables at the student- and course-level. The next chapter will describe the actual implementation of the chosen methods, and provide results of the data collected and analyzed.

Chapter 4 Results

This study is designed as an exploratory investigation of the relationships between the three indicators of students' cognitive engagement (Surface, deep, and self-regulatory learning strategy use) in university courses and the degree to which the First Principles are implemented (Merrill, 2002, 2009). Hierarchical Linear Modeling (HLM) was chosen for the data analysis technique. This chapter presents the research results and more specifically, it includes a description of the sample, a validation of measures, descriptive statistics of the data, an examination of the underlying assumptions of hierarchical linear models, and the results as they related to the research questions.

Descriptions of sample

One thousand and seventy (1,070) students from twenty nine courses in six academic majors participated in this survey research.

The courses included: six courses from the Language Department (e.g., Practical English grammar, Practical Japanese grammar); four courses from the Business and Economics Department (e.g., Theory of futures and options, Taxation); six courses from The Social Science Department (e.g., Organization development methodologies, International relations); three courses from the Natural Science Department (e.g., General physics, Human physiology); five courses from the Engineering Department (e.g., Artificial intelligence programming, Encryption of information); and five courses from Education Department (e.g., Introduction to Education, Sociology of Education). In this study, the academic major to which the courses belong was considered as a course property used to examine whether the relationship between the implementation of the First Principles and students' cognitive engagement differ among varying academic majors.

Table 8 shows that 17.1 % (n=183) of the participants took courses in the Language Department, 16.9% (n=181) took courses in Business and Economics, 29.1% (n=311) took courses in Social Science, 9.3% (n=99) took courses of in Natural Science, 14.8% (n=158) took courses in Engineering, and 12.9% (n=138) took courses in Education.

Table 8 Course profile

	Number of courses	Number of subjects	Percent
Language	6	183	17.1
Business/Economics	4	181	16.9
Social Science	6	311	29.1
Natural Science	3	99	9.3
Engineering	5	158	14.8
Education	5	138	12.9
Total	29	1070	100

Table 9 presents the descriptions of participants. Male students made up 37.7 % (n=400) while female students were 62.3% (n=660) of the total participants. Ten students did not indicate their gender. In regard to academic rank, 5.2 % (n=56) of the participants were freshmen, 32.4% (n=346) were sophomores, 34.1 (n=364) were juniors, and 28.3% (n=303) were seniors. In addition, 28.9 % (n=298) of the participant chose the courses as core courses, and 71.1% (n=732) chose the courses as elective courses.

Table 9 Sample profile

Sample Characteristics		Number of subjects	Percent
Gender	Male	400	37.7
	female	660	62.3
Academic rank	Freshman	56	5.2
	Sophomore	346	32.4
	Junior	364	34.1
	Senior	303	28.3
Course type	Core	298	28.9
	Elective	732	71.1

Validation of measures

In this study, a Confirmatory Factor Analysis (CFA) was chosen to validate cognitive engagement measure, and an Exploratory Factor Analysis (EFA) was chosen for First Principles measure. The reason why each method was chosen is that CFA is appropriate where a factor structure is hypothesized based on a well-developed theory, while EFA is often considered to be more appropriate for exploring a factor structure than CFA (Hurley et al., 1997). Thus, CFA is used to test the hypothesized structure based on sample data with the purpose of confirmation, and EFA is used to generate the structure in early stages of scale development with the purpose of discovery.

Thus, to ensure the validity of results for the current study, CFA was used to test a hypothesized factor structure of cognitive engagement that was established based on prior theoretical and empirical foundations as presented in Chapter 2. In contrast, the factor structure of First Principles has less been explored because it was developed recently. Initially, a study conducted by developers of the measure (Frick et al., 2010) found a single factor structure with undergraduate students, although the measure consists of five underlying constructs (activation, demonstration, application, integration and task-centered principles). EFA was performed again for First Principles measure to explore factor structure with the sample of this study.

Cognitive engagement measure. The cognitive engagement measures were adopted from the Motivated Strategies for Learning Questionnaire (MSLQ: Pintrich et al. 1991). Three subscales of cognitive engagement were conceptualized in this study based on theoretical and empirical foundations. The scales include: surface levels of engagement indicated by rehearsal strategies; deep levels of engagement indicated by elaboration strategies, organizational strategies and critical thinking strategies; and self-regulated strategies indicated by metacognitive self-regulated strategies of the MSLQ. In order to establish construct validity for the suggested factor structure, a Confirmatory Factor Analysis (CFA) was performed based on data from 1,070 participants. AMOS 20 was used for the analysis. Four items lowering internal consistency were included because low reliability implies higher errors of measurement, thus it would affect the errors of measurement factors. Finally, twenty seven items entered into the model. The initial model yielded χ^2=2434.01 (df=249, p<.0001). The goodness-of-fit statistics indicated that the model did not fit well with RMSEA=0.90, CFI=0.81, and TLI=0.80. These fit indices suggested that the model needed to be modified. A review of Modification Indices (MI) revealed that several items were related to all three factors. Therefore, considering the estimated parameter change suggested by MI, the items were eliminated one by one until the satisfactory model was achieved. The overall fit statistics of the final model were found acceptable with RMSEA=0.07, CFI=0.91, and TLI=0.90, with the exception of the chi-square value, which was significant χ^2=821.21 (df=130, p<.0001). However, this might be expected with a large sample size (N=1,070), since chi-square fit statistics are known to be affected by sample size (Klein, 2005). RMSEA is between .05 and .08; CFI is greater than .90, which indicates reasonably good fit with the model (Kline, 2005). The TLI values between .90 and .95 are considered adequate (Hu & Bentler, 1999).

In sum, nine items that were cross-loaded to all three factors were excluded in the final model: one items of rehearsal; two items of elaboration; two items of organization; and four items of self-regulated strategies. Thus, in the final model, two items of rehearsal strategies were included for the surface cognitive strategy use scale; four items of elaboration, one item of organization, and four items of critical thinking strategies were included for the scale of deep cognitive strategy use; and seven items of self-regulated strategies were included for the scale of self-regulated strategy use. The final model is represented in Figure 3.

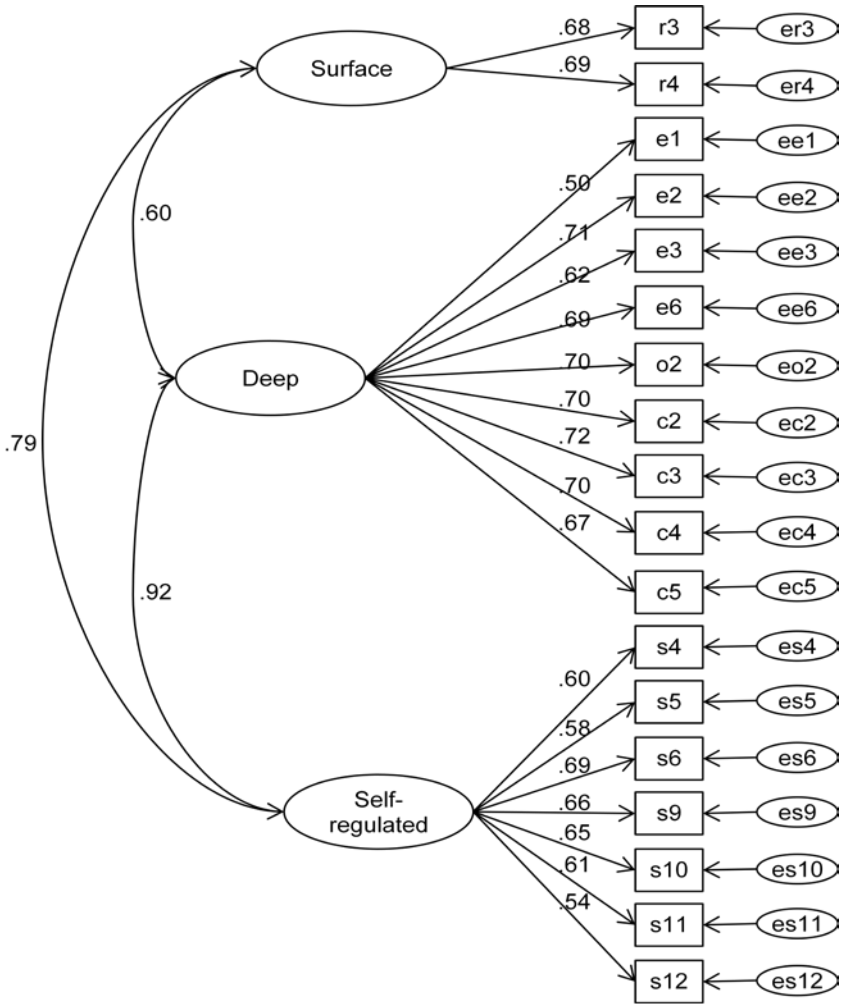

Figure 3 Standardized output for the cognitive engagement measures
Note: r represents rehearsal; e represents elaboration; o represents organization, c represents critical thinking; s represents self-regulatory strategy; er, ee, eo, ec, es represent error terms.

The parameter estimates are summarized in Table 10. The loadings for the two items on surface cognitive strategies are .68 and .69; the loadings for the nine items on deep cognitive strategies range from .50 to .72; and the loadings for the six items on self-regulated strategies range from .54 to .69. All the factor loadings are considered good to excellent (Tabachnick & Fidell, 2007), and all items significantly load on the expected latent variable ($p<.001$). R^2 indicates how much variance in each item is accounted for by each latent variable. For example, 49% of the variance in R4 is accounted for by surface cognitive strategies.

The results from the CFA indicate that it is possible to separate the three indicators of cognitive engagement as conceptualize in this study.

Table 10 Unstandardized and standardized parameter estimates

Observed Variable	Latent construct	Standardized Estimate	Unstandardized Estimate	Standard Errors	P-value	R^2
R3	Surface	.68	1.00			.47
R4	Surface	.69	1.13	0.72	<.001***	.49
E1	Deep	.50	1.00			.25
E2	Deep	.71	1.40	0.09	<.001***	.50
E3	Deep	.62	1.10	0.08	<.001***	.38
E6	Deep	.69	1.37	0.09	<.001***	.47
O2	Deep	.70	1.30	0.08	<.001***	.50
C2	Deep	.70	1.31	0.08	<.001***	.50
C3	Deep	.72	1.41	0.09	<.001***	.52
C4	Deep	.70	1.34	0.09	<.001***	.49
C5	Deep	.67	1.31	0.09	<.001***	.44
S4	Self-regulated	.60	1.00			.36
S5	Self-regulated	.58	0.93	0.06	<.001***	.34
S6	Self-regulated	.69	1.12	0.06	<.001***	.47
S9	Self-regulated	.67	1.00	0.06	<.001***	.44
S10	Self-regulated	.65	0.89	0.05	<.001***	.42
S11	Self-regulated	.61	1.05	0.06	<.001***	.37
S12	Self-regulated	.54	0.89	0.06	<.001***	.29

First Principle measure. Frick et al. (2010) developed the First Principles measure and conducted an Exploratory Factor Analysis (EFA) to validate factor structure. They confirmed a single factor structure with the measure. This study conducted an Exploratory Factor Analysis again to verify the factor structure. Principal components extraction with varimax rotation was used. Excluding four items that lowered internal consistency, the factor analysis extracted a single factor with Eigen values greater than 1.0, accounting for 42.8% of the variance. The factor loadings ranged from .69 to .49.

The factor Plot shown in Figure 4 clearly presents that all items are loaded on one factor.

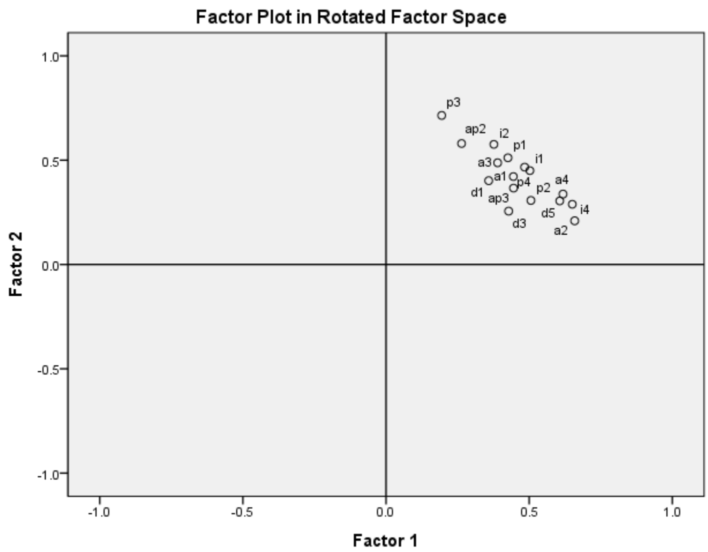

Figure 4 Factor plot of First Principle measure

Results of the factor analysis are presented in Table 11. The internal consistency measure of the First Principle was α=.92.

Table 11 Exploratory factor structure for First Principles of Instruction

Items	1
a4. In this course I was able to connect my past experience to new ideas and skills I was learning.	.687
a2. In this course I was able to recall, describe or apply my past experience so that I could connect it to what I was expected to learn.	.678
i1. I had opportunities in this course to explore how I could personally use what I have learned.	.675
p4. In this course I was expected to solve a variety of authentic problems that were organized from simple to complex.	.672
i2. I see how I can apply what I learned in this course to real life situations.	.664
p1. I was expected to perform a series of increasingly complex authentic problems in this course.	.658
d5. My instructor provided alternative ways of understanding the same ideas or skills.	.656
i4. In this course I was able to reflect on, discuss with others, and defend what I learned.	.632
p3. I was expected to solve authentic problems or to complete authentic tasks in this course.	.619
a3. My instructor provided a learning structure that helped me to mentally organize new knowledge and skills.	.615
a1. I engaged in experiences that subsequently helped me learn ideas or skills that were new and unfamiliar to me.	.612
p2. My instructor directly compared problems or tasks that we did, so that I could see how they were similar or different.	.582
ap2. I had opportunities to practice or try out what I learned in this course.	.582
ap3. My instructor gave me feedback on what I was trying to learn.	.576
d1. My instructor demonstrated skills I was expected to learn in this course.	.535
d3. My instructor gave examples and counterexamples of concepts that I was expected to learn.	.490
Eigenvalues	5.22
Total variance explained	42.78

Note: a represents activation; d represents demonstration; ap represents application; i represents integration; and p represents problem-centered principle.

All items of the First Principle measure strongly load on the same factor. This means that although the First Principle measure consists of five instructional design principles such as activation, demonstration, application, integration, and task-centered, students perceive them as overall course context. The results were consistent with EFA results conducted by Frick et al. (2010).

Reliability of measures

Cronbach's alpha reliability and number of items for each scale included in the current study are shown in Table 12. Cronbach's alpha ranged from .640 (surface cognitive strategy use) to .917 (the integration of FP). This indicates good internal consistency for each scale except surface cognitive strategy. The small number of items in surface strategy might affect decreasing the value of alpha.

Table 12 Cronbach's alpha reliability

Variables	Cronbach's alpha	Number of Items
FP	.917	16
Surface	.640	2
Deep	.880	9
Self-Regulated	.817	7
Intrinsic	.734	3
Extrinsic	.733	3

Descriptive statistics

Table 13 shows descriptive statistics of scores. In order to test statistical significance of the mean differences, an ANOVA was performed on student background characteristics and academic major. Gender differences were found in deep cognitive strategy use ($F(1, 1026)=13.362$, $p<.001$) and self-regulated strategy use ($F(1, 1038)=11.039$, $p<.001$). Males were engaged in learning at deeper levels and were more self-regulated than females. However, males and females did not differ on surface level engagement.

Table 13 Mean differences by students' characteristics and academic majors

			FP	Surface	Deep	Self-regulated	Intrinsic	Extrinsic
Gender	Male	Mean	3.60	4.89	4.65	4.68	4.82	5.51
		SD	0.57	1.21	0.95	0.97	1.12	1.02
	Female	Mean	3.41	4.89	4.44	4.49	4.44	5.56
		SD	0.56	1.10	0.85	0.87	1.13	1.01
Academic rank	Freshman	Mean	3.46	4.40	4.37	4.35	4.76	5.22
		SD	0.55	1.02	0.89	0.79	1.07	1.02
	Sophomore	Mean	3.43	4.87	4.42	4.47	4.50	5.54
		SD	0.54	1.19	0.88	0.93	1.09	1.06
	Junior	Mean	3.48	4.92	4.58	4.68	4.65	5.56
		SD	0.59	1.14	0.91	0.91	1.17	1.00
	Senior	Mean	3.55	4.96	4.56	4.55	4.54	5.59
		SD	0.60	1.11	0.89	0.90	1.16	0.97
Course type	Elective	Mean	3.48	4.84	4.53	4.56	4.61	5.52
		SD	0.60	1.14	0.91	0.90	1.14	1.03
	Core	Mean	3.47	5.00	4.48	4.55	4.53	5.61
		SD	0.54	1.18	0.90	0.96	1.14	0.98
Academic major	Business/ Economics	Mean	3.33	4.98	4.28	4.52	4.33	5.77
		SD	0.54	1.05	0.85	0.90	1.14	0.92
	Engineering	Mean	3.60	4.86	4.66	4.75	4.72	5.52
		SD	0.61	1.09	0.88	0.88	1.16	0.97
	Education	Mean	3.65	4.62	4.56	4.41	4.63	5.38
		SD	0.49	1.23	0.81	0.83	1.10	0.96
	Social Science	Mean	3.44	5.01	4.53	4.60	4.60	5.54
		SD	0.58	1.15	0.94	0.92	1.16	1.03
	Language	Mean	3.58	4.81	4.65	4.54	4.78	5.45
		SD	0.57	1.15	0.88	0.92	1.13	1.06
	Natural Science	Mean	3.29	4.88	4.34	4.44	4.32	5.57
		SD	0.56	1.21	0.95	0.99	1.01	1.14

A main effect of academic rank was significant for surface cognitive strategy use ($F(3, 1062)=3.921$, $p<.01$), deep cognitive strategy use ($F(3, 1034)=2.788$, $p<.05$), and self-regulated strategy use ($F(3, 1046)=4.481$, $p<.01$). A main effect of course type was also found for surface cognitive strategy use ($F(1, 1026)=4.349$, $p<.05$) . Students who enrolled in electives reported significantly less use of surface strategies than did the students in a core course. Sophomores and seniors reported significantly higher use of surface, deep, and self-regulated strategies than freshmen and juniors.

The differences regarding academic disciplines are represented by the following: the perception of FP, $F(5, 1037)=10.252$, $p<.001$; surface cognitive strategy use, $F(7, 1059)=5.525$, $p<.001$, deep cognitive strategy use, $F(7, 1028)=8.030$, $p<.001$, self-regulated strategy use, $F(7, 1040)=2.255$, $p<.05$, intrinsic orientation, $F(7, 1053)=10.233$, $p<.001$, and extrinsic orientation , $F(3, 1058)=3.449$, $p<.001$. Student's surface strategy use was highest in Business and Economics courses, deep strategy and self-regulated strategy use were highest in Engineering course. Students' perceptions of course implementation of First Principles were highest in Education course.

Means, standard deviations, and zero-order correlations for the variables used in the study are shown in Table 14. Students' perceptions of the First Principles were positively related with all scales of cognitive engagement and intrinsic motivation. The perception of the First Principles was strongly correlated with deep level engagement ($r=.624$, $p<.01$); moderately correlated with self-regulated learning ($r=.492$, $p<.01$); and weakly correlated with surface level engagement ($r=.286$, $p<.01$). Students' perception of the First Principles were not significantly correlated with extrinsic goal orientation (r=.049, p>.05), while they were significantly correlated with intrinsic goal orientation (r=.453, p<.01).

Table 14 Means, Standards Deviations, and Zero-order Correlations among observed variables

	Mean	SD	FP	Mean_FP	Surface	Deep	Self-Regulated	Intrinsic	Extrinsic
FP	3.483	0.576	1						
Mean_FP	3.482	0.276	.477**	1					
Surface	4.888	1.145	.286**	.033	1				
Deep	4.513	0.898	.624**	.280**	.496**	1			
Self-Regulated	4.558	0.911	.492**	.127**	.580**	.786**	1		
Intrinsic	4.581	1.139	.453**	.240**	.249**	.625**	.535**	1	
Extrinsic	5.544	1.014	.049	-.060*	.305**	.194**	.271**	.023	1

Note: **. P< 0.01; *. P< 0.05
FP represents individual perceptions of course implementation of First Principles
Mean_FP represents the mean scores of each course assigned to individual students.

Correlations between class-mean First Principles, computed by aggregating students' perceptions within each course are also presented in Table 14, showing that a different pattern of results. Most notably, overall correlation coefficients were smaller or no longer significant than those with the individual perceptions. The class-mean First Principles were still positively correlated with deep cognitive strategy use and self-regulated strategy use, but the correlation coefficients were substantially reduced from r=.624 to .280 and from r=.492 to .127, respectively. In contrast to the individual perceptions, the class-mean First Principles were not significantly correlated to surface cognitive strategy use (r=.033, p>.05), and negatively correlated with extrinsic goal orientation (r=-.060, p>.05).

The three indicators of cognitive engagement were positively related to extrinsic goal orientation as well as intrinsic goal orientation. In addition, the scales of surface engagement, deep engagement, and self-regulated learning were correlated to each other. Intrinsic goal orientation and extrinsic goal orientation were not significantly correlated.

Examining assumptions of Hierarchical Linear Models

For multilevel models, the following statistical assumptions are suggested (Ferron et al., 2004; Hofmann, 2000; Raudenbush & Bryk, 2002):

1. Homogeneity of level-1 variance: The errors within groups are assumed to have equal variance across groups.
2. Normality of level-1 and level-2 residuals: Level-1 residuals and level 2 residuals are assumed normally distributed.

HLM software allows for testing the homogeneity of level-1 variance. The chi-square test statistics were not significant at $p<.01$. The results showed that level-1 variance of each indicator are not significantly different among the courses, indicating the data sampled in this study is not likely to violate the assumption 1.

Table 15 Test Results for Homogeneity of Variance

	Surface	Deep	Self
Test of homogeneity	$\chi^2(28)= 34.370$	$\chi^2(28)= 29.976$	$\chi^2(28)=43.867$
	p=0.189	p=0.364	p=0.028

Normality of level-1 and level-2 residuals was assessed by the plots of the distribution of the residuals, displayed in Figure 5. The normal curves suggest that the residuals of each variable are possibly normal. Thus, normality assumption of level-1 residuals may hold with the sample of this study.

Surface Deep Self-regulated

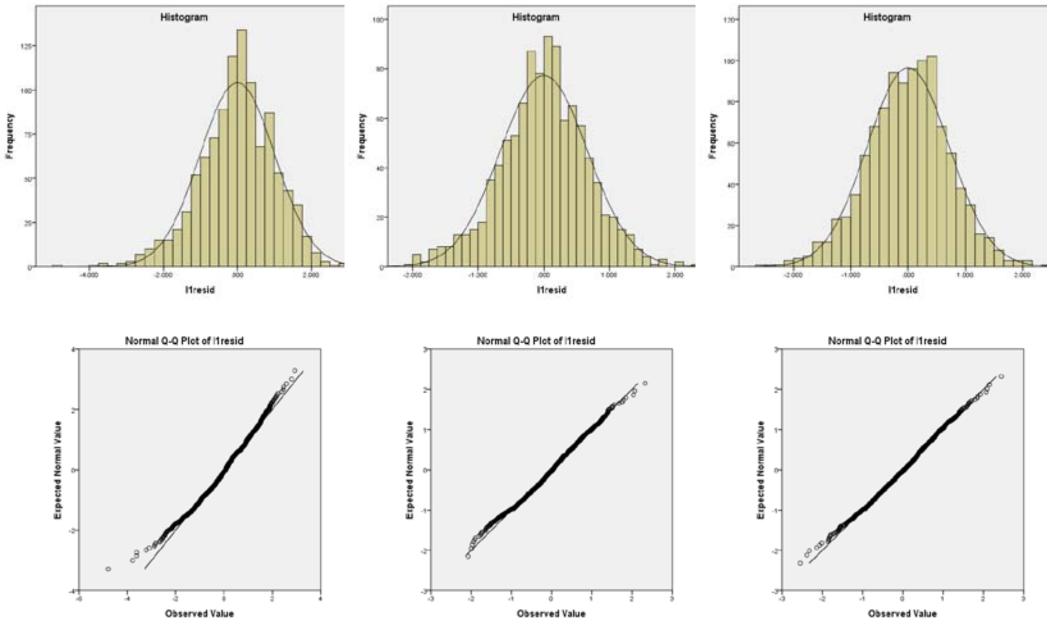

Figure 5 Testing of the normality of level-1 residuals

Surface Deep Self-regulated

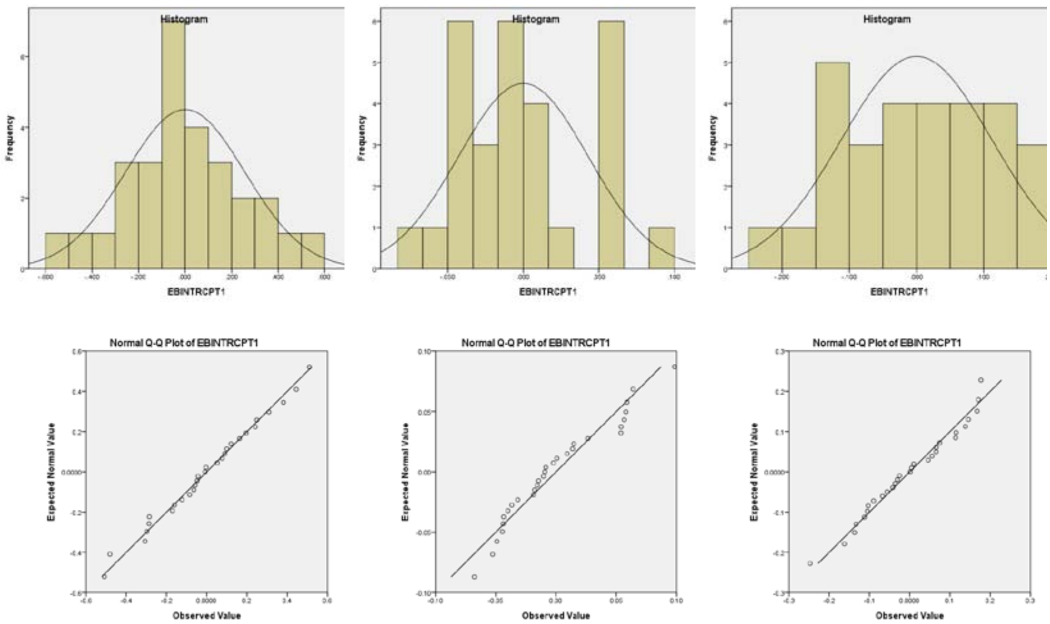

Figure 6 Testing of the normality of level-2 residuals

Figure 6 displays the histograms and Q-Q plots of the distribution o f level-2 residual. The graphs also show possible normal distribution for each variable this study sample.

In addition, the Skewness and Kurtosis values for level-1 and level-2 residuals fell between -.441 to .544 and between -.722 to .759, respectively. In general, a variable is reasonably close to normal if its Skewness and Kurtosis have values between -1.0 and +1.0. The Skewness and Kurtosis values indicate that the study sample of each variable approximately followed a normal distribution.

Table 16 Skewness and Kurtosis Statistics for level 1 and level 2 residuals

	Level-1 residual				Level-2 residual			
	Skewness		Kurtosis		Skewness		Kurtosis	
	Statistics	S.E.	Statistics	S.E.	Statistics	S.E.	Statistics	S.E.
Surface	-.441	.075	.759	.150	-.015	.434	-.317	.845
Deep	-.139	.076	.388	.152	.544	.434	-.392	.845
Self-regulated	-.144	.076	.338	.152	-.117	.434	-.722	.845

Overall, the test results of homogeneity and normality indicate that these data are not likely to violate the statistical assumptions required for hierarchical linear modeling.

Research questions

R1: Does student cognitive engagement vary across courses? This study hypothesized that cognitive engagement would be predicted by class-level predictor. For the hypothesis to be supported there must be variation in student engagement at the class level. Therefore, as a precondition of further analyses, research question 1 investigates the amount of between-group variance in cognitive engagement by partitioning the total variance in the cognitive engagement into the within-group and between-group components. A null model does not include any predictor, and allows for assessing variability among courses. The null model is conceptually equivalent to one-way analysis of variance (ANOVA). The following equation represents the null model.

$$Cognitive\_engagement_{ij} = \beta_{0j} + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

β_{0j} is mean for each cognitive engagement indicator for course j. γ_{00} is grand mean of each indicator (intercept). r_{ij} indicates within-course variance and u_{0j} indicates between-course variance in each cognitive engagement indicator.

Table 17 shows that the average of each cognitive engagement indicator (γ_{00}) was 4.850, 4.549, and 4.556, respectively. The chi-square test statistics for u0 showed that the between-course variance is significant for each outcome, which means students' use of surface cognitive strategies, deep cognitive strategies and self-regulated strategies vary across courses.

Table 17 Null model

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.850^{***}	0.067	4.549^{***}	0.057	4.556^{***}	0.043
Variance						
γ	1.234		0.734		0.799	
u0	0.093^{***}		0.072^{***}		0.031^{***}	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05

To assess a ratio of the between-course variance in each outcome to the total variance, Intraclass Correlation Coefficient (ICC) was analyzed based on the variance components. The following equations were used to calculate the ICC:

$$ICC = \frac{Between\ course\ variance}{Within\ course\ variance\ +\ Between\ course\ variance}$$

$$= \frac{u0}{\gamma +\ u0}$$

The ICC of surface strategy use was .070, the ICC of deep strategy use was .089, and the ICC of self-regulated strategy use was .037. The ICCs indicate that 7.0% of the variance in surface strategy use, 8.9% of the variance in deep strategy use, and 3.7% of the variance in self-regulated strategy use is accounted for by course-level characteristics. Those results allow further analyses using HLM approach.

R2: Is there a significant relationship between students' perceptions of the degree to which First Principles are implemented in courses and their cognitive engagement? Research question 1 confirmed that there was significant between-course variance in each cognitive engagement measure. Research question 2 investigates whether class-level FP accounts for the between-course variance in cognitive engagement. Four HLM models were analyzed for each cognitive engagement indicator as outcome variables to account for the effects of student variables and academic majors and ultimately to yield unique contribution of class-level FP. The first model included only class-level FP and the aggregated students' perceptions at course-level as a level 2 predictor; the second model added student variables as level-1 predictors; the third model added academic major as level-2 predictors, and the final model added both student-level variables and academic majors. For each model, pseudo-R^2 was presented to assess how much outcome variance is explained by the model's predictors. HLM does not provide R^2; therefore, pseudo-R^2 was computed by comparing the variance components to those of the null model (Singer & Willett, 2003). Pseudo-R^2 was presented for both within- and between-course variances.

The first model tested the effect of course-level FP with the following equation:

$$Cognitive\_engagement_{ij} = \beta_{0j} + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(MEAN\_FP_j) + u_{0j}$$

Table 18 Multilevel Analysis with Class-level FP (Model 1)

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.852***	0.067	4.565***	0.033	4.568***	0.038
Class level						
Mean_FP	0.111	0.222	0.905***	0.135	0.417**	0.038
Variance						
γ	1.234		0.733		0.799	
u0	0.097***		0.012*		0.019**	
Pseudo-R^2						
R_1^2	0.000		0.002		0.000	
R_2^2	-0.048		0.830		0.389	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05
R_1^2 indicates within-course variance explained; R_2^2 indicates between-course variance explained.

Table 18 indicates that class-level FP is significantly related to students' use of deep cognitive strategies (γ_{01}=.905, $t(27)$=140.321, p<.001) and self-regulated strategies (γ_{01}=.417, $t(27)$=121.353, p<.001). However, the integration of FP is not significantly related to the use of surface cognitive strategies (γ_{01}=.111, $t(27)$=.498, p>.05). The results suggest that, on average, a standard deviation increase in the class-level FP score increase students' deep cognitive strategy use by .905 standard deviation and students' self-regulated strategy use by .417 standard deviation.

R_2^2 was computed to assess how much outcome variance is explained by class-level FP using the following equation:

$$R_2^2 = \frac{u0\ (Null\ model) - u0\ (Model\ 1)}{u0\ (Null\ model)}$$

Using the formula, for example, R_2^2 for deep strategy use is:

$$R_2^2 = (0.072 - 0.012)/0.072 = 0.830$$

R^2 statistics indicate that class-level FP accounted for 83.0% of the between-course variance in deep cognitive strategy use and 38.9 % of the between-course variance in self-regulated strategy use. However, R_2^2 for surface strategy use indicates negative magnitude. This means the addition of class-level FP increased the between-course variance in surface strategy use. According to Singer and Willet (2003), the estimated proportion of variance explained in traditional OLS regression cannot be negative value; however, in the multilevel model, this is likely to happen when most of the variation in outcome is accounted for exclusively by either level 1 or level 2 predictors. Thus, it could be argued that students' surface cognitive strategy use is predicted by individual-level variables rather than class-level variables.

The chi-square test associated with the residual variance in the intercepts (u0) across courses indicates that there is still significant variance remaining in this parameter across courses: u0=.097, $\chi^2(27)= 96.188$, $p<.001$ for surface cognitive strategy use; u0=.012, $\chi^2(27)= 42.075$, $p<.05$ for deep cognitive strategy use; and u0=.019, $\chi^2(27)= 49.692$, $p<.01$ for self-regulated strategy use.

The next step of analyses was conducted to investigate whether the relationship between class-level FP and student cognitive engagement is significant when accounting for the effects of student variables. Gender, academic rank, course type and intrinsic and extrinsic goal orientation were entered in the model.

$$Cognitive\_engagement_{ij} = \beta_{0j} + \beta_{1j}*(Rank_{ij}) + \beta_{2j}*(Gender_{ij}) + \beta_{3j}*(Course\_type_{ij}) + \beta_{4j}*(Intrinsic\_goal_{ij}) + \beta_{5j}*(Extrinsic\_goal_{ij}) + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(MEAN\_FP_{j}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

Table 19 indicates that intrinsic and extrinsic goal orientation were significant predictors of the cognitive engagement indicators, although the magnitudes of the coefficients for each indicator were different.

Extrinsic goal orientation was the strongest predictor of surface level engagement (γ_{50} =.317, $t(1036)=13.015$, $p<.001$), and intrinsic goal orientation was the strongest predictor of both deep level engagement (γ_{40} =.455, $t(1036)=17.567$, $p<.001$), and self-regulated strategy use (γ_{40} =.324, $t(1036)=15.490$, $p<.001$). Class-level FP was a significant predictor of deep level engagement (γ_{01} =.437, $t(27)=4.079$, $p<.001$), but it was no longer significant for self-regulated strategy use (γ_{01} =-.024, $t(27)=-.174$, $p<.05$). Academic rank was also a significant predictor of deep level engagement (γ_{10} =.070, $t(1036)=3.463$, $p<.001$).

Table 19 Multilevel Analysis with Class-level FP and Student Variables (Model 2)

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.842***	0.064	4.535***	0.027	4.530***	0.035
Student level						
Gender	0.043	0.073	-0.052	0.058	-0.028	0.057
Academic_rank	0.070	0.036	0.070***	0.020	0.041	0.026
Course_type	-0.129	0.073	-0.002	0.040	0.021	0.053
intrinsic	0.261***	0.037	0.455***	0.026	0.424***	0.027
extrinsic	0.317***	0.024	0.160***	0.021	0.220***	0.018
Class level						
Mean_FP	-0.077	0.229	0.437***	0.107	-0.024	0.135
Variance						
γ	1.058		0.452		0.531	
u0	0.089***		0.009*		0.022***	
Pseudo R^2						
R_1^2	0.143		0.384		0.335	
R_2^2	0.047		0.878		0.296	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05
R_1^2 indicates within-course variance explained; R_2^2 indicates between-course variance explained.

When adding these student-level variables, the effect of class-level FP on deep strategy use was substantially reduced (from beta coefficient of .905 to .437) and the significant effect of class-level FP on self-regulated strategies was diminished (from .417 to -.024). The effect of class-level FP on surface strategy use was still not significant. The results indicated that some of the variance in cognitive engagement could have resulted from the differences in students' characteristics. In this model, students' intrinsic and extrinsic goals were strong predictors of cognitive engagement outcomes. Thus, the addition of student-level predictors reduced the within-course variance in cognitive engagement outcome. The student-level predictors account for 14.2% of the within-course variance in surface strategy use, 38.40% in deep strategy use, and 33.52% in self-regulated strategy use. This model better accounted for both within- and between-course variations than the model with class-level FP.

The third step of analyses was conducted to account for the effects of academic majors with the following equations.

$$Cognitive\_engagement_{ij} = \beta_{0j} + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Engineering_j) + \gamma_{02}*(Education_j) + \gamma_{03}*(Social\_Science_j) + \gamma_{05}*(Natural_j) + \gamma_{06}*(MEAN\_FP_j) + u_{0j}$$

Coefficients from the HLM analyses present a very similar picture with the results of initial analyses (Model 1). Without student-level variables, the effects of class-level FP on cognitive engagement were similar to those of Model 1.

The results, displayed in Table 20, indicate that the relationships between class level FP and both deep engagement and self-regulatory strategy use are still significant when accounting for academic major. There were modest effects on students’ cognitive engagement given their academic majors. As shown in Table 22, only in Education, average scores of surface and self-regulatory strategy use significantly lower than the scores of other majors. When comparing R^2 statistics to those of Model 1, between-course variance explained for deep strategy use was reduced (from R_2^2 of .830 to .807), and between-course variance explained for surface strategy use was increased (from R_2^2 of .380 to .510). This means that the model with class-level FP and academic majors did better explain students’ use of self-regulated strategies, but did not explain deep strategy use. Without student-level variables, R_2^2 for surface strategy use still indicated negative magnitude.

Table 20 Multilevel Analysis with class-level FP and academic majors (Model 3)

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.998***	0.143	4.475***	0.071	4.630***	0.098
Class level						
Mean_FP	0.255	0.211	0.888***	0.129	0.471***	0.110
Engineering	-0.104	0.209	0.132	0.086	0.092	0.088
Education	-0.483*	0.226	-0.011	0.085	-0.289*	0.126
Social Science	0.002	0.194	0.131	0.108	-0.013	0.102
Language	-0.198	0.181	0.150	0.118	-0.096	0.120
Natural Science	-0.086	0.235	0.081	0.108	-0.078	0.103
Variance						
γ	1.233		0.733		0.798	
u0	0.098***		0.014*		0.015*	
Pseudo R^2						
R_1^2	0.001		0.001		0.002	
R_2^2	-0.054		0.807		0.510	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05. Business/Economics is a reference group.
R_1^2 indicates within-course variance explained; R_2^2 indicates between-course variance explained.

The final HLM analyses were conducted to investigate whether the relationships between class-level FP and student cognitive engagement are significant when accounting for both student-level variables and academic majors. Coefficients from the HLM analyses are summarized in Table 21.

$$Cognitive\_engagement_{ij} = \beta_{0j} + \beta_{1j}*(Rank_{ij}) + \beta_{2j}*(Gender_{ij}) + \beta_{3j}*(Course\_type_{ij}) + \beta_{4j}*(Intrinsic\_goal_{ij}) + \beta_{5j}*(Extrinsic\_goal_{ij}) + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Engineering_{j}) + \gamma_{02}*(Education_{j}) + \gamma_{03}*(Social\_Science_{j}) + \gamma_{05}*(Natural_{j}) + \gamma_{06}*(MEAN\_FP_{j}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

The results suggest that the score on surface cognitive strategy use was higher when students enrolled in a core course rather than in an elective course, and when intrinsic and extrinsic goal orientations are higher. Students in education courses reported lower levels of surface cognitive strategy use than in other courses. The strongest predictor of surface cognitive strategy use was extrinsic goal orientation (γ_{50} =.315, t(1036)=13.220, p<.001).

The score on deep cognitive strategy use was higher when students are in higher academic years, and when intrinsic and extrinsic goal orientations are higher. Students in Social Science, Natural Science and Language courses reported higher levels of deep engagement. Class-level FP was also a positive predictor of deep levels of engagement, even after controlling for student-level variables. That is, deep cognitive strategy use was clearly a function of between-course variation in the degree to which First Principles are implemented in courses. Intrinsic goal orientation and class-level FP were strong predictors of deep cognitive strategy use (γ_{40} =.453, $t(1036)$=17.712, p<.001 and γ_{06} =.435, $t(22)$=4.417, p<.001, respectively).

Table 21 Multilevel Analysis with Level 1 and Level 2 predictor (Model 4)

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.836	0.057	4.535	0.027	4.526	0.029
Student level						
Gender	0.072	0.071	-0.061	0.062	0.010	0.058
Academic_rank	0.067	0.037	0.082***	0.022	0.035	0.025
Course_type	-0.178*	0.073	0.006	0.039	-0.033	0.046
intrinsic	0.262***	0.036	0.453***	0.026	0.425***	0.027
extrinsic	0.315***	0.024	0.162***	0.020	0.217***	0.019
Class level						
Mean_FP	0.064	0.223	0.435***	0.099	0.055	0.114
Engineering	-0.048	0.171	0.126	0.072	0.111	0.072
Education	-0.482*	0.225	0.096	0.110	-0.294**	0.103
Social Science	0.031	0.160	0.185**	0.064	0.015	0.072
Language	-0.137	0.142	0.171*	0.077	-0.098	0.090
Natural Science	-0.014	0.188	0.216**	0.075	0.024	0.119
Variance						
γ	1.058		0.452		0.532	
u0	0.081***		0.008*		0.013*	
Pseudo R^2						
R_1^2	0.142		0.384		0.335	
R_2^2	0.132		0.890		0.578	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05. Business/Economics is a reference group.
R_1^2 indicates within-course variance explained; R_2^2 indicates between-course variance explained.

The score on self-regulated strategy use was higher when intrinsic goal orientations and extrinsic goal orientations were higher. Students in education courses reported lower levels of self-regulated strategy use rather than students in other courses. The strongest predictor of self-regulated strategy use was intrinsic goal orientation (γ_{40} =.425, *t*(1036)=19.572, p<.001).

When comparing this model to Model 3, the effect of class-level FP on deep strategy use was reduced again (from beta coefficient of .888 to .435) and the effect of class-level FP on self-regulated strategies was no longer significant (from .471 to .055). The effect of class-level FP on surface strategy use was still not significant. R^2 statistics show that the final model better accounted for within- and between-course variances than the three models –that is, cognitive engagement outcomes are better predicted by both student- and course-level variables.

Again, the addition of student-level variables made the effect of class-level FP on cognitive engagement diminished. The results of subsequent model is implies that the effects of class-level FP on engagement are likely to be indirect -that is it is possible to be mediated by student-level variables. As students' intrinsic and extrinsic goal orientations were most strongly related to each cognitive engagement outcome, research question 3 examined a causal mechanism that the effects of class-level FP on cognitive engagement operate through students' goal orientations.

R3: Is the relationship between students' perceptions of the degree to which First Principles are implemented in courses and student cognitive engagement mediated by student goal orientation? The next sets of analyses were conducted to test research question 3, cross-level mediation that students' goal orientations mediate the effects of class-level FP on cognitive engagement. Using the procedure outlined by Zhang et al. (2004), three steps of analyses were performed.

The first step in testing the mediation effect was to establish a relationship between class-level FP (level 2 predictor) and cognitive engagement (level 1 outcome).

$$Cognitive\_engagement_{ij} = \beta_{0j} + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(MEAN\_FP_j) + u_{0j}$$

The analyses were conducted in response to research question 2 and the coefficients are presented in Table 18. The significant relationship was found between class-level FP and deep cognitive strategy use and between class-level FP (γ_{01}=.905, $t(27)$=140.321, p<.001) and self-regulatory strategy use (γ_{01}=.417, $t(27)$=121.353, p<.001). However, there was no significant relationship between class-level FP and surface strategy use (γ_{01}=.111, $t(27)$=.498, p>.05). According to Baron and Kenney (1986), this non-significant relationship between class-level FP and surface level of engagement implies that there is no effect to mediate, thus an indirect effect would not exist. However, Rucker et al. (2011) suggest that the predictor exerts a stronger influence on the mediator than on the outcome, which could lead to a significant indirect effect even when the effect of the predictor on the outcome is not significant. Therefore, further analysis for surface level of engagement also commenced.

The second step was to establish a relationship between class-level FP (level 2 predictor) and individual goal orientation (level 1 mediator). The equations in this step were as follows.

$Gol\_orientations_{ij} = \beta_{0j} + r_{ij}$

$\beta_{0j} = \gamma_{00} + \gamma_{01}(MEAN\_FP_j) + u_{0j}$

The results indicate that there was a significant effect of class-level FP on students' intrinsic goal orientation (γ_{01}=.970, $t(27)=4.462$, $p<.001$), but not for extrinsic goal orientation (γ_{01}=-.216, $t(27)=-1.440$, $p>.05$). Since the significant relationship between class-level FP and extrinsic goal orientation did not exist, further analysis was not justified. It implies that extrinsic goal orientation is not a mediator of the relationship between class-level FP and cognitive engagement.

Table 22 Multilevel Analysis with Level 2 predictor and Level 1 mediator

	Intrinsic		Extrinsic	
	Coefficient	SE	Coefficient	SE
Intercept	4.650***	0.050	5.512***	0.040
Class level				
Mean_FP	0.970***	0.217	-0.216	0.150
Variance				
γ	1.189		1.003	
u0	0.037***		0.023**	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05

The final step in analysis was to show the effect of class-level FP (level 2 predictor) on cognitive engagement (level 1 outcome) after adding students' goal orientation (level 1 mediator). The equation in the final step is represented below.

$Cognitive\_engagement_{ij} = \beta_{0j} + \beta_{1j}(Intinsic_{ij}) + \beta_{2j}(Extrinsic_{ij}) + r_{ij}$

$\beta_{0j} = \gamma_{00} + \gamma_{01}(MEAN\_FP_j) + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

Table 23 shows the paths coefficients between goal orientations and cognitive engagement and between class-level FP and cognitive engagement.

Table 23 Multilevel Analysis with Level 2 predictor, Level 1 mediator and Level 1 outcome

	Surface		Deep		Self-regulated	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	4.844***	0.065	4.541***	0.024	4.541***	0.035
Student level						
intrinsic	0.261***	0.035	0.459***	0.024	0.426***	0.026
extrinsic	0.315***	0.022	0.166***	0.021	0.219***	0.019
Class level						
Mean_FP	-0.093	0.225	0.465***	0.102	0.037	0.134
Variance						
γ	1.051		0.446		0.523	
u0	0.094***		0.006*		0.023***	

Note: ***. P< 0.001; **. P< 0.01; *. P< 0.05

For illustration of the results from all three steps, the following path model (Figure 7) is presented. Standardized β weight represents the path coefficients.

The results from the mediation analysis of surface level engagement indicate that there was no previously significant effect of class-level FP on students' use of surface cognitive strategies, but the effect was mediated by intrinsic goal orientation. The results suggest that class-level FP increases intrinsic goal orientation (.970, p<.001), which in turn increase surface cognitive strategy use (.261, p<.001).

Previously a significant relationship between class-level FP and a deep level of engagement was established (.905, p<.001). The subsequent analysis supported a partially mediated relationship between class-level FP and a deep level of engagement through intrinsic goal orientation. In the presence of goal orientations, the effect of class FP was still significant, but with a smaller coefficient than that of step 1 (from beta coefficient of .905 to .465). This addition of goal orientation led to a significant reduction in the relationship between class-level FP and deep engagement; therefore, intrinsic goal orientation is a partial mediator because the class-level FP coefficient decreased after the effects of goal orientation was partial out but is still significant. The results suggest that class-level FP directly increase students’ use of deep cognitive strategy use as well as increases intrinsic goal orientation (.970, $p<.001$); further, the increased intrinsic goal orientation affects increased levels of deep cognitive strategy use (.459, $p<.001$).

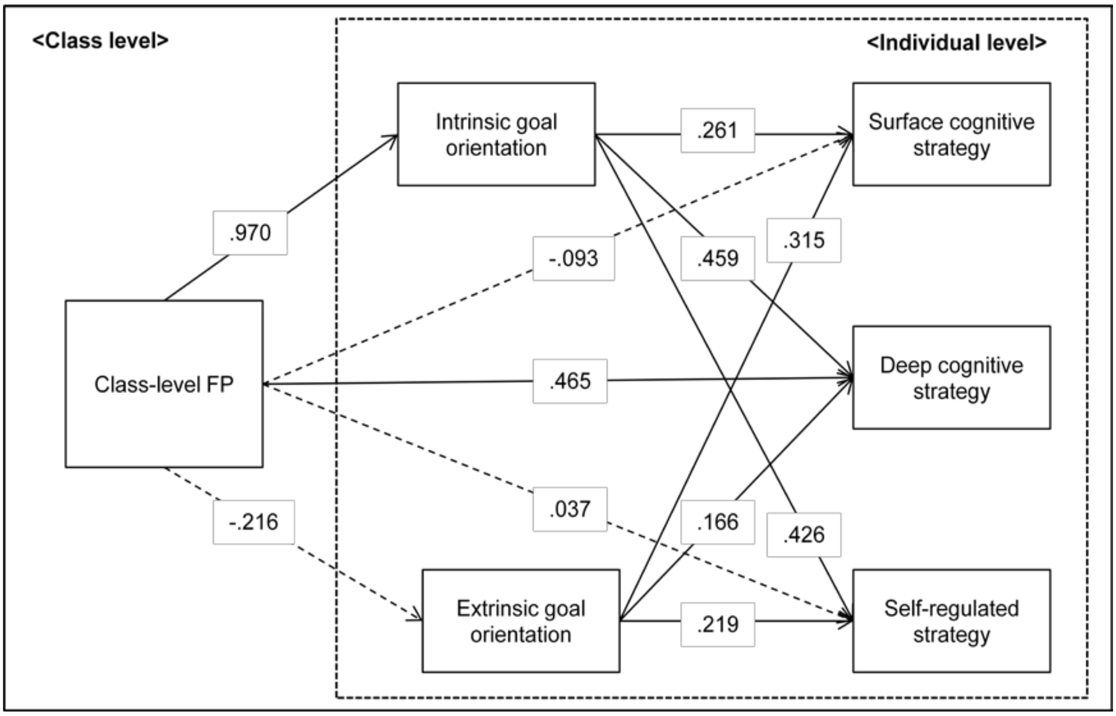

Figure 7 Class-level FP to Cognitive Engagement Mediation Model
Note: Solid lines represent significant paths; Dotted lines represent nonsignificant paths at $p<.05$

The mediation relationship between class-level FP and self-regulated strategy was also established. There was a significant relationship between class-level FP and self-regulatory strategies. When goal orientations were included in the model, the relationship between class-level FP and self-regulatory strategies was not significant 1 (from beta coefficient of .417 to .037). Intrinsic goal orientation would be considered a complete mediator because in the presence of intrinsic goal orientation, the effect of class-level FP was no longer significant. Thus, the overall significant relationship between class-level FP and self-regulated strategy use was due to the effect of class-FP on intrinsic goal orientation. The results suggest that class-level FP affects intrinsic goal orientation (.970, p<.001), which in turn affects higher levels of deep cognitive strategy use (.426, p<.001).

The direct, indirect and total effects of class-level FP on each engagement outcome through intrinsic goals are presented in Table 23.

Table 24 Direct, indirect, and total effects of class-level FP on cognitive engagement

	Surface	Deep	Self-regulated
Direct effect	-.093	.465***	.037
Indirect effect	.253***	.445***	.413***
Total effect	.111	.905***	.417**

Note: ***. P< 0.001; **. P< 0.01

As explained in Chapter 3, the indirect effects were calculated by multiplying the path coefficients between class-level FP and intrinsic goal orientation and between intrinsic goal orientation and engagement outcome. The significance of the mediation effect was tested using a Sobel z statistic (Sobel, 1982). In this mode, the indirect effect of class-level FP on surface strategy use was .253 (.970 × .261; Sobel z =326, p<.001), the indirect effect on deep strategy use was .445 (.970 × .459; Sobel z=3.648, p<.001), and the indirect effect on self-regulated strategy use was .413 (.970 × .426; Sobel z=3.624, p<.001). In single-level mediation models, the sum of the direct and indirect effects is equivalent to the total effect, however in multi-level models, the sum of the direct and indirect effects and the total effects can produce different values (Zhang et al., 2009).

In summary, the influences of class-level FP are transmitted to cognitive engagement through individual intrinsic goal orientation. Class-level FP does not directly influence surface strategy use and self-regulated strategy use without going through intrinsic goal orientation. Extrinsic goal orientation does not act as a mediator.

Chapter 5 Discussion

This study attempted to verify Merrill's claim that the extent to which First Principles of Instruction are implemented in a course determines effectiveness, efficiency and student engagement. Despite the theoretical and practical importance of First Principles of Instruction, few attempts have been made to empirically test the relationships of the principles with instructional outcomes. This study focuses on cognitive engagement, a specific form of learning engagement, as an outcome of instruction that implements First Principles.

Specifically, this study attempted to answer the question of whether the degree to which First Principles of Instruction are implemented in courses indeed makes a difference in student cognitive engagement. Therefore, the focus of this study is on between-course differences in the implementation of First Principles associated with the levels of cognitive engagement; thus, HLM approach was applied. In addition, the model employed students' goal orientations as a mediator of the association, since goal orientations appeared to be key predictors of cognitive engagement in prior theoretical and empirical findings.

One thousand and seventy (1,070) students from twenty-nine courses in a Korean university were surveyed. Participants were asked to answer questions about their perceptions of courses in terms of course-level implementation of First Principles, the intrinsic and extrinsic goal orientations they endorsed in the courses, and the use of three cognitive engagement outcomes (surface, deep, and self-regulatory learning strategy).

Findings from the study were presented in Chapter 4. This chapter summarizes significant findings of this study, discusses the implications of these findings and concludes with a discussion of the implications for future study.

Significant Findings

Between- and within-course variance in cognitive engagement

Overall, this study focused on cross-level relationships between the implementation of First Principles at the course-level and students' individual cognitive engagement. For the relationships to be supported, there must be significant variation in cognitive engagement across courses; thus, research question 1 investigated whether student cognitive engagement varied across courses. The partitioning of variance across the levels is a significant first step in conducting multilevel analyses. The proportion of variance at the student- and course–level provides an indication of how the scores on the cognitive engagement measures are related to student characteristics or course characteristics.

The results of HLM analysis showed that the scores on each cognitive engagement outcome significantly differed among courses. Seven percent of the variance in surface strategy use, 8.9% of the variance in deep strategy use, and 3.7% of the variance in self-regulated strategy use resides between courses. Considerably less between-course variance in self-regulated strategy use than in surface or deep strategy use appeared. The remaining 93.0% of the variance in surface strategy use, 91.1% of the variance in deep strategy use, and 96.3% of the variance in self-regulated strategy use resides between students within the courses.

According to Snijders and Bosker (1993), in most educational settings, typically from 5% to 20% of variance in student-level outcomes arises due to between-course or between school differences. The findings in this study are similar to those found in previous HLM studies that confirmed between-course variances in cognitive engagement outcomes. Nie and Lau (2010) reported that 7.6% of variance in surface cognitive strategy use and 3.5% of variance in deep cognitive strategy use attributable to between-course in their study with a sample of 3000 grade 9 students from 108 classes in Singapore. Wolters' (2004) study with 525 junior high school students from 38 mathematics classes also reported that 10% or less of the variance in each cognitive and self-regulated strategy use outcome could be attributed to between-class differences. Thus, this study's results related to course variance are similar to other studies investigating class-level variables.

This evidence justified continued analysis of the student- and course-level variables under investigation that were expected to account for the between- and within-course variance.

Explaining variances in cognitive engagement

Subsequent HLM analysis found that the degree to which First Principles are implemented in courses as a class-level predictor ***did*** account for the variance in students' deep cognitive strategy use and self-regulated strategy use, but ***not*** for the variance in surface cognitive strategy use. That is, greater implementation of First Principles in courses was significantly predictive of higher uses of students' deep levels of engagement, but not a significant predictor of the surface levels of engagement. It would be expected that a standard deviation change in the class-level

FP score would change deep cognitive strategy use by .905 standard deviation and self-regulated strategy use by .417 standard deviation.

When student-level variables such as gender, academic rank, course type and goal orientations are accounted for, the predictability of class-level implementation of First Principles on deep and self-regulated strategy use was substantially reduced. The effect of First Principles on ***deep strategy use*** was reduced by about half (from beta coefficient of .905 to .437), but still remained significant when controlling student-level predictors. The significant effect of First Principles on ***self-regulated strategy*** was diminished (from .417 to -.024) and the effects of goal orientations were only significant predictors of self-regulated strategy. The effect of First Principles on ***surface strategy use*** remained not significant (from .111 to -.077). The ***strongest predictor of surface strategy use was extrinsic goal orientation*** and the ***strongest predictor of both deep strategy use and self-regulated strategy use was intrinsic goal orientation***.

This pattern of findings suggests that some of the variances in cognitive engagement could have resulted from between-course differences in the integration of First Principles, but the influence may be indirectly through students' goal orientations. In other words, the results provide evidence for the role of goal orientations as a mediator between class-level implementation of First Principles and cognitive engagement. These findings point to the need to better understand a causal mechanism by which the effect of First Principles operates through student goal orientations. For example, it is likely that in a course integrating more First Principles students endorse higher levels of goal orientations, and then the levels of goal orientations influence students' adoption of cognitive and self-regulated strategies in learning processes.

This suggestion on the mediating role of goals was made in previous Wolters' (2004) study which showed a similar pattern of results. In Wolters' (2004) study, when student personal goal orientations were present, the strength of the relationship between course goal structure and cognitive engagement significantly reduced. Wolters (2004) did not test a mediational relationship; rather, he suggested that further analysis should extend the results by examining a causal mechanism among learning environmental factors, individual factors, and cognitive engagement outcomes.

Variance components of the outcome variables and variances explained by student- and class-level predictors are presented in Table 24 and provide insight into the relative importance of learning environment and goal orientations in predicting students' cognitive engagement. Variance components represent "the portion of the outcome variation unexplained by a model's predictors" (Singer & Willet, 2003, p. 103). Within-course variance represents the amount of variance residing within courses, and between-course variance represents the amount of variance attributable to between-course differences. Within-course variance explained and between-course variance explained represent the percentage of each level variance in outcome that is accounted for by the predictors entered in the model.

In the case for the courses sampled in this study, 7.0% of the variance in surface strategy use, 8.9% of the variance in deep strategy use, and 3.7% of the variance in self-regulated strategy use are related to the different characteristics among the courses. The remaining variances in each cognitive engagement measure are related to student characteristics.

Table 25 Variance components and variance explained by predictors

	No predictor (null model)			Class-level FP			Goal orientations & class-level FP		
	surface	deep	self	surface	deep	self	surface	deep	self
Within-course variance	1.234	0.734	0.799	1.234	0.733	0.799	1.033	0.439	0.513
Between-course variance	0.093	0.072	0.031	0.097	0.012	0.019	0.094	0.006	0.023
Within-course variance explained				0.01%	0.19%	0.01%	16.29%	40.19%	35.82%
Between-course variance explained				-4.79%	83.04%	38.87%	-1.32%	91.38%	25.71%

When class-level FP was added as a predictor, the between-course variances in deep and self-regulated strategy use were substantially smaller than in the null model. The decline in variance components suggests that "the predictors make a big difference; a small, or zero, decline suggests that they do not. To assess these declines on a common scale, we compute the proportional reduction in residual variance as we add predictors" (Singer & Willet, 2003, p. 103). The estimated proportion of variance between courses explained by the model with class-level FP indicates that 83.04% of the between-course variance in deep cognitive strategy, and 38.87% of the between-course variance in self-regulated strategy, is accounted for by class-level implementation of First Principles. However, the addition of class-level FP increased the variance component of surface strategy use, thus the estimated proportion of variance explained by the model with class-level FP indicates negative magnitude. As explained in Chapter 4, the estimated proportion of variance explained in traditional OLS regression cannot be negative value; however, in the multilevel model, this is likely to happen when most of the variation in outcome is accounted for exclusively by either level 1 or level 2 predictors (Singer & Willett, 2003). Thus, it could be argued that students' surface cognitive strategy use is predicted by individual-level variables rather than class-level variables. For example, in a course, students' use of surface cognitive strategy is predicted by their adoption of goals rather than learning environmental factors such as the integration of instructional design principles.

The HLM model including both goal orientations and class-level FP substantially reduced both within- and between-course variances in the cognitive engagement outcome. The results indicate that 16.29% of the within-course variance in surface strategy, 40.19% of the within-course variance in deep strategy, and 35.82% of the within-course variance in self-regulated strategy is accounted for by individual goal orientations. Also, 91.38% of the between-course variance in deep strategy, and 25.71% of the between-course variance in self-regulated strategy is accounted for by class-level implementation of First Principles.

Mediating effects of goal orientation on the relationships between the integration of FP and cognitive engagement

As noted in the previous section, HLM analysis with class-level FP and student-level predictors has shown that it is possible that the effects of the implementation of First Principles were indirect in nature, mediated by students' goal orientations. That is, it is likely that if a course integrates more First Principles, then students endorse higher levels of goal orientations. Students' goal orientations, in turn, affect student engagement in learning. Therefore, research question 3 investigated cross-level mediation that students' goal orientations mediate the effects of First

Principles on cognitive engagement, and the results clearly demonstrated that the influence of First Principles on cognitive engagement outcomes was indirect. (see Figure 7 in Chapter 4)

Overall, class-level implementation of First Principles does not directly affect surface strategy use and self-regulated strategy use. Rather, the effect of First Principles appears to be mediated by intrinsic goal orientations. That is, class-level implementation of First Principles does not directly increase the levels of surface and self-regulated strategy use, but it increases the levels of intrinsic goal orientation and the increased levels of intrinsic goal orientation affect the higher levels of surface and self-regulated strategy use. If a course implements more instructional design principles such as activation, demonstration, application, integration, and task-centered principles, then students are likely to focus on mastery and learning of course materials. As a result of students' endorsement of mastery and learning goals, they tend to report more use of surface strategies and self-regulated strategies.

As for deep strategy use, class-level implementation of First Principles affects deep cognitive strategy use directly as well as indirectly through intrinsic goal orientation. This suggests that courses with greater implementation of First Principles increase students' use of deep cognitive strategy as well as increase the levels of intrinsic goal orientation, which in turn affects increased levels of deep cognitive strategy use. The direct effect of First Principles was slightly stronger than the indirect effect. As a course integrates more First Principles, students are likely to engage in the course with the purpose of mastering the course materials. This in turn encourages students to use more deep cognitive strategies such as elaboration, organization and critical thinking.

In addition, the path between class-level FP and goal orientations indicated that class-level implementation of First Principles was positively associated with students' intrinsic goal orientation, but not with extrinsic goal orientation. If a course implements more instructional design principles, students engage in the course with the purpose of mastery and learning (intrinsic orientation) rather than the purpose of competing with others and of demonstrating their abilities. Thus, the mediating relationship through extrinsic goal orientation was not established. This suggests that course-level implementation of First Principles affects cognitive engagement as well as intrinsic goal orientation. Thus, intrinsic goal orientation also appeared to be context dependent, wherein learning environmental characteristics such as course-level instructional practices play an important role in students' intrinsic pursuits.

Unlike most previous studies (Dupeyrat & Mariné, 2005; Greene & Miller, 1996; Lyke & Young, 2006; Walker et al, 2006), the paths between goal orientations and cognitive engagement outcomes showed that both intrinsic and extrinsic goal orientations were positively related to the three indicators of cognitive engagement, although the strengths of relationships with each indicator varied. Extrinsic goal orientation was more strongly related to surface strategy use, and intrinsic goal orientation was more strongly related to deep strategy use and self-regulated strategy use. This means that students who endorse both intrinsic and extrinsic goals use a higher level of surface strategies, deep strategies as well as self-regulated strategies.

Student variables and academic major as predictors of cognitive engagement

ANOVA results showed that male students were engaged in learning at deeper levels and were more self-regulated than female students. However, male and female students did not differ on surface level engagement. The relationships between gender and students' learning strategy use have been a concern of cognitive engagement researchers, but the results seem to be inconclusive. For example, with college students, some studies reported that females use less meaningful approaches to learning than males (e.g., Cavallo, Potter, & Rozman, 2004), whereas others found that there are no significant gender differences (e.g., Vermunt , 2005; Zeegers, 2001). In Korean context, a study with 2,019 undergraduate students from 50 universities reported that male students use more high-order thinking strategies than female student (Yu et al., 2011).

Consistent with prior studies (Vermunt, 2005; Wolters et al., 1996), sophomores and seniors reported significantly higher use of surface, deep, and self-regulated strategies than did freshmen and juniors. This trend was also found in a Korean study that reported the upper grade undergraduate students such as sophomores and seniors tended to use more cognitive and metacognitive strategies than freshmen and juniors (Kim et al., 2011). Researchers argued that prior learning experiences make the differences in students' learning strategy use by academic rank (Kim et al., 2011; Vermunt, 2005). That is, as undergraduates move through the grade levels, they encounter a variety of tasks and practice the use of effective learning strategies.

In addition, students who enrolled in an elective course reported significantly less use of surface strategies than did the students in a core course. In fact, little has known about the differences in students' learning strategy use according to course types. However, it was suggested that course type should be considered in cognitive engagement research because students' motivation varies depending on the different types of courses and the differences in motivation in turn lead to different approaches to learning (Duncan & McKeachie, 2010; Ferrer-Cajaa & Weissa, 2002). Students in elective courses are likely to make their choice of enrolling with more personal relevance and to have more interest and value with contents than in required courses; thus students in elective courses are likely to be motivated and engage at a deeper level.

In terms of academic majors, the highest mean score of surface strategy use was reported by the students in Business and Economics courses, whereas the highest mean scores of deep strategy and self-regulated strategy use were reported by the students in Engineering courses. Regarding disciplinary differences in students' learning strategy use, Nelson Laird et al. (2009) argued that the degree of consensus in disciplines about content and method of inquiry would explain the disciplinary differences. That is, in fields with less consensus, such as Social Science, teachers are likely to encourage deep approaches to learning such as analysis, synthesis and active learning, and in the fields with more consensus such as Natural Science and Engineering, students are often required to engage in more memorization and application of concepts (Braxton et al., 1998). Thus, students' in the field with less consensus are likely to engage at a deeper level than in the fields with more consensus. Although there was no or few consistent findings regarding the effects of academic majors, previous empirical studies reported that students in Social Science courses were more likely to use deep approaches to learning (Nelson Laird et al., 2008; Wolters & Pintrich, 1998), whereas students in Business and Economics courses (Booth et al., 1999; Eley, 1992) and in Engineering and Science field were less likely to use deep approaches to learning (Eley, 1992). In this current study, students in

Business and Economic courses reported the highest mean level of surface cognitive strategy use and the lowest mean level of deep cognitive strategy use. These results are consistent with other studies reporting that students in Business and Economics field such as Accounting courses focus more on rote learning of facts and procedures, memorizing information rather than attempting to engage with the subject matter (e.g., Beattie et al, 1996; Booth et al., 1999; Gow et al., 1994, Eley, 1992). In general, it is argued that accounting education emphasizes knowing facts; thus instruction in this field does not encourage students to use deeper levels of processing strategies (Spencer, 2003). Meanwhile, in contrast with other studies, it was found in the current study that students in Engineering courses reported higher use of deep and self-regulated strategies. It might be because the score of the implementation of First Principles was higher in Engineering courses than other courses.

When taking into account all the effects of gender, academic rank, and course type (e.g., core and elective course) at the student-level and of academic majors at the course-level in the regression model, there were modest effects on students' cognitive engagement given the academic majors. It was found that the levels of surface cognitive strategy use were related to the course type, and the levels of deep cognitive strategy use were related to academic rank. Surface strategy use was higher when students enrolled in a required course rather than in an elective course, and deep strategy use was higher when students were in a higher academic year. As mentioned above, this may be because students enrolled in required courses are likely to be less motivated than the students in elective courses, and because the upper grade students are likely to have accumulated learning experiences related to the effective use of learning strategies.

In addition, when compared to the students in Business and Economics course, students in Education courses reported lower levels of surface cognitive strategy use; students in Social Science, Natural Science and Language courses reported higher levels of deep engagement. Contrary to expectations, students in Education courses reported lower levels of self-regulated strategy use than students in Business and Economics course. A possible explanation for these findings is that all Education courses were core courses that were mandatory for the students. Thus, as previously explained, students in Education courses are likely to be less motivated and less self-regulated.

Discussion and Implications

First Principles of Instruction and engaging instruction

Cognitive engagement research has focused on how certain structures within the course promote student learning engagement in conjunction with a concern for the improvement of instruction. Most of the suggestions are made based on task characteristics, classroom goal structures and autonomy orientations of classrooms. Students engaged more in a course where productive and cooperative academic tasks are provided (Pintirich et al., 1994), where more autonomy is given to students (Jang et al., 2010), and where course goals are learning-oriented (Lyke & Young, 2006; Wolters, 2004). Also, action learning design integrating project and group work (Wilson & Fowler, 2005), problem-based learning course (Ahlfeldt et al., 2005), and constructivist instruction with frequent use of classroom discussion and extended writing, and teachers' emphasis on in-depth understanding and application (Nie & Lau, 2010) were found to promote deep levels of cognitive engagement.

The present study extends previous work on learning environment design associated with student learning engagement by adding novel evidence linking Merrill's First Principles to cognitive engagement. The results of this study clearly support that the levels of cognitive engagement vary as a function of the degree to which the First Principles are implemented as Merrill claimed (Merrill, 2002, 2009). Specifically, students' deep cognitive strategy uses such as elaboration, organization, and critical thinking strategy uses are directly influenced by course-level implementation of First Principles.

First Principles of Instruction are the underlying principles included in most instructional design theories and models, and are hypothesized to consistently promote student learning and learning engagement during instruction (Merrill, 2002, 2009). Thus, it was argued that if a course does not adequately incorporate these principles, there may be lower levels of student engagement in learning and acquisition of the desired knowledge or skills (Merrill, 2008; van Merrirëboer et al., 2002).

Despite the theoretical and practical importance of First Principles of Instruction in designing instruction, little attempt has been made to empirically validate the association between the principles and various instructional outcomes. Previous empirical works have linked First Principles to overall quality of instruction in online course contexts (Copper et al., 2009), students' levels of remembering, understanding, and problem solving in undergraduate biology courses (Gardner, 2011), and quality of instruction, students' satisfaction with course, and academic learning time in university courses (Frick et al., 2009, 2010). These studies suggest that the First Principles framework can be applied for both instructional design purposes and evaluation purposes.

Copper et al. (2009) compared the rubric of First Principles to other evaluation rubrics in terms of its reliability and validity, and Frick et al. (2009, 2010) conducted a series of studies to validate First Principles as a university course evaluation framework. Both studies suggested that the principles are a reliable and valid measure for evaluating the quality of online and traditional university courses. Gardner (2011) introduced the principles as an instructional design framework and suggested that instruction that implements First Principles increase students' abilities to solve problems and remember information. The current study suggests that instructional design practices that integrate Merrill's First Principles are more likely to help students adopt deeper levels of cognitive strategies and endorse intrinsic goal orientation.

The multilevel modeling approach as an analytical technique also advances early work in cognitive engagement. When studying course context, it is important to account for the social nature of data (Pintrich, 2003). That is, instructional practices are inherent in a course or an instructor, thus the differences in the characteristics of the course or the instructor may influence a specific learning outcome. However, despite the obvious social nature of the data involved in most learning environment studies, few studies have focused on the course-level effects on student learning outcomes. The majority of existing research linking learning environment and cognitive engagement has ignored the course-level effects (e.g., Ahlfeldt, Mehta, & Sellnow, 2005; Meece et al., 1988; Nijhuis, Segers, & Gijselaers, 2005; Rotgans &

Schmidt, 2011; Wilson & Fowler, 2005). In this study, it was clearly evident that there were course-level effects on cognitive engagement as well as student-level effects. This means that the common characteristics of a course in terms of the implementation of First Principles have some relationship to students' levels of cognitive engagement. When students were in the course that integrated more First Principle, they were likely to engage at deeper levels. Overall, 6.6% of variances in students' deep cognitive strategy use were explained by between-course differences in the implementation of First Principles. If such course effects are ignored, statistical inferences that attribute all variance in outcomes to the student may be invalid. Hox (1995) noted that analysis of variance may overestimate the effects of student-level predictors if course effects are not taken into account.

In summary, the differences in student cognitive engagement can be accounted for by student characteristics such as individual goal orientations as well as course characteristics, such as the extent to which each course integrates First Principles.

Mediating role of intrinsic goal orientation

The study provides further support for the mediating role of goals in the relationship between learning environmental factors and cognitive engagement. Most previous studies have directly linked either personal factors or learning environmental factors to cognitive engagement. However, there has been a call for research to consider both simultaneously (e.g., Ames, 1992; Pintrich & Schrauben, 1992; Pintrich et al., 2003). The findings of the present study clearly demonstrate that the influences of course-level implementation of First Principles are transmitted to cognitive engagement through individual intrinsic goal orientation. The implementation of First

Principles was initially found to be a significant predictor of deep cognitive strategy use and self-regulated strategy use. However, the addition of goal orientation variables changed the relationships. A direct relationship between First Principles and deep cognitive strategy use was substantially reduced, and a direct relationship between First Principles and self-regulated strategy use was no longer significant with the presence of goal orientations. Instead, intrinsic goal orientation mediated the effects of First Principles. Particularly, the implementation of First Principles was only indirectly linked to surface strategy use and self-regulated strategy. Thus, it could be argued that intrinsic goal orientation is a necessary condition to convey the effects of First Principles to surface strategy use and self-regulated strategy. In previous empirical studies, this causal mechanism by which course context affects cognitive engagement has been less known, thus, this finding allows a better understanding of the complexity of the processes of learning.

This study also extends earlier work on the role of the context in students' goal orientations. The present study found that the implementation of First Principles also influence students' personally endorsed goals. In courses rated higher on the implementation of the principles, students seem to have higher level of intrinsic goal orientation. Extrinsic goal orientations were not influenced by the principles.

Classroom structures that help students adopt mastery and learning goal has been an important concern in student goal orientation research, but previous studies placed less emphasis on specific instructional practices in influencing student goal adoption (e.g., Ames, 1992; Pintrich & Schrauben, 1992; Pintrich et al., 2003). The most frequently examined course-level predictor in relation to individual goal orientations was classroom goal structures. Research suggests that students are likely to adopt individual goals in a way that is consistent with their course goals (Ames & Archer, 1988; Lyke & Young, 2006; Wolters, 2004). Therefore, students' intrinsic and mastery goals are made when instructional practices and policies stress learning or self-improvement rather than competition and demonstrating ability. Also, an evaluation-focused classroom and harsh evaluation were negative predictors of intrinsic goal (Church et al., 2001). For example, a course where the instructor emphasizes the importance of grades and performance evaluation and where the grading structure is perceived as difficult is likely to discourage students to adopt mastery and learning pursuits. While much of interest in classroom learning environment that enhance the probability that students will adopt mastery and learning goal orientation (Ames, 1992), little attention has been paid to course designs that influence students' adoption of goals. Extending prior studies, the current study clearly identified a set of instructional principles with respect to how a course should be designed to enhance students' adoption of intrinsic goal orientation.

Furthermore, this study sheds additional light on the relationships between specific goal orientations and cognitive engagement outcomes. It was found that both intrinsic and extrinsic goal orientations were positively related to the three indicators of cognitive engagement. These results conflict with those of most prior empirical studies, which reported that a consistent, positive relationship between learning and intrinsic goals predict the deeper levels of engagement, whereas performance and extrinsic goals predict surface levels of engagement among university students (Dupeyrat & Mariné, 2005; Greene & Miller, 1996; Lyke & Young, 2006; Walker et al, 2006). The results of this study suggested that students who endorse both intrinsic and extrinsic goals were likely to use higher level of cognitive and self-regulated strategies. The results can be explained by a multiple-goals perspective that students can be oriented toward both learning goals and performance goals in a course (Meece & Holt, 1993; Pintrich & Schrauben, 1992; Pintrich & Garcia, 1991). That is, a student might be intrinsically-oriented to understand and master the course material, and, at the same time, extrinsically-oriented with a concern about grade or competition in the course.

With the multiple goals perspective, an empirical study conducted by Pintrich and Garcia (1991) examined the interaction between different levels of goal orientations and cognitive engagement instead of the linear relationships. The study showed that intrinsic goal orientation is clearly linked to the use of deep cognitive strategies such as elaboration and organization and the use of self-regulated strategies. It was also found that students who had high levels of extrinsic orientation showed higher levels of cognitive and self-regulated strategy use than students who had both low extrinsic and low intrinsic goal orientations. This implies that a higher level of extrinsic goal orientation still leads to better cognitive engagement. Therefore, Pintrich and Garcia (1991) argued that "a simple intrinsic-extrinsic continuum may not adequately characterize college students' perceptions of the reason they engage in academic tasks in the college classroom" (p. 395).

Evidence from the current study is unclear about the interaction between intrinsic and extrinsic goal orientations; however it shows that students who have both high extrinsic goals and intrinsic goals are more likely to use surface, deep, and self-regulated strategy use. The results supports that there are more than two types of relationships between goal orientations and cognitive engagement that extrinsic goals are associated with surface learning and intrinsic goals are associated with deep learning. Consequently, as both intrinsic and extrinsic goal orientations were identified as significant predictors of cognitive engagement outcomes in this study, it is suggested that courses need to be designed to lead to students' adoption of intrinsic goals and also extrinsic goals.

Distinction between deep cognitive strategies and self-regulated strategies

This study provided a test of the empirical distinction between the cognitive engagement indicators. Findings from the confirmatory factor analysis indicate that it is possible to separate the three indicators of cognitive engagement as theoretically conceptualized. Furthermore, it was found that the indicators of cognitive engagement appeared to act independently, showing that each was differently associated with learning environmental factors and goal orientations. The strength of these variables relationships varies according to each cognitive engagement outcome. The causal mechanisms among the implementation of First Principles, goal orientations, and cognitive engagement outcomes also appear to vary.

Cognitive engagement has typically been operationalized by four scales of basic cognitive strategies (rehearsal, elaboration, organization, and critical thinking strategies) and a single scale of self-regulated strategy in the literature (Pintrich, 2004). The scales have been used separately or in combination based on a distinction between surface and deep levels of engagement. Surface level engagement was typically indicated by the rehearsal or memorization strategy use; however many different combinations of cognitive strategies and self-regulated strategies were used to indicate deeper levels of engagement. Empirical investigation also shows many different factor structures; some separate cognitive strategy and self-regulated strategy (e.g., Pintirich De Groot, 1990); and some others combined deep cognitive strategy and self-regulated strategy as a single indicator of deep levels of engagement in learning (e.g., DeBacker & Crowson, 2006; Greene & Miller; Walker et al., 2006).

Based on the theoretical and empirical evidence, the current study separates (i) surface cognitive strategy use as indicated by rehearsal strategies, (ii) deep cognitive strategy use as indicated by the composite score of elaboration, organizational and critical thinking strategies to indicate a deep level of engagement, and (iii) self-regulated strategy use as indicated by the score of self-regulated strategies.

Consequently, the findings help to clarify the conceptualization of cognitive engagement indicators by suggesting the need to distinguish surface, deep, and self-regulated strategies rather than combine and operationalize them as a single construct. This distinction allows a clearer explanation of the relationships among the implementation of First Principles, goal orientations, and cognitive engagement.

Contributions and Implications for Instructional Design Research and Practice

Instruction that integrates First Principles of Instruction is expected to promote effectiveness, efficiency, and student learning engagement. Therefore, researchers in instructional design research field have attempted to empirically validate the effect of the principles on various instructional outcomes (Copper et al., 2009; Gardner, 2011; Frick et al., 2009, 2010). The results of this study add more evidence that First Principles of Instruction was significantly related to engaging students in the use of deeper cognitive processing strategies such as elaboration, organization, and critical thinking strategies during instruction rather than to use of simple recall and memorization strategies. However, the results may be limited to the specific context of this current study; thus, these results should be replicated with a greater variety of populations, courses, and subjects for strengthening the validity of the effect of principles.

Based on the results of this study, it could be argued that First Principles of Instruction would be effective in designing engaging instruction. The findings have practical implications for the design of instruction in university contexts.

Table 26 Summary of implementation of First Principles of Instruction

Principles	Focus of instruction	Implementation
Task-centered	Authentic tasks	· Use authentic and real-world tasks or problems · Provide a simple to complex progression of whole task
Activation	Structure	· Direct students to recall, describe or demonstrate relevant prior knowledge or experience · Provide learners with organizing structure based on what they know · Give opportunities learners to share previous experience with others
Demonstration	Guidance	· Demonstrate general information as well as specific cases that is consistent with the type of content being taught · Guide learners to focus on critical elements of the information and related to the elements to specific instances · Give opportunities learners with peer-discussion and peer demonstration · Use relevant media to demonstrate content
Application	Coaching	· Provide learners with practice and application that is consistent with the type of content being taught · Provide learners with intrinsic and corrective feedback · Gradually withdraw coaching with succeeding applications · Give opportunities learners to collaborate each other on the application
Integration	Reflection	· Direct students to reflect on, discuss, or defend what they learn · Give opportunities learners to critique others' works · Give opportunities learners to extend what they learn into their everyday life · Give opportunities learners with public demonstration of their newly acquired knowledge and skills

Table 26 provides a summary of how the principles can actually be implemented in a course based on Merrill's suggestions (e.g., Merrill, 2009). It is of course possible that there are more ways of implementing the principles than those presented in Table 25. It is important to note that effective instruction should involve all four of these activities within the context of authentic problems or tasks (Merrill, 2008).

First Principles of Instruction suggests five principles to consistently promote student learning: task- or problem-centered, activation, demonstration, application, and integration. Merrill also proposes these principles as a cycle of instructional phases. That is, instruction should be based on authentic, real-world problems or tasks, and students should engage in a cycle of four principles: activation, demonstration, application, and integration. The cycle of four principles also embed a cycle of structure, guidance, coaching, and reflection within the cycle (Merrill, 2009).

In university contexts, the guideline of the implementation of First Principles presented in Table 25 can be used for both instructional design purposes and evaluation purposes. University faculty often experience a lack of opportunity to develop knowledge and skills for designing courses, and may requires appropriate faculty development to support their effort to develop and implement more effective courses (Lee et al., 2009). In addition, in university context, course evaluations by students are often the only source of feedback to instructors on the quality of instruction (Bangert, 2006; d’Apollonia & Abrami, 1997). Course evaluations are often criticized on the basis that the items are generally less about student learning (e.g., engagement and achievement) and often do not provide information that will help course facilitator improve the course or their own strategies. For example, Frick et al. (2010) argued that:

> On a typical course evaluation, low scores on global items or low scores on student satisfaction do not tell instructors anything about how to improve their teaching in ways that are likely to also improve student mastery of course objectives. (p. 134)

Thus, Frick and his colleagues suggested that the framework of First Principles can adequately evaluate university course quality and showed empirical evidence that the score of First Principles predicted various learning outcomes. Therefore, First Principles could be used as a set of principles of the design of instruction as well as a valid measure of course quality in university contexts.

Recently, the Ministry of Education in Korea and many Korean universities put in a great deal of effort on quality teaching in university contexts; thus, with government support, teaching and learning centers has been dramatically increased in universities (Lee & Lee, 2007; Lee & Lee, 2012). However, according to Lee and Choi (2010), most teaching and learning centers support students' general study skills or self-management skills rather than support their faculty members. However, faculty members will seek institutional supports to improve teaching quality when faculty are pressed to gives more attention to the quality ratings of their teaching (Lee & Lee, 2007). In this context, the framework of First Principles can provides university faculty determine how to better design and evaluate courses.

Limitations of the study

There are limitations to this study. First, the hierarchical linear modeling approach is correlational in nature, thus it provides information about the strength of the relationships observed, but does not allow causal inference about the relationships. For example, this study proposed the model that class-level implementation of First

Principles leads to students' adoption of goal orientations, and the goal orientations lead to cognitive engagement. The proposed direction of the relationships was based on previous theoretical and empirical findings. However, a study by Kyndt et al. (2011) modeled a reversed direction between motivational orientation and learning environment that students' motivational orientations influence their perceptions on academic tasks, and in turn, their perceptions influence cognitive engagement. Thus, it is possible that learning environmental characteristics and goal orientation are causally related in a reciprocal fashion, that learning environmental factors affect goal orientations, and orientations affect learning environmental factors (Keith, 2006). The causal mechanism in this study was reasonably established based on previous studies where the proposed causal relationships were plausible. The limitation in this study is that there is a possibility that the direction of causal mechanism is reversed as this is a correlational study (Bellini & Rumrill, 2009). The directionality of these relationships, experimental manipulation of the classroom environment, and goal orientations would need to be further studied to provide direct evidence of causality.

Also, the study includes a limited set of variables related to student engagement, thus, it is unlikely that the model reflects the full complexity of the phenomena related to learning environment, individual students, and cognitive engagement. This study only included student goal orientations as a key student variable, because relationships with cognitive engagement have been well established in previous literature. The HLM model, taking into account student-level variables as well as course-level variables shown in Table 21, explains 14.2 % of total variance in surface strategy use, 43.0% in deep strategy use, and 34.3% in self-regulated strategy use. This implies that there are other variables that play an important role in cognitive engagement such as task value (Pintrich, Roeser, & De Groot, 1994), self-efficacy (Meece et al., 1988, 2003), and prior achievement (Wolters, 2004) that were not included in the current measures, but which may make important contributions to cognitive engagement. These variables could also act as mediators, although this study tested only one causal mechanism with students' goal orientations.

In addition, this dissertation focused only on the implementation of First Principles in the design of instruction. However, another major aspect of instructional context is instructor characteristics. In instructor facilitated instruction the characteristics in terms of instructional style such as authoritarianism (Jang et al., 2010) and teacher's behavior (Pintrich et al., 1994) are often perceived by students as affecting their success in learning in different ways, often varying across programs, courses, and subject areas. The instructor part of the classroom learning equations was not examined in this study based on acknowledging that such variables often do affect students' perceptions of their learning environment and the level of engagement they have during learning. Future research should be designed to examine both the instructor and design variables of instruction together. Since this study only examined the instructional design aspects of the learning environment the missing component of students' perception of teacher variables or data from teachers about their perceptions of the design variables may have weaken the internal validity of the study.

Another limitation of this study lies in the measure of learning environment. As in many other studies (Lyke & Young, 2006; Nie & Lau, 2010; Nijhuis, Segers, & Gijselaers, 2007; Pintrich et al., 1994; Trigwell & Prosser, 1991; Wolters, 2004), this study relied on students' perception data as a measure of learning environment. Although theoretical and empirical evidence suggests that students' perception of learning environment is a valid measure, there have been several studies that use multiple sources of information such as teacher perception data or observational data (Jang et al., 20101; Meece, 1991; Urdan et al., 1998). Such an approach would have provided the researcher with additional validating information on the extent to which student perceptions reflect actual features of the classroom environment versus within-individual differences in perceptions (Church et al., 2001).

Furthermore, this study could not address the idea of whether First Principles of Instruction were fully implemented in a course, since a factor analysis result indicated that students perceived all items of First Principles measure as a single factor, and thus this study used overall score of First Principles. However, the degrees of implementation of all principles could vary among courses. For example, with the current measure of First Principles it is possible that two courses have equivalent overall scores of First Principles, but an instructor may demonstrate a new concept, and not engage learners in practice or reflection in contrast to another instructor. In other words, a higher score of First Principles of Instruction does not necessarily indicate a full implementation of all five principles. This requires more studies related to the degrees of implementation of each principles and their relationship with the level of cognitive engagement.

The fact that this study did not examine a link between cognitive engagement and any achievement measure is also a limitation. The current study was grounded on the argument that qualitative and quantitative differences in student engagement determine the quality of learning outcomes (e.g., Astin, 1999; Kuh et al., 2008; Fredricks et al., 2004). Empirical studies have consistently reported that cognitive engagement is positively related to various learning outcomes such as standardized test scores (Nie & Lau, 2010), grades (Wolters, 2004; Wolters & Pintrich,1998), and task and assignment scores (Pintrich & De Groot, 1990). In order to provide a more persuasive and meaningful knowledge claim for researchers and practitioners in higher education, the sophisticated relationships between cognitive engagement outcomes and various learning outcomes should be further investigated.

Finally, the data collection was limited to undergraduate students in a Korea university. As mentioned previously, Korean students may have responded based on cultural preconceptions that are different from those of students in other cultures. Therefore, the generalizability of the study results is limited to this specific context of research. In general, it has been reported that Asian classroom context are more expository, and students tend to use more surface strategies (Biggs, 1991; 1998). Also, as students move through the grade level, they are likely to use more effective learning strategies with their accumulated learning experiences (Kember, 2000; Kim et al., 2011; Vermunt, 2005). Therefore, with the model proposed in this study, comparative studies in different culture and with different group of students should be conducted in the future to ascertain the generalizability of the findings to a wider population within and outside Korea. .

In light of these limitations, the methods used and data received provide significant insights into the relationships among course design, student characteristics, and learning engagement.

Recommendations for future research

Based on the data analysis results and limitations, several recommendations are made for future study. First, this cross-sectional study, which is correlational in nature, still leaves the possibility of an alternative explanation of how the variables under consideration are related to each other. To yield a stronger causal claim of the relationship among the implementation of First Principles, goal orientations, and cognitive engagement, an experimental study approach or a test for rival explanation of causal mechanism would be necessary.

Second, there is considerable variance in the outcome of engagement that remained unaccounted, which is the portion of the outcome variance that is not accounted for by the variables of interest in this study. This implies that more research on other variables is further needed to reveal the complexity of students' cognitive engagement. Prior research suggested that task value (Pintrich, Roeser, & De Groot, 1994), self-efficacy (Meece et al., 1988, 2003), prior achievement (Wolters, 2004), and teachers' instructional style such as authority (Jang et al., 2010) may make important contributions to cognitive engagement. In addition, future research could focus on testing single factors and on dependence among the suggested factors in cognitive engagement with a comprehensive approach.

Third, the exclusive use of students' perception data is a limitation of this study. Therefore, another area for future research is to use multiple sources of data such as observation data or instructor's ratings to assess learning environment and compare the extent to which each data reflects actual features of the environment. For example, two perspectives on how well the First Principles are implemented in courses from students and instructors could be uses as sources of data and examined in relation to student cognitive engagement. This type of study would increase the validity of a study of learning environment.

Fourth, this study did not focus on how well all five principles of Merrill's model were implemented in courses and student cognitive engagement according to the degrees of implementation. However, Merrill (2009) suggested as five principles as a cycle of instruction that should be embedded in instruction as a set of principles. Therefore, future research should look at the degrees of implementation of each principle as integrated into instruction as compared to the degree which students are cognitively engaged.

Fifth, this study did not link the levels of cognitive engagement to learning outcomes such as achievement. However, based on a big picture that cognitive engagement plays a mediating role in the relationships between learning environment and various learning outcomes should be further addressed to provide more meaningful implication for researchers and practitioners.

Finally, the sample of the current study is limited to this specific context of research. Replications of the study in a variety of settings with a variety of students would be necessary to produce generalized results. .

Conclusion

This study attempted to answer the question of whether there are significant variances in students' cognitive engagement outcomes across university courses and whether the variances are related to the course-level implementation of First Principles. In addition, the role of individual goals in these relationships was examined.

Each cognitive engagement outcome (surface, deep, self-regulated strategy use) significantly differed among courses, and the differences in deep strategy use and self-regulated strategy use were clearly accounted for by course-level implementation of First Principles. Surface strategy use however, was not related to the First Principles. The mediating role of intrinsic goal orientation was also clarified. Course-level implementation of First Principles does not directly affect surface strategy use and self-regulated strategy use, rather the effect of class-level FP appears to be mediated by intrinsic goal orientations. It also affects deep cognitive strategy use directly as well as indirectly through intrinsic goal orientation.

This study helps understand how course design, in terms of the implementation of First Principles, and individual goal orientations operate together in undergraduate course context to influence students' cognitive engagement. The study suggests that students in a course with greater implementation of First Principles was more interested in learning and mastery, and ultimately will be likely to become engaged in learning in more cognitive and self-regulated fashion than those who are in a course with less implementation of the principles.

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Appendix A: IRB APPROVAL

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Tiffany Koszalka
DATE: February 13, 2012
SUBJECT: **Determination of Exemption from Regulations**
IRB #: 12-024
TITLE: *A Relationship Between College Students' Perceptions of Course and Cognitive Engagement*

The above referenced application, submitted for consideration as exempt from federal regulations as defined in 45 C.F.R. 46, has been evaluated by the Institutional Review Board (IRB) for the following:

1. determination that it falls within the one or more of the five exempt categories allowed by the organization;
2. determination that the research meets the organization's ethical standards.

It has been determined by the IRB this protocol qualifies for exemption and has been assigned to categories **1** & **2**. This authorization will remain active for a period of five years from **February 9, 2012** until **February 8, 2017**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Instructional Design, Development & Evaluation, 330 Huntington Hall **STUDENT:** Sunghye Lee

Office of Research Integrity and Protections
121 Bowne Hall Syracuse, New York 13244-1200
(Phone) 315.443.3013 ◆ (Fax) 315.443.9889
orip@syr.edu ◆ www.orip.syr.edu

Appendix B: IRB MODIFICATIONS APPROVAL

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Tiffany Koszalka
DATE: June 25, 2012
SUBJECT: **Amendment for Exempt Protocol**
AMENDMENT#: 1 - A) Revised Consent Form(s)
B) Change in Sample Size
C) Addition of Research Site(s)
D) Change in Questionnaire
IRB #: 12-024
TITLE: *A Relationship between College Students' Perceptions of Course and Cognitive Engagement*

Your current exempt protocol has been re-evaluated by the Institutional Review Board (IRB) with the inclusion of the above referenced amendment. Based on the information you have provided, this amendment is authorized and continues to be assigned to category **1 & 2**. This protocol remains in effect from **February 9, 2012** to **February 8, 2017**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy J. Cromp

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Instructional Design, Development & Evaluation, 330 Huntington Hall **STUDENT:** Sunghye Lee

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Appendix C: A LETTER OF COOPERATION

A Letter of Cooperation

Dear the Chair of Teaching and Learning Center,

I am Sunghye Lee, a doctoral student in the Department of Instructional Design, Development and Evaluation at Syracuse University, Syracuse, New York in the United States. I would like to invite you to support my research on the student engagement in learning. This study will focus on the relationship between instructional design components in college courses and student engagement in their learning process. I would like to ask you to allow me to gather data from some of courses in your university about student's perceptions on the course and course experiences. Students will be informed about this research before beginning an online survey.

The risk associated with participation in this study is minimal. The participants might feel uncomfortable expressing their experiences due to the nature of some of the questions asked. If students no longer wish to continue, students can withdraw from the survey at any time. The participants are not required to answer any questions regarding anything that is beyond their course experiences. Involvement in the study is voluntary, so the participants may choose to participate or not. There is no direct benefit to participants, but we hope the information will contribute to general knowledge about how to improve college courses in terms of instructional design. With your permission, I will contact instructors of each class and send an introductory e-mail to obtain the permission to administer the survey in the classes. To complete questionnaires, it may take about 20 minutes.

All information will be kept anonymous and confidential; this means that the students' name will not appear anywhere and no one will know about their responses. If you have any questions, you may contact me at 010-6858-2662 or contact the Syracuse University's Institutional Review Board at

Phone:(315) 443-3013 E-mail: orip@syr.edu
Address: Office of Research Integrity and Protections
121 Bowne Hall, Syracuse, New York 13244-1200

Thank you for your time and kindness.

가톨릭대학교 교수학습센터
CATHOLIC UNIVERSITY OF KOREA THE CENTER FOR TEACHING & LEARNING

YOUR STATEMENT OF PERMISSION:

I, Kisun Sung allow Sunghye Lee to conduct research with the students. My signature in the blank space below indicates my permission.

Department: Center for Teaching & Learning
University: Catholic University of Korea
E-mail: education@catholic.ac.kr
Phone: +82-2-2164-4544

Kisun Sung 2012-6-15

Your Name and Signature Date

가톨릭대학교 교수학습센터
CATHOLIC UNIVERSITY OF KOREA THE CENTER FOR TEACHING & LEARNING

A Letter of Cooperation

교수학습 센터장님께,

안녕하세요? 저는 미국 뉴욕주의 시라큐스 대학 박사과정에 재학중인 이성혜입니다. 학습자의 수업 참여에 관한 연구와 관련하여 도움을 요청드리고자 메일을 드립니다. 이 연구는 학습자의 학습 참여가 수업에 적용한 교수 설계 원리와 관계가 있는지를 파악하고자 하는 연구입니다. 교육학과 수업에서 수업에 대한 학생들의 인식과 수업 경험에 대해 설문할 수 있도록 도와주시면 감사드리겠습니다. 학생들은 설문 전에 연구에 대한 안내를 받게 될 것입니다.

연구와 관련된 위험은 거의 없지만, 학생들은 수업과 관련된 설문에 응답하면서 약간의 불편함을 느낄 수 있습니다. 그 경우 학생들은 언제 든지 설문 중간에 설문을 그만 둘 수 있습니다. 학생들은 참여 의사에 따라 본 설문에 자발적으로 참여할 수 있습니다. 학생들의 설문은 교수의 수업 설계 요인과 학생의 학습 경험과의 관계를 밝히는데 귀중한 자료가 될 것이며, 본 연구의 결과는 대학에서 수업의 질을 개선하는데 활용될 예정입니다.
설문을 허락해 주신다면, 각 수업의 교수님들께 연락하여 연구를 소개하고 설문조사에 대한 허가를 구하고자 합니다. 설문지 작성은 20분 정도 소요될 예정입니다.

모든 정보는 본인을 제외한 누구에게도 공개되지 않으며, 본 연구의 분석을 위한 목적으로만 사용됩니다. 또한 학생들의 이름이 실제 연구자료로 사용되지는 않으며, 기입해주신 정보는 자료 분석과정에서 실제 이름대신 기호나 번호로 바꾸어 사용하게 됩니다.
이 연구는 시라큐스 대학으로부터 연구 허가를 받은 연구입니다. 만약 연구에 대한 문의 사항이 있으시거나 확인을 원하시면 아래 연락처를 이용하시기 바랍니다.

Office of Research Integrity and Protections
주소: 121 Bowne Hall, Syracuse, NY 13244-1200
(전화: 1-315-443-3013 / Email: orip@syr.edu)

궁금하신 사항은 010-6858-2662로 연락주십시오. 많은 협조를 부탁드립니다.

가톨릭대학교 교수학습센터
CATHOLIC UNIVERSITY OF KOREA THE CENTER FOR TEACHING & LEARNING

나 성 기선 는 이성혜(Sunghye Lee)에게 본 연구를 수행하는 것을 허가합니다. 아래의 내 사인은 내가 허가 하였음을 의미합니다.

대학: 가톨릭대학교 교수학습센터

이메일: education@catholic.ac.kr

전화: 82-2-2164-4514

성 기선 [signature] 2012-6-15

서명 날짜

가톨릭대학교 교수학습센터
CATHOLIC UNIVERSITY OF KOREA THE CENTER FOR TEACHING & LEARNING

Appendix D: INFORMED CONSENT FORM

School of Education

Department of Instructional Design, Development and Evaluation

INFORMED CONSENT

Project Title: A Relationship between College Students' Perceptions of Course and Course Experiences

My name is Sunghye Lee, I am a graduate student at Syracuse University, Instructional Design, Development and Evaluation department. I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate or not. This sheet will explain the study to you and please feel free to ask questions about the research. I will be happy to explain anything in greater detail.

You will be asked to answer the questions related to your perceptions of the course and course experiences.

This survey will take approximately 20 minutes of your time. All information will be kept confidential. This means that a number will be assigned to your responses, and only I will have the key to indicate which number belongs to each respondent.

While there are no direct benefits to you, you will be adding to the body of knowledge with regard to the relationship between what instructors do and how well students learn. By taking part in the research, you may contribute to improving the quality of college courses from students' perspective. Any direct risk to you is not anticipated. However, you might feel uncomfortable to express your experiences.

If you do not want to take part, you have the right to refuse, without penalty. If you decide to take part and later no longer wish to continue, you have the right to withdraw from the study at any time, without penalty. If you have any questions, concerns, complaints about the research, contact Sunghye Lee (010-6858-2662). If you have any questions about your rights as a research participant, you have questions, concerns, or complaints that you wish to address to someone other than the investigator, contact the Syracuse University Institutional Review Board at orip@syr.edu.

All of my questions have been answered, I am over the age of 18 and I wish to participate in this research study. I have received a copy of this consent form.

________________________________ __________
Signature of participant Date

____
Print name of participant

________________________________ __________
Signature of investigator Date

____
Print name of investigator

School of Education

Department of Instructional Design, Development and Evaluation

동 의 서

연구제목: 학습자의 수업에 대한 인식과 수업 경험과의 관계

안녕하세요? 저는 미국 뉴욕주의 시라큐스 대학 박사과정에 재학중인 이성혜입니다.
귀하에게 간단한 설문에 응답해 주실 것을 부탁드립니다. 설문은 자발적으로 참여하실 수 있습니다. 연구에 대한 안내를 읽으면서 질문이 있으시면 언제든지 질문해 주시면 자세히 설명드리겠습니다.
본 연구는 귀하의 수업에 대한 생각과 수업 참여를 파악하고자 진행됩니다. 해당 수업을 떠올리시면서 수업에 대한 귀하의 인식과 수업 경험에 대해 답변해 주시기 바랍니다.
설문지 작성은 약 20분 정도 소요될 예정이며, 모든 정보는 본인을 제외한 누구에게도 공개되지 않습니다.또한 개인정보가 실제 연구자료로 사용되지는 않으며, 기입해주신 정보는 자료 분석과정에서 실제 이름대신 기호나 번호로 바꾸어 사용하게 됩니다.
귀하의 협조는 교수의 수업 설계와 학생의 학습 경험과의 관계를 밝히는데 귀중한 자료가 될 것이며, 본 연구의 결과는 대학에서 수업의 질을 개선하는데 활용될 예정입니다.
원치 않으시면 설문에 참여하지 않으셔도 되며, 설문 도중 문항에 응답하는데 불편함을 느끼신다면 언제라도 중단하실 수 있습니다.

이 연구는 시라큐스 대학으로부터 연구 허가를 받은 연구입니다. 만약 연구에 대한 문의 사항이 있으시거나 확인을 원하시면 아래 연락처를 이용하시기 바랍니다.

Office of Research Integrity and Protections
주소: 121 Bowne Hall, Syracuse, NY 13244-1200 (전화: 1-315-443-3013/ Email: orip@syr.edu)

궁금하신 사항은 010-6858-2662로 연락주십시오. 많은 협조를 부탁드립니다.

모든 질문에 응답하였으며, 나는 18세 이상으로 본 연구에 참여하고자 합니다. 나는 동의서 사본을 받았습니다.

참여자 서명 날짜

참여자 이름

연구자 서명 날짜

연구자 이름

Appendix E: INSTRUMENT

Students' perceptions of course and course experiences

Department:

Academic rank:

□ Freshman □ Junior □ Sophomore □ Senior

Gender: □ Male □ Female

Please answer the following questions based on your perception of this course. Remember there are no right or wrong answers, just answer as accurately as possible.

Note: In the items below, authentic problems or authentic tasks are meaningful learning activities that are clearly relevant to you at this time, and which may be useful to you in the future (e.g., in your chosen profession or field of work, in your life, etc.)

	Strongly disagree	**disagree**	**neutral**	**disagree**	**Strongly agree**
1. I was expected to perform a series of increasingly complex authentic problems in this course.					
2. I engaged in experiences that subsequently helped me learn ideas or skills that were new and unfamiliar to me.					
3. My instructor demonstrated skills I was expected to learn in this course.					
4. My instructor detected and corrected errors I was making when solving problems, doing learning tasks or completing assignments.					
5. I had opportunities in this course to explore how I could personally use what I have learned.					
6. My instructor directly compared problems or tasks that we did, so that I could see how they were similar or different.					
7. In this course I was able to recall, describe or apply my past experience so that I could connect it to what I was expected to learn.					
8. Media used in this course (texts, illustrations, graphics, audio, video, computers) were helpful in learning.					
9. I had opportunities to practice or try out what I learned in this course.					

	Strongly disagree	disagree	neutral	disagree	Strongly agree
10. I see how I can apply what I learned in this course to real life situations.					
11. I was expected to solve authentic problems or to complete authentic tasks in this course.					
12. My instructor provided a learning structure that helped me to mentally organize new knowledge and skills.					
13. My instructor gave examples and counterexamples of concepts that I was expected to learn.					
14. My instructor gave me feedback on what I was trying to learn.					
15. I was able to publicly demonstrate to others what I learned in this course.					
16. In this course I was expected to solve a variety of authentic problems that were organized from simple to complex.					
17. In this course I was able to connect my past experience to new ideas and skills I was learning.					
18. My instructor did not demonstrate skills I was expected to learn.					
19. In this course I was able to reflect on, discuss with others, and defend what I learned.					
20. My instructor provided alternative ways of understanding the same ideas or skills.					

Please answer the following questions based on your experience in this course. Remember there are no right or wrong answers, just answer as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, click 7; if a statement is not at all true of you, click 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you

	1 Not at all true of me	2	3	4	5	6	7 Very true of me
21. During class time I often miss important points because I'm thinking of other things.							
22. When I study for this class, I practice saying the material to myself over and over.							
23. When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.							
24. When I study the readings for this course, I outline the material to help me organize my thoughts.							

	1 Not at all true of me	2	3	4	5	6	7 Very true of me
25. I often find myself questioning things I hear or read in this course to decide if I find them convincing.							
26. When reading for this course, I make up questions to help focus my reading.							
27. Getting a good grade in this class is the most satisfying thing for me right now.							
28. In a class like this, I prefer course material that really challenges me so I can learn new things.							
29. When I become confused about something I'm reading for this class, I go back and try to figure it out.							
30. When studying for this course, I read my class notes and the course readings over and over again.							
31. I try to relate ideas in this subject to those in other courses whenever possible.							
32. When I study for this course, I go through the readings and my class notes and try to find the most important ideas.							
33. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.							
34. If course readings are difficult to understand, I change the way I read the material.							
35. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.							
36. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.							
37. Before I study new course material thoroughly, I often skim it to see how it is organized.							
38. I memorize key words to remind me of important concepts in this class.							
39. When reading for this class, I try to relate the material to what I already know.							
40. I make simple charts, diagrams, or tables to help me organize course material.							
41. I treat the course material as a starting point and try to develop my own ideas about it.							

	1 Not at all true of me	2	3	4	5	6	7 Very true of me
42. I ask myself questions to make sure I understand the material I have been studying in this class.							
43. If I can, I want to get better grades in this class than most of the other students.							
44. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.							
45. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.							
46. I make lists of important items for this course and memorize the lists.							
47. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.							
48. When I study for this course, I go over my class notes and make an outline of important concepts.							
49. I try to play around with ideas of my own related to what I am learning in this course.							
50. I often find that I have been reading for this class but don't know what it was all about.							
51. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.							
52. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.							
53. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.							
54. 69. I try to understand the material in this class by making connections between the readings and the concepts from the lectures.							
55. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.							
56. When studying for this course I try to determine which concepts I don't understand well.							
57. When I study for this class, I set goals for myself in order to direct my activities in each study period.							

	1 Not at all true of me	2	3	4	5	6	7 Very true of me
58. I try to apply ideas from course readings in other class activities such as lecture and discussion.							
59. If I get confused taking notes in class, I make sure I sort it out afterwards.							

수업에 대한 인식과 학습 경험 조사

소속학과:

학년: □ 1학년　□ 2학년　□ 3학년　□ 4학년　□ 석사과정　□ 박사과정

성별: □ 남　□ 여

* 아래의 문항은 귀하가 수강한 수업에 대한 인식을 묻는 문항들입니다. 각 문항을 읽고 해당하는 항목에 표시하여 주시기 바랍니다.

* 아래 문항에서 "실제적 문제" 또는 "실제적 과제"는 귀하의 생활과 관련이 있으며,향후에도 귀하의 직업이나 업무 등에 도움이 될 수 있는 학습 활동을 말합니다.

	전혀 그렇지 않다	그렇지 않다	보통 이다	그렇다	매우 그렇다
1. 이 수업에서는 갈수록 복잡해지는 일련의 실제적 문제들을 다룰 수 있었다					
2. 이 수업에서는 새롭고 익숙하지 않은 아이디어나 기술을 배울 수 있는 활동에 참여할 수 있었다.					
3. 이 수업에서 교수님은 우리가 수업시간에 배우고 있는 지식이나 기술을 시연하거나 구체적인 실례를 들어 설명해 주었다.					
4. 이 수업에서 교수님은 과제를 수행하거나 문제를 푸는 과정에서 나오는 실수를 찾아 정정해 주었다.					
5. 이 수업에서는 배운 것들을 개인적으로 어떻게 활용할 수 있을지 탐색해 볼 기회가 있었다.					
6. 이 수업에서는 교수님이 학생들이 수행한 과제나 문제를 비교해 주어, 그것의 유사점이나 차이점을 파악할 수 있었다.					
7. 이 수업에서는 새롭게 배우는 것과 연결해 보기 위해, 나의 경험들을 회상하고, 설명(묘사)하고, 적용할 수 있었다.					
8. 이 수업에서는 학습에 도움이 되는 다양한 매체 (삽화, 그림, 오디오, 비디오 등)가 활용 되었다.					
9. 이 수업에서는 배운 것을 실행하거나 연습해 볼 기회가 있었다.					
10. 이 수업에서는 배운 것들을 현실에 어떻게 적용할 수 있는지 알 수 있었다.					
11. 이 수업에서는 실제적인 문제를 풀거나 과제를 다룰 수 있었다	.				

	전혀 그렇지 않다	그렇지 않다	보통 이다	그렇다	매우 그렇다
12. 이 수업에서는 새롭게 배우는 지식이나 기술을 이해하고 체계화하는데 도움이 되는 학습 구조가 제공되었다.					
13. 이 수업에서 교수님은 개념에 대해 공부할 때 해당되는 예와 그것의 반대되는 예를 함께 제시해 주었다.					
14. 이 수업에서 교수님은 공부하고 있는 것에 대해 피드백을 제공해 주었다.					
15. 이 수업에서는 배운 것을 여러사람 앞에서 설명해 볼 수 있었다.					
16. 이 수업에서는 단순한 것부터 복잡한 것까지 다양한 종류의 실제적 문제들을 다룰 수 있었다.					
17. 이 수업에서는 내가 공부하고 있는 새로운 아이디어나 기술을 나의 경험과 연결지을 수 있었다.					
18. 이 수업에서 교수님은 우리가 수업 시간에 배우고 있는 지식이나 기술을 시연하거나 구체적인 실례를 들어 설명해 주지 않았다.					
19. 이 수업에서는 배운 내용에 대해 성찰하고, 토론할 수 있었다.					
20. 이 수업에서 교수님은 동일한 아이디어나 기술을 이해할 수 있는 대안적인 방법을 제시하였다.					

* 아래 문항들은 귀하의 학습 경험에 대해 묻는 문항들입니다. **1 을 전혀 그렇지 않다 (not at all true of me) 7 을 매우 그렇다 (very true of me)** 라고 할때 귀하의 학습 활동에 비추어 1 부터 7 사이에 해당되는 정도를 표시해 주시기 바랍니다.

	1 전혀 그렇지 않다	2	3	4	5	6	7 매우 그렇다
21. 나는 이 수업에서 수업 중 종종 딴 생각을 하느라고 중요한 것을 놓칠 때가 있었다.							
22. 나는 이 수업을 위해 공부할 때 강의 자료를 혼잣말로 반복하여 말하였다.							
23. 나는 이 수업을 위해 공부할 때 강의, 읽기자료, 토론 등에서 얻은 다양한 정보를 종합하였다.							
24. 나는 이 수업을 위한 자료를 읽을 때 내 생각을 정리하기 위해 요약을 했다.							
25. 나는 이 수업 중에 듣거나 읽는 내용이 설득력를 가지는지 의문을 가져보았다.							

	1 전혀 그렇지 않다	2	3	4	5	6	7 매우 그렇다
26. 나는 이 수업을 위한 자료를 읽을 때 집중에 도움이 되는 질문을 만들어 보았다.							
27. 이 수업에서 좋은 성적을 받는 것이 현재 내가 가장 바라는 일이다.							
28. 이런 수업에서 나는 새로운 것을 배울 수 있는 도전적인 수업 자료를 좋아한다.							
29. 나는 이 수업에서 수업 자료를 읽다가 헷갈리면 다시 앞으로 돌아가 다시 읽으면서 이해하려고 노력했다.							
30. 나는 이 수업을 위해 공부할 때 강의 노트와 읽기자료를 반복해서 읽었다.							
31. 나는 이 과목 (또는 이 수업)에서 나오는 아이디어를 다른 과목의 아이디어와 연관 지어 보려고 노력했다.							
32. 나는 이 수업의 교재 및 자료, 강의 노트를 읽으면서 중요한 아이디어를 찾아내려고 노력했다.							
33. 나는 수업이나 읽기 자료에서 제시된 이론, 해석, 결과에 대해 충분한 근거가 있는지 판단하려고 노력했다.							
34. 나는 이 수업의 자료를 읽으면서 이해가 잘 안 갈 경우, 읽는 방법을 바꿔보았다.							
35. 현재 나에게 가장 중요한 것은 좋은 학점을 받는 것이기 때문에 이 수업에서 나의 주된 관심은 성적을 잘 받는 것이다.							
36. 이런 수업에서 나는 좀 어렵더라도 호기심을 자극하는 수업자료들을 좋아한다.							
37. 나는 이 수업에서 새로운 수업자료를 꼼꼼하게 공부하게 전에, 자료가 어떻게 구성되어 있는지 대략적으로 살펴보았다.							
38. 나는 이 수업에서 중요한 개념들을 기억하기 위해 핵심단어(키워드)들을 외웠다.							
39. 나는 이 수업의 자료를 읽을 때 이미 알고 있는 것들과 연결시켜 보려고 노력했다.							
40. 나는 이 수업에서 자료 정리를 위해 간단한 차트, 다이어그램, 표 등을 이용했다.							
41. 나는 수업자료를 내 생각을 발전시키기 위한 출발점으로 삼았다.							
42. 이 수업에서 공부하고 있는 내용들을 확실히 이해했는지 확인하기 위해 스스로에게 질문을 던져보았다.							
43. 이 수업에서 가능하면 다른 학생들보다 좋은 성적을 받고 싶다.							

	1 전혀 그렇지 않다	2	3	4	5	6	7 매우 그렇다
44. 이 수업에서 내가 가장 바라는 점은 수업 내용을 최대한 정확하게 이해하는 것이다.							
45. 나는 이 수업에서 교수님의 수업 방식과 수업의 요구사항에 따라 공부하는 방법을 맞추려고 노력했다.							
46. 나는 이 수업에서 중요한 항목들을 목록으로 만들고 그 목록들을 암기했다.							
47. 나는 이 수업을 위해 공부할 때 수업 교재와 자료, 강의 노트의 핵심 내용을 간략하게 정리하였다.							
48. 나는 이 수업을 위해 공부할 때 강의 노트를 읽고 중요한 개념을 요약했다.							
49. 나는 이 수업에서 배우는 것과 관련하여 나만의 아이디어를 생각하려고 노력했다.							
50. 나는 이 수업의 자료를 읽었지만 종종 무슨 내용인지 잘 이해하지 못할 때가 있었다.							
51. 가족, 친구, 교수님 등에게 실력을 보여주는 것이 중요하기 때문에 이 수업을 잘 마치고 싶다.							
52. 이런 수업에서 기회가 주어졌을 때 좋은 성적이 보장되지 않더라도 뭔가 배울 수 있는 과제를 선택한다.							
53. 나는 이 수업을 위해 공부할 때 자료를 읽기 보다는 주제를 생각해 보고 자료를 통해 배우게 될 것이 무엇인지 파악하려고 노력했다.							
54. 나는 이 수업의 교재와 자료를 강의에서 나온 개념과 연결하면서 수업 내용을 이해하려고 노력했다.							
55. 나는 이 수업에서 어떤 주장이나 결론에 대해 들을 때 마다 가능한 대안들을 생각해 보았다.							
56. 나는 이 수업을 위해 공부할 때 내가 제대로 이해하지 못한 개념이 무엇인지 파악하려고 노력했다.							
57. 나는 이 수업을 위해 공부할 때 학습 활동을 관리하기 위해 시기별 목표를 세웠다.							
58. 나는 이 수업의 교재 및 자료에서 얻은 아이디어를 강의나 토론과 같은 수업 활동에 적용하려고 노력했다.							
59. 나는 이 수업에서 노트필기를 하면서 불분명한 부분이 있으면 차후에 반드시 이해하려고 했다.							

CURRICULUM VITAE

SUNGHYE LEE

EDUCATION

Ph.D. Instructional Design, Development and Evaluation May 2013
Syracuse University, Syracuse NY
Dissertation: A Relationship between Course-level Implementation of First Principles of Instruction and Cognitive Engagement: A Multilevel Analysis

M.A. Lifelong Learning February 2001
Seoul National University, Seoul, Korea
Thesis: A study on adult learners' evaluation criteria of a cyber education program

B.S. Computer Education February 1998
Chungbuk National University, Cheongju, Korea

PUBLICATIONS

Lee, H. & Lee, S. (2008). An Inverstigation of Professors' Needs to Activate Blended eLearning System in a Conventional University. *The Journal of Educational Information and Media*, Vol. 13, No. 4, pp.77-102.

PRESENTATIONS

Lei, J., Luo, H., & S. Lee. (2011). Collaboration in Technology-enhanced, Modeling-based Instruction (TMBI) Environments in Science Education: Collaboration and Technology Design. Paper accepted for presentation at the 9th International Conference on Computer Supported Collaborative Learning. July 4-8, 2011.

Shen, J., Lei, J., Enriquez, R., Luo, H., & Lee, S. (2010). Achievements and Challenges of Modeling-based Instruction (ACMI) in Science Education from 1980 to 2008. The National Science Foundation PI Meeting, Washington DC., December 1-3, 2010.

Lee, S. (October 2010). Factors affecting students' perceptions on their learning experiences in an online class: An activity theory approach, Association for Educational Communications and Technology, Anaheim, CA.

Lee, S. (November 2009). An exploration of context-sensitive learning environment. Association for Educational Communications and Technology. Louisville, KY.

Lee, S & Lee, H. (November 2008). Professors' perceptions and needs on blended e-learning. E-Learn, Las Vegas, NV.

WORK EXPERIENCE

Research Assistant August 2010-present
Modeling-based Instruction Research Team, Syracuse University, Syracuse, NY
Participated in collaborative research project, "Achievements and Challenges of Modeling-based Instruction (ACMBI) in Science Education from 1980 to 2009" funded by National Science Foundation (NSF) with University of Georgia research team.

Graduate Assistant August 2010-May 2011
MSIT (Master of Science in Instructional Design and Development) Program Committee, Syracuse University, Syracuse, NY
Organized MSIT board meeting and renew IDD&E websites
Organized and managed IDD&E Websites and Social Networks (Twitter, Facebook)

Graduate Assistant September 2008-May 2009
Editor of Department Newsletter, Syracuse University, Syracuse, NY
Edited Department Newsletter

Graduate Assistant September 2007-May 2008
After School Computer Club Project Team, Syracuse University, Syracuse, NY
Facilitated themed after school computer club sponsored by NASA

Instructional Designer January 2007-July 2007
Faculty Development e-Learning Program Development Team, Seoul National University, Seoul, Korea
Conducted need analysis of university faculty and designed e-learning course to promote e-learning use in a university
Manage e-learning course development process

Instructional Designer November 2005-July 2007
Digital Media Center, Korea National Open University, Seoul, Korea
Coordinated e- ASEM network (e-Learning research network under ASEM Lifelong Learning) project team
Designed e-Learning programs for international service

Project Coordinator January 2000-August 2003
Cyber ICU, Information and Communications University, Deajeon, Korea
Designed and implemented IT professional development program funded by Korean Ministry of Information and Communications
Designed and implemented e-learning system

Graduate Assistant August 1998-December 1999
Instructional Media Center, Seoul National University, Seoul, Korea
Operated e-learning system (WebCT)
Designed online courses and provided faculty support services

Research Assistant July 1997-February 1998
Korea Educational Development Institute (KEDI)
Participated in Educational Statistics System development

TEACHING EXPERIENCE

Emerging Technology and e-Learning Summer 2005
Chungbuk National University, Cheongju, Korea
Instructor, In-service teacher training program

Developing classroom web pages Fall 2007
Syracuse University, Syracuse, NY
Instructor, A Technology Workshop for Pre-service and In-service K-12 Teachers

PROFESSIONAL ASSOCIATIONS

- Association for Educational Communications and Technology (AECT)
- American Educational Research Association (AERA)
- Association for the Advancement of Computing in Education (AACE)
- The Korean Society for Educational Technology (KSET)

HONORS/AWARDS/SCHOLARSHIP

- Dissertation Support Award, IDD&E, Syracuse University.
- Research and Creative Grant, School of Education, Syracuse University.
- Burton Blatt Scholarship, Fall 2009-Spring 2010, School of Education, Syracuse University.

CERTIFICATES

- Certificate of Teacher in Computer and Information Technology for Secondary Education (1998) issued by Minister of Education, Seoul, Korea.

SERVICE ACTIVITIES

- Graduate Student Volunteer of Association of Educational Communications and Technology (AECT), 2010 Conference, Anaheim, CA.
- Coordinator of Student Research Seminar (IDD&E Brownbag Seminar), Fall 2009-Spring 2010, Syracuse University.
- Coordinator of IDD&E New Students Orientation, August 2009, IDD&E, Syracuse University.
- Coordinator of e-ASEM Colloquy, September 2006, Seoul, Korea.
- Coordinator of "e-Learning strategies to facilitate IT training" workshop, June 2003, Seoul, Korea.

COMPETENCIES

- Instructional design theory and model
- Learning theory
- e-Learning course and system (LMS) design
- Need analysis
- Modeling-based instruction in Science education
- Meta analysis
- Research design
- Advanced quantitative statistical methods
- SAS, SPSS, HLM, AMOS