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The Effects of Deep Approaches to Learning on Students' Need for Cognition Over Four Years of College

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University of Iowa

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THE EFFECTS OF DEEP APPROACHES TO LEARNING ON STUDENTS' NEED
FOR COGNITION OVER FOUR YEARS OF COLLEGE

by
Jui-Sheng Wang

A thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Educational Policy and Leadership Studies
in the Graduate College of
The University of Iowa

August 2013

Thesis Supervisor: Professor Ernest T. Pascarella

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Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

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ACKNOWLEDGMENTS

First and foremost I want to thank my advisor Ernest Pascarella for his contributions of time, ideas, and guidance during my graduate studies at the University of Iowa. For this dissertation, his mentorship was paramount in providing me scrupulous spirit to scholarship in higher education and student affairs. I would like to thank my committee members: Dr. Michael Paulsen, Dr. Christopher Morphey, Dr. David Bills, and Dr. Brian An, for their time, comment, and insightful input.

To the faculty in the Educational Policy and Leadership Studies Department at the University of Iowa, your expertise provided a foundation of knowledge for which I pursued as a professional scholar in higher education and student affairs.

I gratefully acknowledge the funding sources that helped me pursue my Ph.D. The Educational Policy and Leadership Studies Department funded me for my first four years. Through my research assistant job with the Department of Educational Policy and Leadership Studies, I had many opportunities to learn all kinds of statistical software, and cutting-edge technology.

Lastly, I would like to thank my family for their supports and encouragement. I thank my parents for their unending encouragement and support in all my pursuits. I would like to share this accomplishment with my two sisters in Taiwan. I also share this accomplishment with my wife, Yu-Lan, and my two children, Ilene and Albert.

ABSTRACT

This study examines the effect of deep approaches to learning on development of the inclination to inquire and lifelong learning over four years, as an essential graduated outcome that helps students face the challenges of a complex and rapidly changing world. Despite the importance of the inclination to inquire and lifelong learning, some literature has attempted to operationalize this concept in practical ways. In another limited line of studies, researchers explored how the education process and deep approaches to learning affected students' cognitive development among first-year undergraduates. This dissertation focuses on the ways that the process of deep approaches to learning influences the development of the inclination to inquire and lifelong learning through the positive feelings from information acquisition and the conceptual change from meaningful structure of information.

The individuals in the sample were 1,914 first-year undergraduate students participating in the Wabash National Study on Liberal Arts Education at each of the 17 institutions in the study. This longitudinal study was designed to use three waves of data to control for student background characteristics, institutional types, overall exposure to organized instruction, and other college experiences. The current study employed ordinary least squares regressions with a weighting algorithm and also investigated whether the effects were general or conditional based on differences in race, gender, precollege total academic preparation, and precollege measure of need for cognition.

Using longitudinal, pretest-posttest design with statistical control, this study found that the higher-order learning subscale, the integrative learning subscale, and reflective

learning subscale generated a significant positive effect on the development of inclination to inquire and lifelong learning over four years. Furthermore, the study demonstrated that the effect of deep approaches to learning appear to be general rather than conditional. In summary, the results confirm that the growth of inclination to inquire and lifelong learning can be fostered through deep approaches to learning. The findings suggest that higher education educators should create a developmentally-appropriate learning environment for students to organize their knowledge into cognitive structure, which fosters the capacity for lifelong learning.

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CHAPTER I

INTRODUCTION

In the context of fast-changing economic markets and societies in constant flux, it is an essential mission to ensure that citizens and employees have the capacity for lifelong learning. Demographic change, social change, globalization, and technological advances require citizens and employees to enhance their skills and competence for continuous learning in a rapidly changing society (Knapper & Cropley, 2000). Lifelong learning has been identified as an essential learning outcome for educated adults that has been shown to improve their marketability in the job market and functioning in a demanding knowledge economy (Association of American Colleges and Universities, 2007; Biggs & Tang, 2011; Tynjälä, 2008). Similarly, college students need to develop the skills to be “intellectually resilient, cross-culturally and scientifically literate, technologically adept, ethically anchored, and fully prepared for a future of continuous and cross-disciplinary learning” (Association of American Colleges and Universities, 2007, p. 15).

With increasing demands for accountability, policy-makers, educational researchers, and employers have strongly emphasized the need for postsecondary institutions to develop students’ capacity for lifelong learning to face a rapidly changing work environment (Association of American Colleges and Universities, 2007; European University Association, 2008). In Europe, the Bologna Process determined that promoting lifelong learning should be a part of the mission of educational institutions of higher education to enhance creative learning environments in all European universities for the benefit of individuals and society (European University Association, 2008). As a result, the functions of higher education are expected to

create not only private benefits for college students (e.g., personal financial gains and the love of learning) but also public benefits (e.g., economic growth and productivity) (Paulsen, 2001) .

Pascarella and Terenzini (2005) discovered that employability-related differences in individuals' intellectual and personal characteristics were related to their education level. From the perspective of human capital, an investment in education that improves individuals' productive capacities not only augments their earning potential but also increases local and national income and output (Pascarella, & Terenzini, 2005; Paulsen, 2001). However, there is a gap between the knowledge needed at work and the knowledge acquired from postsecondary institutions (Tynjälä, 2008). The author of an empirical study of university graduates with 2-10 years of work experience concluded that most graduates think a university education is outdated and inadequate for work-life development. The participants further indicated that they needed to learn the necessary skills at work rather than during their formal education (Tynajala, Slotte, Nieminen, Lonka, & Olkinuora, 2006). To meet the changing demands of today's society, employers require workers to be adaptive to change and know how to enhance their job skills (McCombs, 1991).

Despite the fact that lifelong learning has become a slogan or has been listed in the mission statements of many higher education institutions, only a few researchers have attempted to operationalize this concept in practical ways. The difficulty of undertaking controlled empirical research on the concept of lifelong learning and the fact that there are few instruments available to measure the adoption of lifelong learning skills are barriers to assessing traditionally aged students' capacity for lifelong learning (Kirby, Knapper, Lamon, & Egnatoff, 2010).

Hayek and George (1999) attempted to discover the association between college experiences and

the capacity for lifelong learning but did not uncover how higher education educators help students develop their capacity for lifelong learning.

A number of empirical studies have explored the need for cognition (NFC) as a conceptual proxy for lifelong learning orientation (Lindsay, 2007; Mayhew, Wolniak, & Pascarella, 2008). McCombs (1991) suggested that “the motivated person is the life-long learner, and the life-long learner is the motivated person” (p.117). McCombs (1991) also asserted that lifelong learning can be defined as “a natural propensity of human beings to continue to learn, grow, and develop that is facilitated by ‘uncovering’ natural learning tendencies and enjoyment of learning and by reducing or eliminating negative, insecure thoughts and belief systems” (p.338). NFC has been portrayed as a stable intrinsic motivation and as an individual’s “enjoyment and tendency to engage in effortful cognitive activity” (Cacioppo, Petty, Feinstein & Jarvis, 1996, p.198). Individuals with high NFC were more likely to enjoy the process of information acquisition and higher-order thinking to solve predicaments (Cacioppo et al., 1996). As such, an individual’s tendency to enjoy learning, defined as NFC, can facilitate his or her capacity for lifelong learning. Thus, NFC can be used as an important attitudinal proxy for lifelong learning orientation.

In recent years, a few studies have investigated the effects of specific college experiences and college characteristics on the development of first-year undergraduates’ NFC. Some found that students’ NFC could be significantly influenced by exposure to purposeful pedagogical practices, such as perspective taking, active learning, reflection (Mayhew, Wolniak, & Pascarella, 2008), and integrative experiences (Lindsay, 2007). The researchers of several recent large-scale studies have sought to demonstrate the effects of college experiences on gains in NFC among first-year undergraduates based on institutional size (Lindsay, 2007), a liberal arts

discipline (Lindsay, 2007), and the psychological climate for diversity and behavior (Goodman, 2011). However, Arum and Roksa (2010) concluded that U.S. higher education had a limited effect on undergraduate education, including on higher-order cognitive skills. Although each of these studies provided solid evidence that specific college experiences and college characteristics can increase the development of NFC among first-year undergraduates, stakeholders in higher education are more eager to examine the effects of postsecondary education on graduate outcomes, especially cognitive development.

A few researchers have demonstrated that general or broad-based pedagogical approaches have a greater impact on cognitive development than on subject matter content (Pascarella, & Terenzini, 2005). As such, King (2005) suggested that “there is a need for focused research attention on questions of the process as well as the content of student development” (p.49). In recent years, a series of studies have explored how the educational process and deep approaches to learning have affected students’ cognitive development, including critical thinking, moral reasoning, inclination to lifelong learning, and positive attitudes toward literacy (Mayhew, Seifert, Pascarella, Nelson Laird, & Blaich, 2012; Nelson Laird, Seifert, Pascarella, & Mayhew, 2011; Nelson Laird, Shoup, Kuh, & Schwarz, 2008; Pascarella, Seifert, & Blaich, 2008; Phan, 2007; Phan, 2009a; Phan, 2009b; Phan, 2011). These studies documented that students who adopt deep approaches to learning show an intention—from intrinsic curiosity or a determination to do well—to engage in tasks meaningfully, see things from diverse perspectives, and seek to integrate and synthesize information to make learning conceptual (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003). As Taggs (2003) indicated, “Deep learning is learning that takes root in our apparatus of understanding, in the embedded meanings that define us and that we use to define the world” (p.70).

For several decades scholars in higher education have suggested that students who adopted deep approaches to learning not only showed positive feelings, including interest, pleasure, challenge, and exhilaration (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003), but also had a positive impact on cognitive development (Nelson Laird et al., 2011; Nelson Laird et al., 2008; Phan, 2007; Phan, 2011). As Ramsden (1992) articulated, students who adopted a surface approach to learning showed feelings of “resentment, depression, and anxiety,” where students who used a deep approach to learning tended to show feelings of “personal fulfillment and pleasure” (p.58). Yet, a few scholars have asserted that the importance of deep approaches to learning lies in a conceptual change that helps learners to look at their world from different perspectives (Biggs & Tang, 2011), and the organization of knowledge into a cognitive structure that guides future perceptions and learning (Pintrich, 1988). As Cacioppo et al. (1996) argued, the benefits of cognitive development, feelings of enjoyment, and higher-order thinking develop individuals’ NFC in educational settings. The idea that the process of deep approaches to learning not only empowers students with feelings of enjoyment but also creates conceptual change, which enhances the development of NFC over the four years of college, guided my study.

Purpose of the Study

This longitudinal study was designed to address research issues and gaps in previous studies. The purpose of this study was to adopt Pascarella’s general model for assessing the effects of differential environments on student learning and cognitive outcomes (1985) to estimate the effect of deep approaches to learning on NFC based on the following measures:

- Three deep approaches to learning measures.

- NFC in the presence of potential covariates, such as pre-college characteristics, teaching context, and academic major.
- Score of NFC before college.

As a result, the NFC posttest score, measured at the end of the fourth year of college, can be attributed to the effect of the main independent variable: deep approaches to learning. In addition, this study was designed to investigate whether the effects were general or conditional based on differences in race, gender, precollege total academic preparation, and precollege-measure of NFC.

The following research questions were defined to guide the study:

1. What are the effects of student background, precollege characteristics, and the academic college experiences and non-academic college experiences on end-of-the-fourth-year NFC?
2. What are the net effects of deep approaches to learning on end-of-the-fourth year NFC?
3. Are the net effects of deep approaches to learning on NFC conditional or general?

Statement of the Problem

Postsecondary institutions encourage learning environments that foster deep approaches to learning to enhance students' academic achievement and cognitive development. The importance of a deep approach to learning has been validated by a growing body of studies designed to measure various academic outcomes, including academic achievement (Biggs, 1987; Diseth, 2002; Diseth, 2003; Diseth, Pallesen, Hovland, & Larsen, 2006; Diseth, 2007b; Diseth,

Pallesen, Brunborg, & Larsen, 2010; Duncan & Mckeachie, 2005; Entwistle & Ramsden, 1983; Furnham, Monsen, & Ahmetoglu, 2009; Marton & Säljö, 1976a; Prosser & Millar, 1989; Ramsden, 1992; Rowell, Dawson, & Pollard, 1993), college satisfaction (Nelson Laird et al., 2008), moral reasoning (Mayhew et al., 2012), the development of first-year NFC (Nelson Laird et al., 2011), and critical thinking (Nelson Laird et al., 2011; Nelson Laird et al., 2008; Phan, 2007; Phan, 2011). Unfortunately, research examining deep approaches to learning that predict NFC in college is limited. The present study was designed to address four gaps in the outcomes associated with deep approaches to learning.

First, there is a substantial lack of research that uses NFC as a dependent variable to investigate the effect of deep approaches to learning on the development of fourth-year NFC. Two prior studies found an association between deep approaches to learning and NFC among first-year undergraduates (Evans, Kirby, & Fabrigar, 2003; Pacarella, Seifert, & Blaich, 2008). Even though Nelson Laird et al. (2011) established the causal effect relationship between deep approaches to learning and engagement and the enjoyment of effortful thinking among first-year undergraduates, these researchers did not completely eliminate the effects of students' perceptions of the learning environment. More recently, scholars in higher education found that a large proportion of undergraduates failed to make significant gains in critical thinking and complex reasoning (Arum & Roksa, 2010; Pascarella, Blaich, Martin, & Hanson, 2011). Lack of an operational definition of the expected magnitude of the change makes the interpretation of the small change intellectual and moral development difficult to conclude the values of postsecondary education and therefore puts the reliability of the findings of the two studies into question (Pacarella, Blaich, Martin, & Hanson, 2011). Even so, the findings of the studies remind American higher education to re-examine higher education's functions. This study corroborates

the importance of the adoption of deep approaches to learning to achieve gains in NFC over the four years of colleges.

Second, most of the previous studies on student learning strategies were not designed as longitudinal or randomized experiments to test for internal validity. Randomized experiments of student learning strategies are typically impossible in an educational setting without separating the socialization effects and recruitment effects on intellectual development (Pascarella, 2006). Pascarella (2006) argued that longitudinal pretest-posttest designs with precollege measures of the outcomes and controlled covariates can achieve internal validity by accounting for the socialization (i.e., the effects of the intervention) and recruitment effects (i.e., the effects of student characteristics). The uniqueness of this study is in adopting pretest- posttest designs that estimate the unique effects of deep approaches to learning on the development of NFC over the four years of college. This longitudinal study was designed to use three waves of data to allow for the accountability of socialization effects, recruitment effects, discipline effects, and academic or non-academic experiences in providing a cause-and-effect relationship.

Despite the substantial number of studies that were designed to examine the conditional effects of deep approaches to learning and NFC (Baeten, Kyndt, Struyven, & Dochy, 2010; Cacioppo et al., 1996), no single study has examined the effect of deep approaches to learning on NFC among senior college students as general or conditional effects. Due to the increasing diversity of the American postsecondary student population, Pascarella (2006) argued that in order to avoid being misleading and masking dramatic differences in the impacts of an intervention program addressing various student characteristics, researchers should anticipate that the conditional effects are the rule, not the exception. Although Nelson Laird et al. (2011) found that the effect of deep approaches to learning on the development of first-year NFC is

general rather than conditional, a stringent study to examine whether the conditional effects appeared among senior students represents an important gap in the literature.

Significance of the Study

The results of the current study contribute several findings for practical, policy, and theoretical considerations in creating developmentally appropriate learning environments for senior college undergraduates. The findings of Evans et al. (2003), Pascarella et al. (2008), and Nelson Laird et al. (2011) that established the causal linkage between deep approaches to learning and the development of first-year NFC were extended. The researcher also addressed existing gaps in the literature in which specific courses, programs, or the same institutions were investigated. This longitudinal study was the first large-scale, multi-institutional investigation to examine the effects of deep approaches to learning on end-of-fourth-year NFC after accounting for the potential confounding effects of pre-college characteristics, academic major field, and academic and non-academic experiences. The investigation of whether the effect of deep approaches to learning is general or conditional based on student characteristics, contextual effects, and perceived contextual effects also contributed to this study's significance.

The findings of this study will be important for higher education policy makers, administrators and educators all over the world. For several decades, higher education scholars have believed that deep approaches to learning not only have produced positive educational outcomes but also changed the learner's perspective on how he/she sees the world and how he/she represents knowledge (Biggs & Tang, 2011). In both Europe and the United States, the skills and abilities related to lifelong learning have been considered one of the essential learning outcomes for college students. This study was the first to provide solid evidence regarding the

cause-and-effect relationship between deep approaches to learning and the inclination for lifelong learning.

Investigating conditional effects contributes important implications for higher education administrators and educators. Despite substantial numbers of empirical studies arguing that deep approaches to learning are affected by students' characteristics, contextual factors, and perceived context (Baeten et al., 2010), the conditional effects on NFC among senior students have not been investigated. If deep approaches to learning are particularly beneficial for certain types of students based on race, gender, ACT score, or precollege measure of NFC, leaders in higher education institutions should be encouraged to create specific programs or curricula for those specific student to maximize the benefits of deep approaches to learning. Moreover, college educators should be encouraged to adopt an effective pedagogy to ensure that all students can benefit from the deep approaches to learning.

The findings from this study make a significant contribution to theory development. Biggs and Tang (2011) argued that the acquisition of information cannot change the way we see the world. However, effective learning that helps students structure information leads to conceptual change. A growing body of empirical studies have been focused on the effects of deep approaches to learning on college GPA, course grades, and course satisfaction. In more recent years, a smaller number of researchers have investigated the importance of deep approaches to learning that result in conceptual change, and influence students' cognitive development, such as critical thinking (Nelson Laird et al., 2011; Phan, 2007; Phan, 2009a; Phan, 2009b), moral reasoning (Mayhew et al., 2012), and the development of first-year NFC (Nelson Laird et al., 2011). Some scholars have argued that the process of deep approaches to learning generates positive feelings in students (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003), an

idea that supports the purpose of the present study. It was hoped that the study findings would provide solid evidence that encourages scholars to consider that deep approaches to learning improve academic performance and also contributes to the development of lifelong learning. Furthermore, the findings may also show that the process of deep approaches to learning via conceptual change enhances cognitive development among senior students.

Finally, due to the use of the National Survey of Student Engagement's (NSSE) deep approaches to learning scales as operational variables, this study was the first to test the validity of NSSE's deep learning scales on fourth-year NFC. Scholars have empirically demonstrated the association between deep learning scales with liberal arts outcomes (Pacarella et al., 2008), the relationship to enhance first-year NFC (Nelson Laird et al., 2011), and first-year moral reasoning (Mayhew et al., 2012). Since NSSE has become an important instrument for surveying student participation in educationally purposeful experiences and an assessment tool of important college outcomes (Kuh, 2003; Kuh, 2009; Pacarella et al., 2008; Pascarella, Seifert, & Blaich, 2010), this pioneering study provides additional evidence to show the validity of the prediction of deep approaches to learning on the inclination for lifelong learning.

Assumptions and Delimitations

The present study was designed to focus on the effects of deep approaches to learning on the development of fourth-year NFC and examines whether the effects on NFC are conditional based on race, gender, ACT score, and precollege measure of NFC. Several assumptions have guided the study. First, although a growing body of studies has demonstrated the importance of deep approaches to learning and their impacts on academic achievement, the scope of the findings should be much broader and include cognitive development. In limited studies,

researchers believed that the process of knowledge acquisition played a vital role in the conceptual change and cognitive development of students. Students who adopted deep approaches to learning to handle a task always showed a positive feeling about the process; thus the educational processes led to the development of NFC. Second, researchers have found that deep approaches to learning are influenced by contextual factors, perceived contextual factors, and students' factors, which contribute varied impacts on certain types of students' NFC.

The present study used data from the Wabash National Study of Liberal Arts Education (WNSLAE). Due to the use of this secondary data, the choice of independent variables limited the development of the study to be consistent with the theoretical and previous empirical findings. The scales from the NSSE deep approaches to learning were confined to the higher-order learning scale, the integrative learning scale, and the reflective learning scale. This study focused solely on individuals who adopted deep approaches to learning more frequently rather than on those who adopted a surface approach, and therefore comparisons of deep learning individuals and surface learning individuals were not made. Further, because the purpose of the study was to investigate the effects of deep learning among senior undergraduates, the study population was limited to students who enrolled in four-year colleges rather than in community college students.

Organization of the Dissertation

The purpose of the study was to estimate the effects of deep approaches to learning on the growth of the inclination to inquire and lifelong learning over four years. Given the substantial number of studies that were designed to examine the conditional effects of deep approaches to learning and NFC, this study was the first to determine whether the effect of deep approaches to

learning on NFC was general or conditional. The second chapter presents an extensive literature review and the college impact models and student learning strategy model. The third chapter discusses the research design, detailed information about the sample, the control variables, independent variables, dependent variables, and statistical procedures used to address the research questions. Chapter IV presents detailed results for each of the research questions and Chapter V discusses the overall results, implications for higher education, recommendations for further studies, and the relationships between the findings and theories.

CHAPTER II

LITERATURE REVIEW

This chapter presents a review of the research and literature on the effects of deep approaches to learning on student learning outcomes and cognitive development, the factors that encourage students to adopt deep approaches to learning or surface approaches to learning, and the findings on NFC. The first review area includes a discussion of three main theoretical frameworks of college impact/learning models is provided to understand how the college experience or student learning strategies influences students' cognitive development, academic achievement, and important college outcomes. Following the theoretical discussion, research on the effects of the deep approaches to learning and the effects of specific student characteristics, perceived contextual factors, and contextual factors on the adoption of the deep approaches to learning is presented. This section is composed of three main parts: the development of the deep approaches to learning, the effects of deep approaches to learning on college outcomes, and the factors that influence the adoption of the deep approaches to learning. In the next section, the literature about construct of NFC, the study of NFC as an important predictor, and the study of NFC as an important outcome of college are presented. The next section, the chapter reviews the research on the effects of deep approaches to learning on NFC. A concluding section summarizes the literature on deep approaches to learning and NFC. The purpose of this review is to provide an understanding of the previous literatures and a rationale to conduct the present study.

Theoretical Framework of College Impact/ Learning Models

Astin's (1970a, 1970b, 1977, 1993) input-environment-output (I-E-O) model, Pascarella's (1985) general model for assessing the effects of differential environments on

student learning and cognitive development, and Biggs's (1987, 1989, 2003) presage-process-product (3P) model of student learning have provided the conceptual and analytical frameworks to understand the impact of college on students. These three models have been used to investigate the unique or net effect of college experiences on student growth or change (Astin, 1977; Nelson Laird et al., 2011; Pascarella & Terenzini, 2005).

In the I-E-O model, Astin (1970a, 1970b, 1977, 1993) asserted that college impact could be viewed as an interactive system that included student inputs, student outputs, and the college environment. Student inputs were defined as demographic characteristics, talents, skills, academic and social experiences, personal attributes, and personal values. It was theorized that the inputs did not only directly influence college outcomes, but also indirectly influence the outcome through the environment in which students were engaged. The environment was defined as all aspects of the higher education institutions that shape college experiences, including faculty, staff, peers, curricular or co-curricular program, policies, cultures, teaching practices (e.g., the use of active learning, the use of teaching assistants, working with students on research, etc.), facilities, and any other experiences students encounter during their college life. Outputs were expressed as all aspects of students' development that educators at higher education institutions tried to shape or attempted to influence, including student achievements, knowledge, skills, values, attitudes, aspirations, and after-graduation behaviors.

In the general model for assessing the effects of differential environments on student learning and cognitive outcomes, Pascarella (1985) provided a more refined and accurate conceptual models for multi-institutional studies of collegiate impact. Pascarella's work was a further extension of Astin's I-E-O college model in that it incorporated both an institution's structural characteristics and its environment (Pascarella, & Terenzini, 2005; Pascarella, 1985).

Pascarella further argued that Astin's college environment could be conceptualized as an interactive system of four variables, (a) the structural and organizational characteristics of institutions; (b) interactions with agents of socialization; (c) the institutional environment; and (d) the quality of student effort. Pascarella (1985) thought that five main sets of variables shaped the direct and indirect effects of learning and cognitive development in college. The first set was student background and precollege traits, similar to Astin's student input that included aptitude, achievement, personality, aspiration, and ethnicity. The second set addressed the structural and organizational characteristics of institutions, including institutional type, admission requirements, faculty-student ratio, percentage of graduate students, and percentage of residential students. The third set—the college environment—was shaped not only by student background and precollege traits, but also by the structural and organizational characteristics of institutions. The fourth set of variables—interactions with agents of socialization (e.g., faculty and peers)—were thought to be shaped by the previous three sets of variables. The fifth set of variables—quality of student effort—was influenced not only by student background and precollege traits, but also by “the press of the dominant environment and the norms and values of the peer and faculty cultures with which the student is in contact” (Pascarella, 1985, p.49). Finally, Pascarella (1985) thought of learning and cognitive outcomes as products resulting from the interaction of the previous five sets of variables. Despite the fact that the initial design of this model was intended to examine student learning and cognitive development, Pascarella's model is “equally appropriate for the study of other student outcomes” (Pascarella, & Terenzini, 2005, p.57).

Biggs's (1987, 1989, 2003) framed an effective theoretical foundation to construct the relationships between institutional teaching and learning processes in his 3P model of student learning. He did this by conceptualizing the learning process as an interactive system with three

main components: the learning environment and student characteristics (presage), students' choice of learning focused activities (process), and the learning outcomes (product)(Biggs, 1987; Biggs, 1989; Biggs & Tang, 1999; Biggs & Tang, 2003; Biggs & Tang, 2011;). The 3-P model represented an interactive system of equilibrium in which the various components at the presage and process levels contributed towards the students' learning outcomes (Biggs, 1989; Biggs & Tang, 2003).

Presage factors, present prior to a student's engagement in learning, included both student factors and teaching context. The student characteristics included abilities, prior knowledge, expectations and motivation for learning, and the predisposition to adopt a particular approach to learning (Biggs, 1987; Biggs, 1993). The teaching context factors included course structure, subject area, teaching methods, learning approaches, and workload, all of which contributed to a learning environment (Biggs, 1987; Biggs, 1989).

Process factors were those that described the approaches students adopted towards their learning. While Biggs (1987, 1989) originally used three terms to describe the approaches—surface, deep, and achieving—most empirical evidence indicated that students adopted either surface approaches or deep approaches.

Product factors were those that described the learning outcomes—cognitive and affective—which derived from students' engagement in learning processes. The learning outcome might be the quantifiable measure of how much students learned or the qualitative measure of how students felt about their learning; both impacted student achievement. The 3P model was designed to represent an interactive system rather than a linear system.

The development of deep approaches to learning

Researchers have investigated the most appropriate student approaches to learning to enhance academic achievement for several decades. Marton and Säljö were the two pioneers who established the concepts of deep and surface approaches to learning that have now become firmly established in student learning research (Marton & Säljö, 1976a; Marton & Säljö, 1976b). Their original research revealed the difference between Swedish university student's levels of information processing: that is, students who adopted deep approaches to learning were intent on understanding the materials while students who used surface approaches to learning were intent on reproducing the materials. The researchers suggested that students who engaged in deep-level processing were curious to seek and make meaning of their learning. Students who adopted deep approaches to learning showed an intention, from an intrinsic curiosity or from a determination to do well, to engage in the task meaningfully, see things from diverse perspective, and seek to integrate and synthesize information to making learning conceptually structured (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003). However, as Ramsden (1991) argued, "Surface approaches can never lead to understanding: they are both a necessary and a sufficient condition for poor quality learning. Deep approaches are a necessary, but not a sufficient condition, for high quality outcomes" (p.59).

Based on the findings of Marton and Säljö, a phenomenographic methodology of inventories was developed on the core construct of deep and surface approaches to learning, although these were developed for different purposes and from contrasting theoretical perspectives (Entwistle & McCune, 2004; Lonka, Olkinuora, & Mäkinen, 2004). The five most common instruments for measuring students' approaches to learning in higher education are the following:

1. Approaches to Studying Inventory or ASI (Entwistle & Ramsden, 1983)

2. The Study Process Questionnaire or SPQ (Biggs, 1987)
3. The Learning and Study Strategies Inventory (LASSI)(Weinstein, Schulte, & Palmer, 1987; Weinstein, & Palmer, 2002)
4. The Motivated Strategies for Learning Strategies Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & Mckeachie, 1991)
5. NSSE Deep Approaches to Learning Scales (Nelson Laird, Shoup, & Kuh, 2006).

The ASI (Entwistle, 1983) was designed to distinguish related intentions, motives, and process of learning and studying. The subscales were based on four orientations to studying: meaning, reproducing, achieving, and non-academic orientation. Students using the meaning orientation were intrinsically motivated in learning and had the intention to understand. They used a deep, comprehensive approach to their learning, relating ideas and using evidence as part of their strategies. Students using reproducing orientation were extrinsically motivated by fear of failure, and relied on rote memorization and a syllabus-bound attitude as strategies. Students with the achieving orientation were motivated by achievement motivation, were aware of the requirements to do well, and used an organized studying strategy. The nonacademic orientation was referred to as an apathetic approach (Tait & Entwistle, 1996) and was a category related to negative attitudes about studying (Entwistle & McCune, 2004).

In the SPQ, Biggs (1987) adopted the student approaches to learning theory and distinguished three approaches to learning, each with a motive and an accompanying strategy: deep, surface, and achieving approach. The motive of a student with a deep approach was an intrinsic interest and appropriate engagement in the task, to maximize meaning as a strategy (Biggs, 1987). The motive of a student with a surface approach was fear of failure and the desire to meet the requirement with minimal effort and trouble; the strategies of these students were

memorization and limited to the essential knowledge. The student with an achieving approach effectively organizes and uses his or her time and working space to obtain the highest achievement. Biggs, Kember, and Leung (2001) created a shortened version of the SPQ that included only the deep and surface approaches. This was a version suitable for teachers to monitor the teaching context and contributed to the confirmation that approaches to learning were best described through a deep and surface approach in response to the tertiary environment (Zeegers, 2002).

The most widely used instrument in the United States to assess students' awareness about and the use of learning and study strategies is the Learning and Study Strategies Inventory (LASSI)(Weinstein et al., 1987; Weinstein & Palmer, 2002). Learning strategies can be defined as “any thoughts, behaviors, beliefs, or emotions that facilitate the acquisition, understanding, or later transfer of new knowledge and skills” (Weinstein, Husman, & Dierking, 2000, p.727). Basing on their work on the cognitive approach to learning to understand the process of information coding and the structure of memory, Weinstein and Mayer (1986) distinguished the basic cognitive strategies for information processing as rehearsal, elaboration, and organizational strategies, which parallel the learning strategies identified by Biggs and Entwistle (Duncan, & McKeachie, 2005; Entwistle, & McCune, 2004). The LASSI is a 10-scale self-report instrument related to skills (i.e., information processing, selecting main ideas, and test strategies), the will (i.e., anxiety, attitude, and motivation), and self-regulation (i.e., concentration, self-testing, study aids, and time management) involved in learning.

The MSLQ (Pintrich et al., 1991) was developed from a social-cognitive view of motivation and learning strategies in which the student was seen as an active information-processor with beliefs and cognition that mediated instructional input and task characteristics

(Pintrich, Smith, Garcia, & McKeachie, 1993). Social-cognitive theorists assume that motivation is contextually influenced and learning strategies can be learned and are under students' control rather than being inborn characteristics (Duncan & McKeachie, 2005). Thus, students' motivation varied based on their interests and the perceived value of a particular course; their learning strategy might depend on the nature of the task (Duncan & McKeachie, 2005). The initial purpose of MSLQ was to evaluate the effectiveness of a "learning to learn" course and was subjected to a psychometric analysis based on an investigation of the correlation with academic performance (Pintrich et al., 1993). Because the MSLQ was designed to focus on course level, the operationalization of motivation and cognition was distinguished from the LASSI, which was intended to measure students' learning strategies toward course level rather than general level (Duncan & McKeachie, 2005).

The MSLQ comprises a motivation section and a learning strategies section; it is an 81-item self-report instrument with fifteen subscales (Pintrich et al., 1991). The motivation section with 41 items was developed based on three motivational constructs: expectation, value, and affect (Duncan, 2005; Pintrich et al., 1991). The learning strategies section, based on a general cognitive model of learning and information processing, was designed around three main constructs: cognitive, metacognitive, and resource management (Pintrich et al., 1993). The most basic cognitive strategy subscale measures the use of rehearsal strategy to help recall information (Pintrich et al., 1993). More complex or deep processing strategies involve elaboration, organization, and critical thinking strategy (Duncan & McKeachie, 2005; Entwistle & McCune, 2004; Pintrich et al., 1993). The second general category is metacognitive control strategies, which are used to plan, monitor, and regulate cognitive progress (Pintrich et al., 1993). The third general strategy category is resource management to measure the strategy to self-regulate

students' resources for academic tasks, including time and study environment management, effort regulation, peer learning, and help seeking (Pintrich et al., 1993).

Researchers using the NSSE to annually collect information at hundreds of four-year institutions regarding student participation in educational experiences provided for their learning and development. More than 14,000 higher education institutions and about 3.2 million students in the U.S. and Canada have already participated in NSSE since 2002. Nelson Laird et al. (2006) used exploratory and confirmatory factor analysis to create a deep approach to the learning scale composed of three subscales: higher-order learning, integrative learning, and reflective learning. Unlike ASI and SPQ, the NSSE deep approaches to learning scale was designed to only measure the use of a deep approach to learning and not multiple learning approaches. The NSSE deep approaches to learning scales are thought of as an indicator of a students' preferred approach because they measure students' experiences in a given year (Nelson Laird et al., 2011). The reliability and validity of the deep approaches to learning scale have been thoroughly vetted (Nelson Laird et al., 2006; Nelson Laird et al., 2008).

Research on Deep Approaches to Learning

A myriad of empirical evidence has shown that students who adopted deep approaches to learning tended to earn higher grades, had long-term information retention, actively sought integration of information, earned more credits per year, and had high qualitative learning outcomes (Biggs, 1989; Duncan & Mckeachie, 2005; Entwistle, 1983; Marton & Säljö, 1976a; Ramsden, 1992; Trigwell, & Prosser, 1991; Tynjälä, Salminen, Sutela, Nuutinen, & Pitkänen, 2005; Vermunt, & Vermetten, 2004). Drew and Watkins (1998) used structural equation modeling (SEM) to deconstruct the relationship among academic causal attributions, self-

concept, learning approaches, and learning outcomes. Their analysis found that students who adopted deep learning approaches had higher self-concept and academic achievement; the responses of students who adopted a surface learning approach were negatively related to locus of control and academic achievement (Drew, & Watkins, 1998). Similarly, Boyle, Duffy, and Dunleavy (2003) concluded that a meaning-directed learning style generated statistically significant positive correlations with GPA while a reproduction-directed learning style did not correlate with any academic performance variable. Other researchers used SEM to explore causal models of academic achievement (grade point average) among first- and third-year college students enrolled in a science course in Australia (Zeegers, 2004). Zeegers (2004) found that prior academic achievement was the best predictor of academic achievement, but after that variable was removed and subsequent models developed, a positive relationship between deep approaches to learning and academic achievement ($B=.15$ for the first-year and $B=.12$ for third-year models) was noted. Also noted was a negative relationship between a surface approach to learning and academic achievement ($B=-.16$ for the first-year and $B=-.25$ for the third-year models).

Lizzio, Wilson and Simons (2002) used a higher-order path to investigate the relationship between prior academic achievements, students' perceptions of their academic environment, students' approaches to learning, and academic achievement. The results indicated that a surface approach to learning was a stronger predictor of a students' GPA than deep approaches to learning because the nature of the assessments were related to the memorization of declarative or procedural knowledge. However, Lizzio et al. (2002) also found that a deep approach is related to the self-reported development of generic skills related to enjoyment and lifelong learning,

including written communication, problem solving, analytic skills, teamwork, ability to plan one's own work and confidence in tackling new situations.

A growing body of studies has examined the relationship between approaches to learning and outcomes in physics (Prosser & Millar, 1989; Prosser, Trigwell, & Taylor, 1994; Rowell et al., 1993), accounting courses (Byrne, Flood, & Willis, 2002; Elias, 2005), chemistry courses (Zusho, Pintrich, & Coppola, 2003), and computer-based curriculum (Aharony, 2006; Sankaran, & Bui, 2001) but the results were mixed. Rowell et al. (1993) identified the characteristics of students at risk among first year university students in physics and concluded that students who adopted a deep approach earned higher grades, failed or withdrew from a physics course less often. Similarly, Byrne et al. (2002) confirmed the effects of students' approaches to learning on their academic performance among Irish accounting students, although the operational definitions of student approaches to learning and outcomes differed in that the Byrne et al. study included a strategic approach and an instrumental approach. After dividing the academic outcome into three subscores—a group presentation score, a problem solving questions score, and an essay question score—Byrne et al. (2002) found that a deep approach and a strategic approach have a statistically significant relationship with problem-solving questions, while the instrumental approach (i.e., a surface approach), has a negative relationship with problem-solving questions. Furthermore, a deep approach and a strategic approach were positively associated with high academic performance and the instrumental approach was related to poor performance. On the contrary, researchers typically found that the key strategy toward success in the natural and social science disciplines was to use a surface approach due to the nature of assessment methods (multiple choice exams), the methods of presenting course materials

(lecture), and the types of knowledge (facts and definitions) (Prosser & Millar, 1989; Vanderstoep, Pintrich, & Fagerlin, 1996; Wolters, & Pintrich, 1998; Zusho et al., 2003).

Another group of studies found a weak and mixed relationship between deep approaches to learning and academic achievement (Diseth, 2003; Diseth et al., 2006; Diseth et al., 2010; Murphy & Alexander, 2002; Watkins, Sternberg, & Zhang, 2001). Watkins et al. (2001) concluded that the correlations between approaches to learning and academic achievement were weak although the results were consistent across cultural and educational levels. Murphy and Alexander (2002) used SEM to investigate the effects of subject-matter knowledge, strategic processing, and interest in domain-specific performance among 77 students enrolled in an educational psychology course. They concluded that the adoption of surface-level strategies positively predicted their posttest performance while the adoption of deep-level strategies inversely predicted their posttest knowledge. The plausible explanation was that the assessment emphasized declarative knowledge in the form of multiple-choice questions (Murphy & Alexander, 2002). Diseth et al. (2006) also used SEM to investigate the relationship between course experience and approaches to learning with academic achievement. Diseth et al (2006) concluded that deep and surface approaches were not significantly related to academic achievement in the form of multiple choice question examination. Watkins et al. (2001) argued that the assessment system determined if students benefited from a deep approach to learning; the relationship between study approaches and grades is moderated by the nature of the assessment relative to whether it emphasized reproduction or the understanding of knowledge (Lizzio et al., 2002).

In delineating the link between deep approaches to learning and portfolio grades, Lonka, Keikkila, Lindblom-Ylänne, et al. (1997) found that meaning-directed learning positively

correlated with students' portfolio grades while reproduction directed learning negatively correlated with students' portfolio grades. The study also resulted in empirical evidence that students who engaged in portfolio assessments were more likely to adopt deep approaches to learning compared to students who participated in multiple choice question examinations. The process of constructing a portfolio stimulated reflection and analysis (Zeichner & Wray, 2001) and required deep approaches to learning. Researchers of a recent study suggested that those who adopted a deep approach to learning perceived the portfolio as stimulating their thinking and as requiring in-depth understanding and meaningful learning (Segers, Gijbels, & Thurlings, 2008). Segers et al. (2008) found teachers' feedback and students' perceptions of that feedback was motivating, supported learning, and encouraged the adoption of deep approaches to learning. Thus, compared to those who adopted a surface approach, students who adopted a deep approach read teacher feedback carefully, applied the feedback to their portfolio, and improved their work.

Scholars have suggested that adopting deep approaches to learning resulted in positive feelings for students that included enjoying the process, devoting themselves to studying, and looking forward to studying. (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003). Svensson (1977) conducted a study to determine the relationship between student learning strategies and examination performance and found that adopting deep approaches to learning resulted in positive affective outcomes for students. For example, they felt the educational material was interesting and simple and they were willing to spend more time on studying. Biggs and Tang (2011) indicated that using the deep approach to handle a task generated positive feelings—interest, a sense of importance, challenge, and exhilaration—in students during the process. Empirical studies also found that deep approaches to learning were associated with satisfaction,

whereas the surface approach was related to dissatisfaction (Biggs, 1987; Nelson Laird et al., 2008).

Another group of small studies addressed the relationship between deep approaches to learning and intellectual and personal development. Gadzella and Masten (1998) investigated differences and relationships between learning styles and critical thinking among 184 undergraduate students. They argued that critical thinking was positive and correlated with deep processing ($r = .35$) and fact retention ($r = .18$). Their results confirmed their hypothesis that students who had higher scores on the deep processing scale were skilled critical thinkers. They concluded that critical thinking can be taught through students' learning strategies. Similarly, Chapman (2001) argued that the adoption of deep approaches to learning as a teaching method improved the gains of higher-order thinking skills among 124 students in the course of a two-semester introductory biology series. Zhang and Watkins (2001) investigated the relationship between student approaches to learning and their stage of cognitive development. Based on Perry's scheme of intellectual and ethical development, Zhang and Watkins developed the Zhang cognitive development inventory with three levels of Perry's theory, including dualism (i.e., knowledge is absolute and dualistic), relativism (i.e., knowledge is contextual and relative), and commitment of cognitive development (i.e., students make commitments to ideas, values, and behaviors). They found that students who reported a more dualistic way of thinking tended to adopt a surface approach to learning; students who reported a more relativistic and committed way of thinking tended to adopt a deep approach to learning.

In an effort to establish the causal linkages between deep processing strategies and reflective thinking, Phan (2007) conducted a path-analytical study to investigate the relationship among learning approaches, self-efficacy beliefs, reflective thinking, and academic achievement.

Using Mezirow's theory of classified reflective thinking that included four stages—habitual action, understanding, reflection, and critical reflection—Phan (2007) found that a surface approach predicted habitual action and a deep approach predicted understanding and reflection. Phan (2008, 2009a, 2009b) conducted a series of studies based on structural equation modeling to establish cause-and-effect relationships between deep processing strategies and critical thinking, and found that reflection and critical thinking contributed to academic performance. Phan (2009) also conducted a longitudinal study to examine mastery goals, self-efficacy, deep processing, and critical thinking among 264 second-year educational psychology students and found that deep processing and critical thinking had a reciprocal relationship. Based on these findings, Phan (2011) explored the developmental course of the deep learning approach and critical thinking over two years with latent growth curve modeling procedures. The findings indicated that the initial state of critical thinking was related to a rapid increase in the adoption of deep learning strategies. This confirmed a significant bidirectional relationship between critical thinking and the deep learning approaches. Phan (2011) concluded that “critical thinking in this case may serve as an informational source to help students engage in deep learning strategies” (p. 292).

Deep approaches to learning have positive influences on intellectual, personal, and cognitive development (Mayhew et al., 2012; Nelson Laird et al., 2008). Nelson Laird et al. (2008) investigated the effect of deep approaches to learning on college outcomes by various disciplinary categories. They concluded that senior college students who frequently engaged in deep learning behaviors reported gaining more in intellectual and personal development (i.e., they acquired a broad general education, learned effectively on their own, understood themselves, and solved complex, real-world problems), earned higher grades and had greater

satisfaction with their collegiate experiences. Deep learning also influenced the development of moral reasoning because complex and higher-order expressions of cognition were found to be related to moral reasoning development (Mayhew et al., 2012). Among three subscales of deep approaches to learning, Mayhew et al. (2012) argued that integrative learning—defined as integrating information from various sources and diverse perspectives—had a modest impact on moral reasoning gain among first-year undergraduates.

Another study focused on the relationships among conceptions of learning, approaches to studying, personal development, and personal change from first year to after graduation (Edmunds & Richardson, 2009). Edmunds and Richardson (2009) found that students who regarded learning as the construction of knowledge and who adopted a deep approach instead of a surface approach reported a greater development of cognitive skills and greater academic change. They also found that students who adopted a surface approach reported negative development of cognitive skills, mathematical skills, academic change, and social skills.

Factors Influencing the Adoption of Deep Learning

In a recent qualitative meta-analysis, Baeten et al. (2010) indicated that age was positively associated with a deep approach to learning and negatively associated with a surface approach to learning. Edmunds and Richardson (2009) argued that “older students are more likely than younger students to hold reconstructive conceptions of learning and to adopt a deep approach to studying” while younger students tended to focus on the intake of knowledge and adopt a surface approach (p.303). In addition, while Marrs and Sigler (2012) found that among American college students women tended to adopt deeper approaches to learning than men, Baeten et al. (2010) concluded that the relationship between gender and approaches to learning

was inconclusive, and a growing body of researchers have not found any significant relationship between gender and approaches to learning. The literature examining how and to what extent race affected a student's learning approaches has found that the relationship was inconclusive. Ridley (2007) administered the revised approaches to studying inventory at an English university. Among 77 first-year psychology undergraduates, Ridley classified students into four groups: White British, White students, Black Caribbean, and Black African. Ridley (2007) concluded that there was no significant difference among these four groups in the use of a deep approach and a strategic approach, but that Black African and Black Caribbean students tended to adopt a surface approach more so than individuals in the two White groups. Richardson (2010) conducted a study to investigate the conceptions of learning and approaches to studying among White and ethnic minority students taking courses via distance learning at the UK Open University. Students were separated into five categories: White, mixed, Asian or Asian British, Black or Black British, Chinese, or other. Richardson concluded that the White students were more likely to adopt meaning-directed learning than the Asian and Black students, who were more likely to adopt a surface approach.

Personality has been found to be an important factor in predicting students' learning approaches and motivations, and also explains students' teaching preferences (Chamorro Premuzic, Furnham, & Lewis, 2007; Chamorro Premuzic, & Furnham, 2008; Diseth, 2003; Furnham, Swami, Arceche, & Chamorro-Premuzic, 2008; Furnham, Monsen, & Ahmetoglu, 2009; Swanberg & Martinsen, 2010; Zhang, 2003). A group of researchers discovered that openness to experiences (i.e., open-mindedness, active imagination, and preference for variety) and conscientiousness (i.e., being purposeful, responsible, and trustworthy) were significantly related to deep approaches to learning (Diseth, 2003; Swanberg & Martinsen, 2010; Zhang,

2003). Chamorro-Premuzic et al. (2007) found that the deep approach to learning was related to low neuroticism (i.e., emotional instability, embarrassment, and pessimism), openness, agreeableness (i.e., being altruistic, sympathetic, and helpful), and conscientiousness. In general, the surface approach to learning was associated with neuroticism (Diseth, 2003; Swanberg & Martinsen, 2010; Zhang, 2003).

The effects of intellectual ability on students' learning strategies differed depending on how intellectual ability was defined and operationalized. Using crystallized intelligence, fluid intelligence, and spatial intelligence to represent general intelligence, a significant negative correlation between surface approach and crystallized intelligence was discovered (Diseth, 2002). Similarly, a study investigated the relationships among intellectual ability, learning style personality, achievement motivation, and academic success among first-year psychology students to find that intellectual ability had a negative correlation with reproduction orientation (Busato, 2000). However, Chamorro Premuzic and Furnham (2008) found that students with higher intelligence ability adopted deep learning approaches, which led to higher achievement. In addition, they also argued that intelligence ability was affected by fluid intelligence, which in turn affected deep learning. Using the same instruments of the Chamorro Premuzic and Furnham (2008) study, but different participants, Furnham et al. (2008) concluded that crystallized and fluid intelligence did not have any association with deep approaches to learning, surface approaches to learning, or achieving approaches to learning.

Researchers have investigated the effect of academic discipline on approaches to learning (Biggs, 1987; Eley, 1992; Entwistle & Ramsden, 1983; Prosser & Millar, 1989). According to Biglan's classification, students who majored in a soft field in which there was less consensus about the content tended to use deep approaches to learning. On the contrary, students who

majored in a hard field with greater consensus about the content tended to use deep approaches to learning less by a quarter of a standard deviation compared to students in soft fields (Nelson Laird et al., 2008). Smith and Miller (2010) found that academic discipline had a significant effect on student learning approaches. For example, compared to business students (hard field), psychology students (soft field) tended to adopt deep approaches to learning rather than surface approaches to learning. Kember, Leung, and McNaught (2008) stated that “the nature of a teaching and learning environment in the arts, humanities, and social science is more conducive to cultivating a deep approach” than in science and engineering (p.54). However, Basten et al. (2010) conducted a qualitative metasynthesis and concluded that academic discipline seemed to make a difference in adopting deep approaches to learning, although some researchers did not find any differences between disciplines.

Many empirical studies have argued that the association between a perceived inappropriate and excessive workload and a surface approach is unequivocal (Diseth et al., 2006; Diseth, 2007a; Diseth, 2007b; Entwistle & Ramsden, 1983; Entwistle & Tait, 1990; Kember, Sandra, Harrison, Wong, & Pomfret, 1996; Kember, 2004; Lawless & Richardson, 2002; Lizzio et al., 2002; Trigwell & Prosser, 1991; Trigwell, Ashwin, & Millan, 2012). Many researchers have also found that a perceived appropriate course workload was positively correlated to deep approaches to learning (Cope & Staehr, 2005; Diseth et al., 2006; Diseth, 2007a; Diseth, 2007b; Trigwell et al., 2012). Entwistle and Ramsden (1983) argued that students who perceived their workload to be excessive tended to adopt a reproduction orientation or a surface approach. Diseth (2007b) used SEM to investigate five evaluation-perception factors—workload, presentation, perspective-integration, lecture, and effect—on academic achievement. Diseth argued that workload had a direct effect and an indirect effect on examination grades based on

surface approaches to learning. The plausible explanation was that the perception of a heavy workload encouraged students to adopt a surface approach because they felt they had less freedom and, as a result, tended to resort to short cuts and undesirable approaches to handle the excessive demands (Kember, 2004; Trigwell & Prosser, 1991). However, Karagiannopoulou and Christodoulides (2005) did not find any significant relationships among workload, approaches to learning, and academic outcomes. Kember (2004) argued that workload perceptions were shaped by many factors and the manifestation of a perceived heavy workload was influenced by pressure and stress.

Scholars have demonstrated that good teaching, defined by clear goals and standards, appropriate assessments, and an emphasis on independence, was associated with deep approaches to learning (Crawford, Godon, Nicholas, & Prosser, 1998; Diseth et al., 2006; Diseth, 2007b; Entwistle, 2009; Entwistle & Tait, 1990; Karagiannopoulou & Christodoulides, 2005; Lawless & Richardson, 2002; Lizzio et al., 2002). Lizzio et al. (2002) indicated that good teaching has not only a direct effect on academic achievement and qualitative learning outcomes, but also an indirect effect on students' learning strategies. Lizzio et al. (2002) concluded that the strongest predictor for the adoption of a deep approach to learning was the quality of teaching and appropriate assessments. Diseth (2007a) indicated that students who perceived bad teaching quality were likely to adopt a surface approach, resulting in lower achievement. In addition, Diseth (2007b) concluded that students who perceived good teaching quality (defined as presentation, integration, perspective, and lecturer characteristics) tended to adopt deep approaches to learning through the effects of teaching (challenge, overall value, and stimulation of interest). In addition, students tended to adopt a deep approach to learning when they perceived teaching support, defined as a general supportive encouragement of their learning,

clear goals, sensitivity to student mental processing in learning, and an emphasis on independent learning (Eley, 1992).

In addition to good teaching, the effect of feedback on the adoption of a deep approach to learning has also proved to play a crucial role. Segres et al. (2008) investigated 11 conditions for assessments to enhance student learning and explain the relationship between assessment practice and students' learning approaches. They concluded that "with respect to a deep approach to learning, the results indicated a relationship with what students do with the feedback they receive, how they perceive portfolio assessment to stimulate their learning, and how interesting and stimulating they perceive the portfolio assessment to be" (p.42). To investigate the effects of feedback on the changes in learning approaches, Gijbels, Coertjens, Vanthournout, Struyf, and Van Petegem (2009) conducted a two-year study (a pre- and post-test study) to compare the effects of additional and formative feedback among two cohorts. They found that the increase in feedback in cohort 2 did not "predict surface and deep learning approaches over and above pre-test scores and student characteristics" (p.509). The plausible reason is that student-learning approaches are a complex interplay product between the learning environment and student characteristics.

Need for Cognition (NFC)

The NFC was originally conceptualized as "a need to structure relevant situations in meaningful, integrative ways and reflected a need to create a reasonable world (Cohen, Stotland, & Wolfe, 1955, p. 291). Because the assessment instrument that Cohen et al. (1955) used was never described in detail and is no longer available (Cacioppo, Petty, & Morris, 1983), Cacioppo and Petty (1982) proposed that NFC referred to "...stable individual differences in people's

tendency to engage in and enjoy effortful cognitive activity” (Cacioppo et al., 1996, p. 197). NFC was conceptually thought of as intrinsic motivation rather than intellectual ability, which meant that an individual high in NFC showed more motivation in making efforts for “information acquisition, reasoning, and problem solving to cope with a wide variety of predicaments in their world” (Cacioppo et al., 1996, p. 199).

The NFC construct was developed based on dual-process theories of judgment based on the idea that some judgments were made based on careful consideration of information presented while other judgments were based on a cursory analysis (Petty, Brinol, Loersch, & McCaslin, 2009). The purpose of the elaboration likelihood model (Petty & Cacioppo, 1981; Petty & Cacioppo, 1986) was to provide a general framework to explain differential persistence of communication-induced attitude change. Petty and Cacioppo (1981) argued that individuals who were high in NFC thought carefully about the information in a persuasive message and were influenced by argument quality; individuals low in NFC were more influenced by peripheral cues of persuasion (e.g., celebrities and experts).

Chang (2007) found that individuals high in NFC preferred diagnostic product information to engage in brand-evaluation. This resulted in enhanced advertisement persuasion for these individuals. On the contrary, those low in NFC responded more negatively to diagnostic information and demanded an effort of message elaboration and a higher degree of cognitive capacity (Chang, 2007). Petty et al. (2009) synthesized several studies and concluded that individuals low in NFC tended to treat the following factors as simple cues: “the attractiveness or credibility of the message sources,” “the appearance and frame of the message,” and “their own emotional states” (p. 321).

Individuals with high NFC are more likely to engage in metacognition (Petty, Brinol, Tormala, & Wegener, 2007; Petty et al., 2009). Metacognition was often “referred to as the knowledge about and regulation of one’s cognitive activities in learning processes” (Veenman, Van Hout-Wolters, & Afflerbach, 2006, p. 3). Perry et al. (2007) argued that individuals with high NFC were more likely to think about their thoughts, to “evaluate their own thoughts for validity,” “to engage in controlled and automatic bias correction processes,” and “to draw different metacognitive inferences based on their responses to persuasive messages” (p. 269).

Clearly, individuals with high NFC used a different decision-making process compared to their counterparts. Those high in NFC tended to expend more cognitive effort on an information search preceding a decision (Levin, Huneke, & Jasper, 2000; Verplanken, Hazenberg, & Palenewen, 1992). Individuals with high NFC also tended to make a greater effort than low NFC individuals to think about available options for the purpose of making high quality decisions (Levin et al., 2000). Verplanken (1993) investigated the relationship among NFC, time pressure, and an information search during decision making and found that low-NFC individuals allocated less mental energy to a decision task and used easier strategies when under time pressure. Although high-NFC individuals increased their thinking and information search before their decision making, a better decision was not guaranteed if their thoughts were already biased at the beginning (Lerner & Tetlock, 1999). It was much easier for high-NFC individuals to be influenced by bias because they engaged in more thinking (Cacioppo et al., 1996). Carnevale, Inbar, and Lerner (2011) investigated the relationship between NFC and four domains of decision-making competence: resistance to framing, confidence calibration, consistency in risk perception, and sensitivity to sunk costs among 175 high-level leaders. They concluded that

high-NFC leaders performed much better on task framing and sensitivity to sunk costs but did not correlate with confidence calibration and consistency in risk perception (Carnevale et al., 2011).

Scholars also established causal linkages of NFC and the acquisition of complex skills (Day, Espejo, Kowollik, Boatman, & McEntire, 2007; Espejo, Day, & Scott, 2005). Day et al. (2007) conducted a study to determine whether NFC had a direct effect or an indirect effect relative to learning orientation (defined as improving one's competence by developing new skills), performance-avoidance orientation (defined as avoiding demonstrating one's lack of competence), self-efficacy, or cognitive ability on skill acquisition in a training environment involving a novel and complex computer task. Day et al. (2007) concluded that NFC influenced skill acquisitions indirectly through learning orientation and self-efficacy, but no direct effect was found in this study. The authors also found NFC to be a determinant of skills acquisition for the purposes of selecting individuals for training (Day et al., 2007).

High NFC individuals are motivated to engage in elaborative processing, which has significant associations with student performance (Cacioppo & Petty, 1982). In efforts to think about and elaborate on information, regardless of the argument quality, high NFC individuals made more cognitive efforts and recalled more message arguments (Cacioppo, Petty, & Morris, 1983). Cacioppo, Petty, Kao, and Podriguez (1986) designed a quasi-experimental study using participants from an introductory psychology course to conclude that low NFC individuals recalled fewer arguments presented in an audio tape than high NFC participants. Leone and Dalton (1988) investigated the effect of NFC on college grades among 35 men and 52 women in an introductory social psychology classes. The assumption of the study was that "students predisposed to engage in and to enjoy thinking would better comprehend concepts and ideas"

(Leone & Dalton, 1988, p. 175). They found that NFC was related to the comprehension of course material requiring effortful thought. Elias and Loomis (2002) found that NFC was a significant predictor of college grade point average.

NFC has an indirect effect through elaborative processing on academic achievement rather than a direct effect on academic achievement. Sadowski and Gulgos (1996) examined the relationship between NFC, elaborative processing, and academic achievement among 51 undergraduates in a social psychology course. They found that high NFC individuals showed better test performance, which was attributed to their ability to be more effective in elaborating on the information, thus improving their involvement, comprehension, and retention with the course material. However, Sadowski and Gulgos (1996) also found that NFC did not have any direct effect on test performance after accounting for the effect of elaborative processing. These study results suggested that high NFC individuals tended to use elaborative processing strategies, defined as the ability to organize and synthesize information and provide complex explanations.

The association between NFC and educational attainment has been examined, but the reciprocal relationship is still unclear (Cacioppo et al., 1996; Jensen, 1998). Jensen (1998) investigated the relationship between NFC and educational level among 81 undergraduates and graduates. After controlling for age, verbal ability, and social desirability, Jensen found that the difference in NFC scores was significant between first-year undergraduates and senior undergraduates, and between first-year undergraduates and advanced graduates. Similarly, Cacioppo et al. (1996) conducted a meta-analysis to report the association between NFC and education level ($r = .25, p < .001$). However, it was unclear if the relationship represented a process of self-selection (i.e., high NFC individuals tended to pursue education), was an outcome

of higher education, or other covariates (i.e., individuals with high intelligence tended to attain higher levels of education and NFC) (Cacioppo et al., 1996).

While most empirical researchers considered NFC as an important predictor, one group of studies was designed to consider NFC as an outcome measure. Cacioppo et al. (1996) indicated that an individual's NFC can be changed over time based on past and current experiences, and argued that the development of NFC "may benefit from the construction of contingencies (e.g., in educational settings) that foster both cognitive development and feelings of enjoyment, competence, and mastery in thinking" (p. 246). Cacioppo et al. (1996) also stated that NFC can be "conceived as derived from past experience, buttressed by accessible memories and behavioral histories, manifested in current experience, and be influential in the acquisition or processing of information relevant to dilemmas or problems" (p. 197).

Teaching learning strategies was thought to be a means to help students develop effective methods for adapting and regulating their information processing and to prepare them to be lifelong learners. Mckeachie, Pintrich, and Lin (1985) used a quasi-experimental design to investigate whether the "learning to learn" course, designed to combine the use of learning strategies and the understanding of cognitive and motivational theory, improved the probability of classroom success. The authors concluded that teaching learning strategies had positive impacts on the change in learning strategies, expectancy for success, and NFC. These findings supported the hypothesis that a students' NFC could develop over time in educational settings that purposely fostered cognitive development (Cacioppo et al., 1996). Due to the limitations of a quasi-experimental design, the comparison group had higher SAT scores than the treatment group. Because they did not take self-selection into account, the study authors sacrificed internal validity and needed further validation.

An empirical effort was attempted to discover the effect of educational practice on the development of NFC (Mayhew et al., 2008). They conducted a study to determine the effect of curricular conditions and educational practices on the development of lifelong orientations operationally defined as NFC among 405 university students in five undergraduate courses. Using a pretest-posttest quasi-experimental design, they found that students' NFC changed over the semester of the course and that change was significantly influenced by exposure to purposeful pedagogical practices, such as perspective taking, active learning, and reflection. Positive interaction with diverse peers had a significant effect on the development of NFC. More importantly, the positive effects of exposure to purposeful pedagogical practices regarding the development of NFC benefitted all students regardless of sex, race, level of education, political orientation, and pretest NFC.

In recent years, a small number of researchers have attempted to investigate which college environments fostered the development of NFC. Lindsay (2007) examined how three elements of a liberal arts education—type of institution, discipline, and experiences of liberal arts practices—influenced students' NFC among 315 undergraduates at four institutions: a liberal arts college, a community college, a regional university, and a research university. Lindsay identified several characteristics that had a positive significant relationship with NFC: (a) a larger institutional size was associated with high NFC; (b) students who majored in a liberal arts discipline were more likely to have high NFC than those in a non-liberal arts discipline; (c) the educational experiences, including integrative experiences and enrollment in diversity related courses, may have positively fostered the development of NFC. Goodman (2011) examined how structural diversity, the psychological climate for diversity, and behavior influenced the development of first-year NFC among African-American, Asian-American, Latino, and White

undergraduates. Goodman (2011) found that students' value of racial and cultural diversity influenced the development of NFC among African-American, Asian-American, Latino/ a, and White college students. For example, taking a diversity course positively influenced African-Americans' NFC while the students' belief that the institution facilitated diverse interaction affected the Latinos' NFC; interacting with diverse others and participating in a racial workshop influenced Whites' NFC.

Deep Approaches to Learning and NFC

In an effort to clarify the relationship among a number of constructs related to approaches to learning and thereby giving postsecondary institution educators a comprehensive picture of the different constructs, Evans et al. (2003) conducted research based on the results of an NFC scale, a study process questionnaire, and a strategic flexibility questionnaire administered to 226 first-year students at a Canadian military college. The researchers then conducted confirmatory factor analysis with a maximum likelihood estimation to find substantial associations between deep approaches to learning and NFC ($r = .78$). Further, Evans et al. 2003 conducted another exploratory analysis to investigate the second order model, which indicated an important relationship among self-regulation, deep approaches to learning, and NFC. However, the results of this confirmatory factor analysis only confirmed a correlation between deep approaches to learning and NFC, because the researchers could not directly conclude that deep approaches to learning had a mechanical casualty relationship with NFC.

Researchers in another study have positively linked deep approaches to learning and NFC. Pascarella et al. (2008) analyzed 2006 cohorts from WNSLAE to validate NSSE measures of good practice in undergraduate education against the students' first-year development in

effective reasoning and problem solving, well-being, inclination to inquire and lifelong learning, intercultural effectiveness, leadership, and moral character. The researchers used an upper- and lower-bounds estimate to investigate the effects of the NSSE benchmark and deep learning scales on the liberal arts outcomes.

In another recent investigation of the effect of deep approaches to learning on the cognitive development of first-year college students, including critical thinking skills, the inclination to inquire, and an orientation toward involvement in literacy activities, Nelson Laird et al. (2011) found that deep approaches to learning had a positive and statistically significant relationship with NFC. Positive attitudes toward involvement in literacy activities were also found, after taking covariates including precollege measure of the outcome measures, student background characteristics, and first-year college experiences into account. Furthermore, Nelson Laird et al. (2011) argued that the association between integrative approaches to learning and NFC was positively related because the NFC served as the internal motivation needed to integrate information from varied perspectives. The researchers also found that reflective approaches to learning played a critical role in generating a student's developmental gains in critical thinking, NFC, and positive attitudes toward involvement in literacy activities. However, the study did not address certain covariates of interests, including academic major and the context of institutional teaching. Furthermore, the study only investigated the effect of deep approaches to learning on cognitive development in first-year undergraduates. Although the same researchers are currently implementing a restricted pre-test/post-test design and taking covariates into account, the two time points of data will make it difficult to understand whether the effects of deep approaches to learning on NFC still appear or not.

Conclusion of the Literature Review

Despite a growing body of studies emphasizing the importance of deep approaches to learning among higher-education students over several decades, higher-education researchers have not fully demonstrated that the use of deep approaches to learning will improve NFC among undergraduate students. The traditional student learning strategies literature has focused on academic achievement (Biggs, 1989; Entwistle, 1983; Lizzio et al., 2002; Marton & Säljö, 1976a; Ramsden, 1992; Trigwell & Prosser, 1991; Tynjälä et al., 2005; Vermunt & Vermetten, 2004). Because of the nature of the rapid changing environment in the twenty-first century, students should have the ability to learn more and face intellectual challenges. This is essential after their graduation (AAC&U, 2007) because researchers have found that most graduates think a university education is inadequate for work—life development (Tynjälä, 2008). A small group of studies suggested that the process of deep approaches to learning improved cognitive development, including moral reasoning (Mayhew et al., 2012), the development of first-year NFC (Nelson Laird et al., 2011), and critical thinking (Nelson Laird et al., 2011; Nelson Laird et al., 2008; Phan, 2007; Phan, 2011). These limited studies revealed that the process of deep approaches to learning not only produced enjoyment but also enhanced cognitive development through conceptual change.

Though substantial empirical studies have argued that deep approaches to learning are affected by students' characteristics, contextual factors, and perceived context (Baeten et al., 2010), the conditional effects on NFC among senior students have not been investigated. As Arum and Roksa (2011) argued, college students did not equally benefit from their college experiences or achieve the same progress. In addition, Pascarella (2006) argued that researchers in higher education should anticipate that conditional effects are the rule not the exception

because of the diversity of American society. Furthermore, after an extensive literature review, only one study (Nelson Laird et al., 2011) investigated whether the effect of deep approaches to learning is general or conditional. This study addressed the gaps in the literature—thoroughly discussed in Chapter One and Chapter Two—using a longitudinal study with multi-institutional data to investigate the effect of deep approaches to learning on the development of NFC over four years of college. It also addressed whether the effects of deep approaches to learning varied based on race, sex, effective teaching, and precollege measure of NFC.

CHAPTER III

CONCEPTUAL FRAMEWORK AND METHODOLOGY

Conceptual Framework

The three conceptual frameworks guiding this study were Astin's (1970a, 1970b, 1977, 1993) I-E-O model; Pascarella's (1985) general model for assessing the effects of differential environments on student learning and cognitive development; and Biggs's (1987, 1989, 2003) 3P model of student learning.

In the I-E-O model, Astin emphasized the impact of specific college experiences on college outcomes: the function of students' background characteristics (i.e., gender, race, ability, and academic and social experiences) and the college environment that shaped student experiences (i.e., curricular and co-curricular programs, teaching strategies, and interaction with faculty and peers). In the 3P model, Biggs (1987, 1989, 2003) emphasized how student background characteristics and the college context influenced students' choices of learning approaches. In Pascarella's model, the researcher took into account the effects of structural/organizational characteristics of institutions, student background/precollege traits, interaction with agents of socialization, the institutional environment, and the quality of student effort on students' learning and cognitive development. In addition, Pascarella emphasized interactions with agents of socialization, which was an important factor related to the dual-process theories in social psychology (Petty et al., 2009). The purpose of Pascarella's model was to initially explain changes in students' learning and cognitive development (Pascarella & Terenzini, 2005) and closely to the characteristics of NFC (Petty et al., 2009) that emphasized the interactions with agents of socialization, which is more appropriate to guide this study.

The goal of the present study was to examine the effect of deep approaches to learning on fourth-year college students' NFC after accounting for the confounding variables. In addition, this study was designed to explore whether the effects of deep approaches to learning were conditional or general (i.e., whether the effects of deep approaches to learning differed based on the pre-college characteristics of the students, such as sex, race, ACT score, and pre-college NFC score). Therefore, the conceptual model for this study was derived from Pascarella's model and was comprised of the variables that prior studies identified as predictors of NFC (Cacioppo et al., 1996; Nelson Laird et al., 2011) as well as the variables that influenced the use of deep approaches to learning (Biggs & Tang, 2011; Entwistle, 2009; Hattie, 2009; Nelson Laird et al., 2011; Nelson Laird et al., 2008; Trigwell & Prosser, 1991).

In Figure 1, the conceptual model guiding this study is illustrated. Student background and pre-college traits included race, gender, parental education, precollege ACT score and equivalent secondary school involvement, academic motivation, participation in end-of-first year assessment and a precollege measure of NFC (fall 2006). The institution types in the sample were 17 research universities, regional universities, and liberal art colleges. The study also included academic or nonacademic experiences as covariates, including place of residence during college, work responsibility, academic major field of study, and co-curricular involvement. The major study variables were three deep approaches to learning subscales.

Methodology

In this study, data from the Wabash national study of liberal arts education (WNSLAE) were analyzed. WNSLAE is a multi-institutional longitudinal investigation of the effects of academic and nonacademic experiences on outcomes associated with undergraduate education.

The WNSLAE comprises six general dimensions of liberal arts outcomes: effective reasoning and problem solving, well-being, inclination to inquire and lifelong learning, intercultural effectiveness, leadership, and moral character (Pascarella, 2007). Although the WNSLAE encompassed three cohorts (2006, 2007, and 2008), the current study only included the 2006 cohort due to its higher response rate.

Institutional Sample

The original sample in this study represented incoming first-year students at 17 four-year colleges and universities within the United States purposefully selected to produce representative data. The same students were again surveyed after their second semester as freshmen, and a third time after their senior year was completed.

Institutions were selected from more than 60 colleges and universities whose leaders responded to a national invitation to participate for the 2006 cohort. Funded by the Center of Inquiry in the Liberal Arts at Wabash College, the WNSLAE is a major longitudinal investigation of the effects of liberal arts colleges and liberal arts experiences on the cognitive, psychosocial, and personal outcomes theoretically associated with a liberal arts education.

For the purpose of representing differences in colleges and universities nationwide, the institutions were selected based on a variety of characteristics including institutional type, size, selectivity, location, and patterns of student residence. Given the focus on the impacts of liberal arts colleges and liberal arts experiences, liberal arts colleges were purposefully over-sampled. According to the Carnegie classification of institutions, three of the schools were considered research universities, three were classified as regional universities that did not grant a doctorate, two were community colleges, and 11 were small liberal arts colleges. Because the main

purpose of this study was to investigate the effect of deep approaches to learning on end-of-the-fourth-year NFC, the two community colleges were eliminated. This resulted in a final sample derived from 17 higher education institutions.

Student Sample

The participants in the current sample were first-year, full-time undergraduate students participating in the WNSLAE at one of the 17 institutions in the study. Each institution selected participating students using one of two methods. For larger institutions, the first-year incoming students were randomly selected to participate in the study. For smaller institutions (e.g., all the liberal arts colleges), the entire incoming class of freshmen was invited to participate. All participants were informed that they were selected to participate in a national longitudinal study examining how college influences students with the purpose of improving the future undergraduate experience. All participants were offered a monetary stipend (\$50) for participating in each of the three waves of data collection. Participants were also guaranteed that all information they provided would be kept confidential and would never become part of their institutional records.

Data Collection

The data collection for the 2006 cohort was conducted in three waves: at the beginning of participants' freshmen year (fall 2006), at the end of their second semester (spring 2007), and during the second semester of their fourth year (spring 2010). The first data collection period lasted between 90–100 minutes and included a precollege survey instrument designed to acquire information on demographic characteristics, family background, secondary school experiences,

political orientation, educational aspiration, etc. Participants also completed a series of instruments designed to measure the intellectual and personal development associated with the expected outcomes of a liberal arts education: reasoning and problem solving, psychological well-being, an inclination to inquire and lifelong learning, intercultural effectiveness, socially responsible leadership, and moral character.

The second wave of data collection was conducted in the second semester of the students' first year of college (spring 2007). Two types of data were collected during this second wave. The first type included detailed questions about students' college experience and was collected via two complementary instruments: the national survey of student engagement or NSSE (Kuh, 2001) and the WNSLAE student experiences survey, referred to as WSES. The main purpose of these instruments was to capture student engagement and experiences regarding good practices in undergraduate education. The good practices on the NSSE included questions regarding student learning activities, cooperation with peers, interaction with peers and faculty, approaches to learning, prompt feedback, high expectations, appreciation of diversity experiences, and other similar topics (Chickering & Gamson, 1987; Chickering & Gamson, 1999; Pascarella et al., 2006).

The second type of data collected for the second wave was based on intellectual and personal development questions. These were also posed in the first wave of data collection (fall 2006). Participants completed the NSSE and WSES before they completed the follow-up measure. ACT, Inc. administered and conducted all three waves of data collection. A total of 294 students who participated in the spring 2010 data collection did not participate in the spring 2007 (second wave) data collection; to control for this in the results, a dummy variable was created to indicate whether students participated in the spring 2007 data collection or not.

A total of 2,212 students participated in the third wave of the study in the spring of 2010. During this wave, the students completed the NSSE and WSES again and instruments regarding educational outcomes, and also provided detailed information about their curricular and co-curricular experiences. Of the original 4,501 students who participated in the fall 2006 data collection, 2,212 participated in spring 2010, representing a response rate for the third wave of 52.8%, which was considered acceptable for academic credibility, integrity, and professionalism (Baruch, 1999). These 2,212 students represented 10% of the total population of the first-year students among the 17 participating institutions, although the final available data for the analysis was 1,914. To adjust the sample to be more in line with the total population of incoming first-year students, a weighted algorithm was developed based on each institution's first-year population by sex, race, and ACT score (SAT equivalent). The purpose of the weighted algorithm was to adjust the overall sample to be more similar to the first-year undergraduate population rather than to adjust for a non-response bias. A complete description of dependent variables, independent variables, and control variables is shown in Table 1.

Dependent Variable

NFC was the dependent variable of this study. NFC can be defined as an individual's "tendency to engage in and enjoy effortful cognitive activity" (Cacioppo et al., 1996, p. 197). Cacioppo et al. (1996) argued that those with high NFC naturally "tend to seek, acquire, think about, and reflect back on information to make sense of stimuli, relationships, and events in their world" (p. 198). In contrast to those with high NFC, those with low NFC are more likely to depend on others (e.g., celebrities, experts, cognitive heuristics, or social comparison processes) to make sense of their world (Cacioppo et al., 1996). Furthermore, those with a high NFC

tended to have active and exploring minds that helped them acquire information from their environment through their sense experiences and their intellect (Cacioppo et al., 1996). Those with high NFC were more likely than those with low NFC to “expend effort on information acquisition, reasoning, and problem solving to cope with a variety of predicaments in their world” (Cacioppo et al., 1996, p. 245). Empirical evidence also showed that individuals with a high NFC were more likely to integrate, elaborate on, and evaluate information (Cacioppo & Petty, 1982). NFC has been positively associated with verbal intelligence, ACT scores, high school grade point averages, and college grade point averages (Cacioppo et al., 1996; Elias & Loomis, 2002).

Cohen et al. (1955) conducted an experimental investigation to measure NFC but did not provide detailed information about the test used to measure individual differences in NFC (Cacioppo & Petty, 1982; Cacioppo et al., 1983). As a result, Cacioppo and Petty (1982) developed and validated a new assessment instrument, the NFC scale, to distinguish individuals who tended to engage in and enjoy effortful cognitive activities and those who did not. The original 34-item scale has been demonstrated to be valid based on a factor analysis (Cacioppo & Petty, 1982).

To enhance the efficiency and utility of the NFC scale, a short form, 18-item NFC scale (referred to as NCF-SF) was derived from the original 34-item scale. The short and long forms are highly correlated (Cacioppo, Petty, & Kao, 1984). The reliability and validity of NCF-SF has been proven based on sex (Sadowski, 1993) and race (Culhane, Morera, & Hosch, 2004; Forsterlee & Ho, 1999). The reliability of NCF-SF ranges from .83 to .91 in samples of undergraduate students (Cacioppo et al., 1984) and from .87 to .89 in the WNSLAE data. The questions included in the NCF-SF are provided in Table 2.

Independent Variables

The independent variables in the study—collectively referred to as deep approaches to learning—were assessed with three subscales developed by Nelson et al. (2006; 2008). The three subscales are based on NSSE items completed in the third wave of data collection in spring 2010.

The deep approaches to learning can be grouped into three categories: higher-order learning, integrative learning, and reflective learning (Nelson Laird et al., 2006). Nelson Laird, et al. (2008) stated that the higher order learning scale “focuses on the amount students believe that their courses emphasize advanced thinking skills such as analyzing the basic elements of an idea, experience, or theory and synthesizing ideas, information, or experiences into new, more complex interpretations” (p. 477). The integrative learning scale measures “the amount students participate in activities that require integrating ideas from various sources, including diverse perspectives in their academic work, and discussing ideas with others outside of class” (p. 477). The central concept of reflective learning behaviors is that “students can learn and expand their understanding by investigating their own thinking and then applying their new knowledge to their lives” (p. 477). The internal consistency reliabilities of the three subscales are 0.82, 0.72, and 0.81 respectively. The specific items of the three scales are presented in Table 3.

Control Variables

Although an increasing number of studies have shown that race and gender do not have a statistically significant relationship with NFC (Cacioppo et al., 1996; Culhane et al., 2004; Forsterlee & Ho, 1999; Sadowski, 1993), race and gender were included in the conceptual model of this study as student background to isolate the effect of deep approaches to learning on NFC

development. A dichotomous variable measure for gender (male versus female) was included, as was a dichotomous variable measure of self-report for race (White versus Nonwhite).

Capon and Burke (1980) found that mid/high socioeconomic status (SES) subjects who sought more information were more accomplished information processors than those with low SES. This strongly indicated that SES was an important factor in explaining information processing behavior (Capon & Burke, 1980). Education may be the judicious choice to represent SES (Winkleby, Jatulis, Frank, & Fortmann, 1992). Therefore, an average of the education level of students' parents' was computed based on the responses to the following question: "What is the highest level of education each of your parents/guardians completed?" The response options were: 1= did not finish high school, 2=high school graduate/GED, 3=attended college but no degree, 4=vocational/ technical certificate or diploma, 5= associate or other 2-year degree, 6=bachelors or other 4-year degree, 7=masters, 8=law, 9=doctorate. This information was obtained during the first wave of data collection in the fall of 2006.

The relationship between NFC and the ability index, such as verbal intelligence, ACT scores, high school grade point averages, and college grade point averages have been confirmed (Cacioppo et al., 1996). ACT scores and SAT equivalent scores were included as covariates in the current study, and were provided by staff from each of the 17 participating institutions. These scores were used to control for students' academic ability.

Originating from information processing and motivation theory (Cacioppo & Petty, 1982), Cacioppo et al. (1996) indicated that NFC measured a cognitive motivation that was "analogous to individual differences in people's motivation to engage in effortful physical endeavors" (p. 199). To address this confounding association, a continuous measure of each participants' level of academic motivation was included in this study. Data on academic

motivation was collected during the first wave in fall 2006 via an eight-item scale with an internal reliability of .069. This scale included the extent to which the respondent was willing to work hard in a course to learn the material even if it did not lead to a higher grade; the extent to which the respondent did well on a test because he or she was well-prepared, not because the test was easy; the extent to which the respondent frequently did more reading in a class than was required simply because it interested him or her; the extent to which the respondent enjoyed the challenge of learning complicated new material; the extent to which the respondent agreed that academic experiences were the most important part of college, and so forth.

Secondary school engagement was a seven-item scale that measured involvement during high school and included the following: During the last school year in high school, how often did you participate in each of the following activities: studying with friends, socializing with friends, participating in community service, talking with teachers outside of class, involving yourself in extracurricular activities, studying by yourself, and using the Internet for homework and/or research. The internal reliability for this scale based on the first wave of data collection in the fall of 2006 was .60.

Pascarella and Terenzini (2005) concluded that institutional characteristics played a prominent role in a college impact model and allowed researchers to explore the unique effects between institutional environments. Two dummy variables were created to indicate whether or not the student attended a research university (coded 1) versus a liberal arts college (coded 0); and whether or not the student attended a regional institution (coded 1) versus a liberal arts college (coded 0) based on the Carnegie classification system. Liberal arts colleges have been demonstrated to increase the likelihood that students will be exposed to interaction with faculty, cooperative learning, prompt feedback to students, quality teaching, high academic expectations,

and student academic effort and time on task. These are all factors that influence students' learning strategies (Pascarella, Crue, Wolniak, & Blaich, 2004).

A single item asked whether the respondent completed a spring first year survey. This item was asked during the second wave of data collection at the end of spring 2007. As result, a dichotomous variable measuring whether the respondent participated in the first wave of data collection was included in the current study and coded as 1= Yes or 0= No.

The evidence pertaining to the positive effects of teaching on encouraging students to use a high level of cognitive processing on the intended outcomes has been established (Biggs & Tang, 2011). Pascarella, Edison, Nora, and Hagedorn (1996) argued that effective teaching not only played an important role in academic achievement but also had a positive impact on students' general cognitive development during their first-year in college. Furthermore, a large body of researchers have argued that effective teaching contributed to students' learning outcomes (Entwistle, 2009; Hattie, 2009). Trigwell and Prosser (1991) pointed out that students who perceived they were receiving good teaching and more freedom in learning were more likely to adopt deep learning approaches (Trigwell, 1991).

Due to the importance of effective teaching in students' learning outcomes, a continuous measure of effective teaching to assess overall exposure to effective classroom instruction was included in the current study. This aspect of student experience was assessed via a 10-item scale with an alpha reliability of .89 and gathered in the third wave (spring 2010) of data collection. The 10-item scale included the frequency with which faculty gave clear explanations, made good use of examples and illustrations to explain difficult points, effectively reviewed and summarized the material, interpreted abstract ideas and theories clearly, gave assignments that helped in learning the course material, presented material in a well-organized way, were well

prepared for class, used class time effectively, clearly explained course goals and requirements, and had a good command of what they were teaching. The detailed information included on the scale is shown in Table 4.

A single item asking for the total number of hours a student typically participated in co-curricular activities (i.e., in organizations, campus publications, student government, fraternity or sorority houses, intercollegiate or intramural sports, etc.) on a weekly basis was used to assess co-curricular involvement. The eight responses ranged from 0 to 30 hours. A body of studies have demonstrated that students' co-curricular involvement had positive influences on cognitive development, such as critical thinking skills as well as self-reported intellectual and cognitive growth (Pascarella, & Terenzini, 2005). Through social interaction and sharing information in a small group, group members scoring high on NFC were able to enrich the knowledge pool of the small group (Curseu, 2011). The total number of co-curricular hours was obtained during the third wave of data collection (spring 2010).

Living on campus was a means to enhance social interaction, a factor that was found to influence general cognitive development and knowledge acquisition (Pascarella, & Terenzini, 2005). Living on campus had an indirect effect on individual change by providing maximum opportunities for social, cultural, and extracurricular engagement (Pascarella, & Terenzini, 2005, p. 603). As result, a dichotomous variable measuring on-campus residency was included in the current study and coded as 1=lived in campus housing or 0=lived elsewhere during the previous year.

Though the relationship between on-campus employment and NFC has been inconclusive and inconsistent, Astin (1977, 1993) argued that on-campus employment provided more opportunities to enhance academic and social involvement. Despite some studies arguing that

work limited students' integration to academic life and their time to learn (Levin, Montero-Hernandez, & Cerven, 2010; Ziskin, Torres, Hossler, & Gross, 2010), McCormick, Moore, and Kuh (2010) found that working either on campus or off campus had a positive association with NSSE benchmarks. McCormick et al. (2010) also indicated that students who worked on campus benefited more than those who worked off campus. A single item in the current study asked how many hours in a typical week the respondent spent working for pay on campus and working for pay off campus. There were eight response options ranging from "0 hours" to "more than 30 hours."

Pascarella and Terenzini (2005) found that a student's academic major had a selective influence on cognitive development. Lindsay (2007) concluded that compared to non-liberal arts majors, students who majored in arts/humanities, sciences, and social sciences tended to have higher NFC. Nelson Laird et al. (2008) found that senior students who majored in soft fields were more likely to use deep approaches to learning than those who majored in hard fields. To capture the distinctions in academic major field of study based on Nelson Laird's findings (2008), academic major was recorded by two dummy variables: humanities, fine arts, or social science major versus other; and science, technology, engineering, or mathematics major versus other.

Pascarella (2006) argued that longitudinal, pretest-posttest designs with accompanying statistical controls provided the most powerful and credible evidence. A pretest measure of NFC administered during the first wave of data collection (fall 2006) was included in this study to represent the students' starting point on the measure of NFC, so actual gain could be assessed when compared to the third wave data. By combining the NFC pretest and precollege covariates, the study design provided for an estimation of the impact of deep approaches to learning on

students' development of NFC during the fourth year of college. Furthermore, according to Astin (1970a, 1970b, 1977, 1993), Pascarella (1985), and Biggs (1987, 1989, 2003), the precollege measure of NFC and student characteristics were important to assess the development of NFC.

Missing Data

The default strategy to handle cases with incomplete data was listwise deletion; however this strategy involved two main limitations. First, the overall statistical power of the study would be significantly decreased if a considerable amount of information with incomplete values was found (Graham, 2009; Myrtveit, Stensrud, & Olsson, 2001). The second problem was that the missing data might lead to serious biases if the incomplete cases were not missing at random (Myrtveit et al., 2001). The non-random pattern of missing data could be correlated with other variables and contribute meaningful information (Schafer & Graham, 2002; Treiman, 2009).

A number of diagnostic procedures were conducted to examine the pattern of missing data to avoid the two drawbacks of listwise deletion. The maximum number of possible cases was determined by the number of students who completed the NFC scale during the third wave of data collection in spring 2010 ($n = 2,205$). Among the 20 independent variables and control variables, only two dummy variables representing respondents' academic major had more than 5% missing cases (i.e., 167). The variable representing a weighted algorithm had 94 missing cases or 4.26% of the 2,205 total. The remaining variables had less than 1% of missing data. Therefore, the missing data would not significantly decrease the statistical power of the study.

Then a t-test was performed to investigate if the pattern of incomplete data contributed unique information, the second limitation of listwise deletion. Each independent variable and control variable was recoded into a binary variable, with 1 representing more than one

incomplete case and 0 representing no incomplete cases. Results from the t-test indicated that a relationship between the missing pattern of each variable and the dependent variable did not exist. This test also confirmed that the pattern of incomplete cases was random.

Analysis

Several steps and regression diagnostic methods were used to investigate the effect of deep approaches to learning on NFC to establish the robustness of the findings. Ordinary least squares regressions is the most widely used to predict continuous dependent measure by several independent variables (Allison, 1999). As such, given the nature of the dependent variable and the interests of the study, OLS regressions were conducted to estimate the main effect and the conditional effect of deep approaches to learning on NFC. Although ordinary least squares regressions have several desirable properties, Allison (1999) argued that five basic assumptions should be met: (a) the dependent measure is a linear function of the independent variables; (b) the mean of all unmeasured caused effects of the dependent variables should equal zero; (c) homoscedasticity or the degree of variance should always be the same; (d) the disturbance variables for any two individuals should be uncorrelated; and (5) the unmeasured caused effects of the dependent variables should be normally distributed (Allison, 1999). To be sure of unbiased estimated results, it is necessary to satisfy all five assumptions.

In the first stage of analysis, descriptive statistics were determined for all variables by using weights based on sex, race, and ACT scores to resemble the first-year undergraduate population. Table 5 shows the descriptive statistics for each variable in this model. To investigate whether multicollinearity existed in the models, bivariate correlations were carried out to examine the relationship among all the variables. Table 6 at the end of Chapter 4 shows the

Pearson correlations and indicates that the three deep learning subscales were correlated. This suggested a need to investigate further if multicollinearity existed in this model. To test if multicollinearity existed, a variance inflation factor was used for each independent variable. Treiman (2009) indicated highly correlated independent variables would lead to multicollinearity and would result in a larger and more unstable standard error.

Given the continuous nature of the dependent measure, ordinary least square regressions were conducted to estimate the net effect of deep approaches to learning on NFC. To acquire a comparable effect size, the three deep approaches to learning subscales were standardized prior to analysis. To estimate the effect of student precollege background and characteristics, end-of-fourth-year NFC on all control variables described above were regressed. To estimate the net effect of deep approaches to learning, the researcher added the deep approaches to learning to the first equation.

To explore the presence of conditional effects, the researcher added a series of product terms to the equation. A set of interaction variables were created by multiplying each deep approach to learning subscale with the NFC pretest (fall 2006) score, the ACT score, race, and gender. If all the interaction product terms were added to the general effects model, the variables were highly correlated and indicated multicollinearity. To examine the presence of conditional effects, cross-product terms were added to the general effects equation individually. A Wald Chi-square test was applied to determine if any additional statically significant increase in explained variance (R^2) could be attributed to the presence of conditional effects (Pedhazur, 1982).

Due to the limitation of listwise deletion discussed in the previous section, all analysis in this study was based on weighted sample estimates to closely resemble the first-year undergraduate population. Weighting can reduce bias due to differential responses to the

variables used in the model (Schafer, 2002). To reduce the probability of making a Type I error, (which should be avoided in social science research according to Hayes, 2004) adjusting a smaller standard error for the nesting or clustering effect should also be taken into account. However, to address the issue, the total number of variables in the model cannot exceed the number of institutions (17). Because the total number of variables in the model exceeded 17, the researcher could not employ the procedures to adjust the cluster effect. To maintain the solid design of the study, the researcher used a small α level ($P < .01$) to determine statistical significance.

Limitations

The limitations of this study included a lack of the surface approach to learning, generalizability, and clustered and nested effects. The primary limitation was its lack of generalizability due to the results of the sampling. In spite of the efforts to make the samples representative, the 17 self-selected institutions whose leaders volunteered to participate were not widely representative of all college students. In addition, the large declination of the response rate between wave one and wave three, despite it still being in an acceptable range in social science studies, negatively impacted generalizability. Furthermore, listwise deletion was used to handle missing data, which resulted in including students who participated in all three of the data collection waves and completed all questionnaires. Although this is an inevitable situation common in the social science world, the samples including students who completed the three waves of data collection without any incomplete questionnaires makes it a problem of generalizability.

The clustering or nesting effect might be a minor limitation of the study. The clustering effect refers to participants having similar behaviors; in other words, the homogeneity of the sample produced smaller standard errors (Groves et al., 2009). However, the researcher could not adjust the clustering or nesting effect because the total number of variables in the model exceeded the number of institutions. To maintain a solid theoretically based design, the researcher decided to use a small α level ($P < .01$) for statistical significance to avoid a Type 1 error.

Another limitation of the study was that the NSSE measure of deep approaches to learning only contained 12 items and did not include other types of learning approaches (i.e., the surface approach) (Biggs, 1987; Entwistle, 1983). Without including another measure of learning approach, comparisons could not be determined. It may be necessary to modify the present study to include other approaches to learning to strengthen future findings. Despite this, a large number of empirical studies have demonstrated the effect of active learning, reflection, and deep learning on cognitive development (Mayhew et al., 2012; Mayhew et al., 2008; Nelson Laird et al., 2011; Phan, 2007; Phan, 2009a; Phan, 2009b; Phan, 2011).

The variable chosen for this study required a decision based on theories. Although extensive efforts were made by the researchers conducting the WNSLAE to collect comprehensive information from the appropriate institutions and students, it was inevitable that incomplete information was provided that limited the study. Regarding the effects of academic curricular experiences on gains in NFC, the researcher originally tried to remove the effects of the total credits earned from the first year to the fourth year. However, a useful variable to represent the total credits students earned could not be constructed because staff at the institutions could not provide complete information. Despite this limitation of the study, the

pretest-posttest design combined with a set of statistical controls provided powerful and credible evidence (Pascarella, 2006).

Figure 1. Guiding Conceptual Model

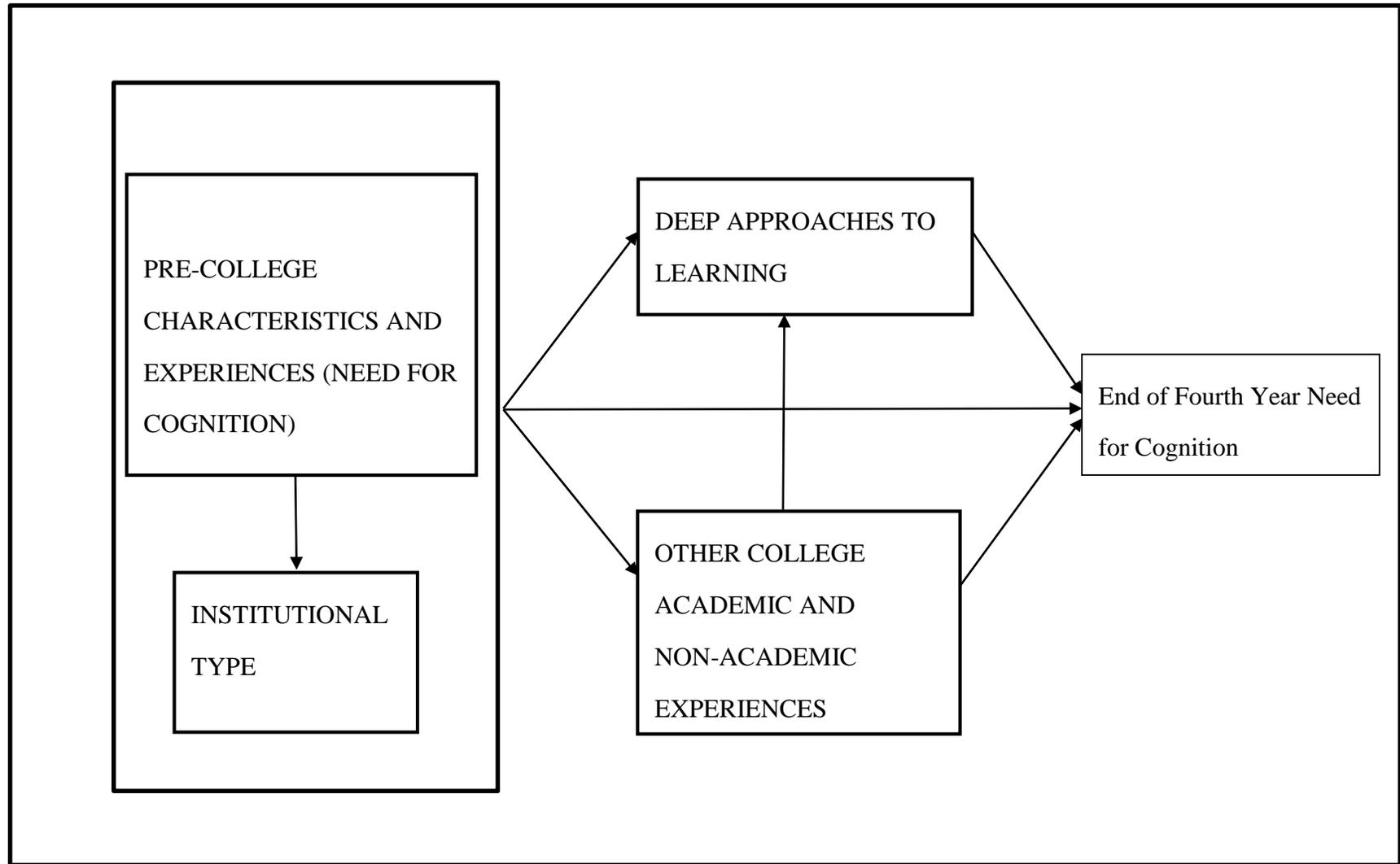


Table 1. Definition of All Variables Used in Analyses

Variable Name	Definition	Response Options
Product Variable		
Need for Cognition Posttest	The 18-item Need for Cognition (NFC) short form completed in Spring 2010.	See Table 2
Presage variables		
Need for Cognition Pretest	The 18-item Need for Cognition (NFC) short form completed in Fall 2006.	See Table 2
Parental educational attainment	Average parental education was computed as the average of the student's parents' education. Respondents reported it in a single item on the WNSLAE Student Survey at the beginning of the first year of college. This item asked "What is the highest level of education each of your parents/guardians completed?"	The response options are: 1= Did not finish high school, 2=High school graduate/GED, 3=Attended college but no degree, 4=Vocational/ technical certificate or diploma, 5= Associate or other 2-year degree, 6= Bachelors or other 4-year degree, 7=Masters, 8=Law, 9=Doctorate
White	Respondent is White (reference group is nonwhite). Race of respondent was provided in a single item at the beginning of the first year of college.	White=1, Nonwhite=0
Male	Dummy variable that represents respondent is male. The reference group is female. Gender of respondent was reported during the first-year data collection.	Male=1, Female=0
Precollege Academic Motivation	An eight-item scale in which students were asked if they agree or disagree with the statement about their academic motivation.	Strongly disagree, disagree, neutral, agree, strongly agree
Precollege Total Academic Preparation	ACT score, SAT equivalent score, or COMPASS equivalent score provided by institution at the beginning of the first year of college	Scores range from 16 to 36

Table 1—continued

Variable Name	Definition	Response Options
Secondary School Engagement	<p>A 7-item scale measuring the degree to which the respondent was involved in a variety of activities during high school ($\text{Alpha}=.62$). Constituent items include:</p> <ol style="list-style-type: none"> 1. During your last year in high school, how often did you study with a friend? 2. During your last year in high school, how often did you socialize with friends? 3. During your last year in high school, how often did you talk with teachers outside of class? 4. During your last year in high school, how often did you participate in community service or volunteer activities? 5. During your last year in high school, how often did you participate in extracurricular activities? 6. During your last year in high school, how often did you use the internet for homework or research? 7. During your last year in high school, how often did you exercise? 	Very often, often, occasionally, rarely
Participated in End-of First year Assessment	The item indicated if respondent completed Spring of first year survey/assessments	Yes=1, No=0
Attended Regional Institution	The reference group is liberal arts college. Dummy variable created based on the 2007 Carnegie Classification of Institutions.	Yes=1, No=0
Attended Research University	The reference group is liberal arts college. Dummy variable created based on the 2007 Carnegie Classification of Institutions.	Yes=1, No=0

Table 1 continued

Variable Name	Definition	Response Options
Lived on Campus	Respondent's self-report of best descriptions to where they lived during the fourth year of the college. The reference group is lived elsewhere. This question is "Which of the following best describes where you are living now while attending college?"	1 = Dormitory or other campus housing (not fraternity/sorority house) 0 = Residence (house, apartment, etc.) within walking distance of the institution, residence (house, apartment, etc.) within driving distance of the institution or fraternity or sorority house
On-and-off Campus Work	Respondent's self-report of the number of hours per week during the fourth year of college one worked both on and off campus.	1=0 hours, 2=1-5 hours 3=6-10 hours 4=11-15 hours 5=16-20 hours 6=21-25 hours 7=26-30 hours 8=More than 30 hours
Humanities, fine arts, or social science major	Dummy variable that represents student's major in a humanities, fine arts, or social science field.	Yes=1, No=0
Stem major	Dummy variable that indicates the students major in a natural science, technology, engineering, mathematics, or health science field	Yes=1, No=0
Co-curricular Involvement	Respondent's self-report of how many hours in a typical week the student spends doing co-curricular activities, such as student organizations, campus publications, student government, fraternity or sorority, and intercollegiate or intramural sports, etc. Respondent reported in a single item on the WNSLAE Student Survey administrated in the 2010 spring semester.	1=0 hours 2=1-5 hours 3=6-10 hours 4=11-15 hours 5=16-20 hours 6=21-25 hours 7=26-30 hours 8=More than 30 hours

Table 1 continued

Variable Name	Definition	Response Options
Teaching Clarity and Organization	<p>A ten item scale measuring the degree to which the respondent's experienced teacher skill/ clarity as well as preparation and organization in teaching (WNS Alpha=.89). Constituent items included:</p> <ol style="list-style-type: none"> 1. Presentation of material is well organized. 2. Teachers are well prepared for class. 3. Class time is used effectively. 4. Course goals and requirements are clearly explained. 5. Teachers have a good command of what they are teaching. 6. Teachers give clear explanations. 7. Teachers make good use of examples and illustrations to explain difficult points. 8. Teachers effectively review and summarize the material. 9. Teachers interpret abstract ideas and theories clearly. 10. Teachers give assignments that help in learning the course material. 	<p>1=never 2=rarely 3=sometimes 4=often 5=very often</p>
Process variables		
Higher-order Learning	See Table 3	
Reflective Learning	See Table 3	
Integrative Learning	See Table 3	
Other variables used for analysis		
WeightT1T3	In order to make the sample more representative of each institution's first-year undergraduate population, a weighting algorithm was developed based on sex (male or female), race (Caucasian, African American/Black, Hispanic/Latino, Asian/Pacific Islander, or other), and ACT (or equivalent score) quartile.	

Table 2. 18-item Short Form of the Need for Cognition Scale

-
1. I would prefer complex to simple problems.
 2. I like to have the responsibility of handling a situation that requires a lot of thinking.
 3. Thinking is not my idea of fun.
 4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.*
 5. I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something.*
 6. I find satisfaction in deliberating hard and for long hours.
 7. I only think as hard as I have to.
 8. I prefer to think about small, daily projects to long-term ones.*
 9. I like tasks that require little thought to make my way to the top appeals to me.
 10. The idea of relying on thought to make my way to the top appeals to me.
 11. I really enjoy a task that involves coming up with new solutions to problems.
 12. Learning new ways to think doesn't excite me very much.
 13. I prefer my life to be filled with puzzles that I must solve.
 14. The notion of thinking abstractly is appealing to me.
 15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
 16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort.*
 17. It's enough for me that something gets the job done; I don't care how or why it works.*
 18. I usually end up deliberating about issues even when they do not affect me personally.
-

Notes: Reverse scoring is used on items with an asterisk. Response options are 1=Extremely characteristic, 2= Somewhat characteristic, 3= Uncertain, 4= Somewhat uncharacteristic, 5= Extremely uncharacteristic.

Table 3. NSSE Deep Approaches to Learning Scales and Constituent Items^a

Items
<i>Higher-Order Learning</i> (alpha reliability = .82) ^b
Analyzed the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components
Synthesized and organized ideas, information, or experiences into new, more complex interpretations and relationships
Made judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions
Applied theories or concepts to practical problems or in new situations
<i>Integrative Learning</i> (alpha reliability= .72) ^b
Worked on a paper or project that required integrating ideas or information from various sources
Included diverse perspectives (different races, religions, gender, political beliefs, etc.) in class discussion or writing assignments
Put together ideas or concepts from different courses when completing assignments or during class discussions
Discussed ideas from your readings or classes with faculty members outside of class discussions
Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)
<i>Reflective Learning</i> (alpha reliability = .81) ^b
Examined the strengths and weaknesses of your own views on a topic or issue
Tried to better understand someone else's views by imagining how an issues looks from his or her perspective
Learned something that changed the way you understand an issue or concept

Note: Response options for the *Integrative Learning* and *Reflective Learning* scales were: 1=Never, 2=sometimes, 3=Often, 4=Very Often. Response options for the *Higher-Order Learning* scale were: 1=Very little, 2=Some, 3=Quite a bit, 4=Very often.

^aSource: Nelson Laird, Shoup, et al. (2008).

^bAlpha reliability is from Nelson Laird, Shoup, et al. (2008) .

Table 4. Constituent Items for the Instructional Organization and Clarity Scale^a

- Presentation of material is well organized.
 - Teachers are well prepared for class.
 - Class time is used effectively.
 - Course goals and requirements are clearly explained.
 - Teachers have a good command of what they are teaching.
 - Teachers give clear explanations.
 - Teachers make good use of examples and illustrations to explain difficult points.
 - Teachers effectively review and summarize the material.
 - Teachers interpret abstract ideas and theories clearly.
 - Teachers give assignments that help in learning the course material.
-

^aScale stem: “Below are statements about teacher skill/clarity as well as preparation and organization in teaching. For the most part, taking into consideration all of the teachers with whom you’ve interacted at [institution name], how often have you experienced each?” Response options: 5= “very often”; 4= “often”; 3= “sometimes”; 2= “rarely”; 1= “never.” The scale was standardized across items for the entire sample. Scale alpha reliability (based on all 10 items) is .89.

Table 5. Descriptive Statistics for Variables in Analysis, Weighted (N=1914)

Variables	Mean	St. Dev.	Min	Max
Need for Cognition (Fourth Year)	3.609	0.020	1.167	5
Need for Cognition (Precollege)	3.415	0.021	1.222	5
Precollege Tested Academic Preparation	26.517	0.147	14	36
Parents' Educational Attainment	15.631	0.073	11	20
Race (White=1)	0.758	0.015	0	1
Gender (Male=1)	0.450	0.017	0	1
Academic Motivation (First Year)	3.535	0.019	1.75	5
Secondary School Involvement	3.716	0.018	1.857	5
Student Completed Spring of First Year Survey	0.850	0.012	0	1
Attends a Regional Institution	0.246	0.016	0	1
Attends a Research University	0.503	0.017	0	1
Lives on Campus	0.275	0.013	0	1
Hours of on-and off-campus work	9.350	0.326	0	55
Humanities, Fine Arts, or Social Science Major	0.586	0.017	0	1
Stem Major	0.226	0.014	0	1
Co-Curricular Involvement	2.666	0.063	1	8
Teaching Clarity and Organization	-0.125	0.025	-3.353	1.273
Higher-order Learning	0.723	0.006	3.64E-09	1
Reflective Learning	0.596	0.007	0	1
Integrative Learning	0.599	0.006	0.0667	1

CHAPTER IV

RESULTS

The findings of this study are presented in Chapter IV; specifically the findings related to undergraduates developing an inclination to inquire and lifelong learning (NFC) based on deep approaches to learning over four years of college. Based on Pascarella's general model for assessing the effects of differential environments on student learning and cognitive outcomes illustrated in Figure 1, analyses were conducted to answer the three guiding questions:

1. What are the effects of student background, precollege characteristics, and the academic college experiences and non-academic college experiences on end-of-the-fourth-year NFC?
2. What are the net effects of deep approaches to learning on end-of-fourth-year NFC?
3. Are the net effects of deep approaches to learning on NFC conditional or general?

Methodology Summary

Data for this study came from WNSLAE, a multi-institutional longitudinal investigation on the effects of academic and nonacademic experiences on outcomes associated with undergraduate education. Participants in this analysis were first-year, full-time undergraduates from the 2006 cohort who attended 17 participating institutions. The researcher used listwise deletion to manage missing data; therefore, the total available participant records for this analysis was 1,914. To establish solid evidence of the effects of deep approaches to learning on the development of NFC, a pretest and posttest design and three waves of data collection were used. A weighting algorithm based on each institution's first-year population by sex, race, and ACT

score (SAT equivalent) was used to adjust the sample to more closely match the total population of incoming first-year students.

The analytical model addressed the research questions by incorporating Pascarella's (1985) general model for assessing the effects of differential environments on student learning and cognitive outcomes and Biggs's 3P (1987, 1989, 2003) model of student learning. Ordinary least squares regression tests were applied to investigate the effects of deep approaches to learning on the development of end-of-fourth-year NFC. To investigate the net effects of deep approaches to learning, the researcher used a three-stage hierarchical procedure. In the first stage, NFC-regressed student characteristics, institutional characteristics, a pretest measure of NFC, and college experiences were addressed. In the second stage, the three deep approaches to learning subscales were added to the first stage of analysis. The third stage analysis was designed to investigate whether the effects of deep approaches to learning on NFC varied based on ACT composite score, race, gender, and precollege measures of NFC. A series of interaction variables were created by multiplying each deep approach to learning subscale with the NFC pretest (fall 2006) score, the ACT score, race, and gender for each participant. To avoid multicollinearity, cross-product terms were added to the general effects equation individually.

In this chapter, four main sections are presented:

Section 1: Descriptive statistics for the variables of interest

Section 2: Findings of the correlation matrix for the variables of interest

Section 3: The results of the main effects model

Section 4: The results of each of the conditional terms

Section 1: Descriptive Statistics

In Table 5, the means, standard deviations, and sample sizes for all the variables with a weighting algorithm are presented. The results showed a gain in average NFC (the dependent measure) increasing from 3.415 (SD = .021) in the fall of 2006 to 3.609 (SD = .020) in the spring of 2010. Among the students in the third wave sample, 72.3% indicated that they had adopted higher-order learning strategies, 59.6% indicated they had adopted a reflective learning strategy, and 59.9% indicated that they used an integrative learning strategy. For the variable on academic major field of study, 58.6% of respondents majored in the humanities, fine arts, or the social sciences; 22.6% majored in science, technology, engineering, or mathematics; and 18.8% majored in other areas.

The results of the precollege variables indicated that 45% of the student participants were male. This distribution slightly exceeded the national male/female ratio of postsecondary institution enrollments of 43% (NCES, 2010). The third wave sample had more White students (75.8%) than nonwhite students. The average parents' educational attainment was 15.63 (SD = .073) resulting in the mean of students' parents' education as approximately 15.6 years of school. The average of total ACT scores and SAT equivalent scores was 26.517 (SD = .147). The academic motivation was 3.53 (SD = .019). The average of the secondary school involvement was 3.72 (SD = .018). For the institutional context variables, most students (50.3%) attended the research universities, 24.6% of students attended regional universities, and 25.1% of students attended liberal arts colleges.

In regard to college academic and non-academic experiences, 27.5% of the participants lived on campus. The average number of hours devoted to on- and off-campus work was 9.35. The average number of hours of co-curricular involvement was 2.66 per week (SD = .063). The mean of the overall exposure to effective classroom instruction was $-.125$ (SD = .025).

Section 2: Correlations for the Variables

In Table 6, the correlation matrix is presented and includes all the variables in the analytical model. All the independent variables, as well as many of the student precollege characteristics, experiences, and college academic or non-academic experiences, were significant when correlated with the development of NFC. In STATA (data analysis and statistical software), four different commands are available to handle the weighted sample, including frequency weights, sampling weights, analytic weights, and importance weights. The sampling weights option only estimated the correlation value without computing p values associated with coefficients. Scribney (2005) suggested that analytic weights was also an appropriate approach for computing p values associated with coefficients. Due to the research design and purpose, I used sampling weights for all analyses except for the bi-correlation matrix, for which I used analytic weights. To interpret the strength of Pearson's r , I used the guidelines Cohen (1992) provided to determine whether a value of r represented a small ($r = .10$), medium ($r = .30$), or large ($r = .50$) effect. The variables are discussed below based on students' precollege characteristics, college experiences, and major independent variables.

Among students' precollege characteristics, precollege measures of NFC had the highest correlation at $.588$ ($p < .001$). Precollege tested academic preparation had a medium effect at $.313$ ($p < .001$), and academic motivation had a small effect at $.286$ ($p < .001$). These results supported the previous studies that NFC measured a cognitive motivation that was related to ACT score (Cacioppo et al., 1996). SES, operationally represented as parents' educational attainment, had a small correlation with NFC, which confirmed that SES was an important factor in explaining information processing behavior (Capon & Burke, 1980). Secondary school involvement also had a small effect at $.116$ ($p < .001$). However, despite the previous studies

indicating that race and gender did not have a statistically significant relationship with NFC (Cacioppo & Petty, 1982; Cacioppo et al., 1996; Culhane et al., 2004; Forsterlee & Ho, 1999; Sadowski, 1993), these results indicated that gender ($r = .133$, $p < .001$) and race ($r = .065$, $p < .01$) had small effects with NFC.

Regarding the institutional context variables, attending a regional university (versus attending a liberal arts college) had a small negative correlation ($r = -.109$, $p < .001$) with NFC, indicating that students in regional universities had lower NFC score than students in liberal arts colleges. Regarding the academic and non-academic experiences, teaching clarity and organization had a small but significant correlation with NFC ($r = .247$, $p < .001$). Living on campus, working at on- and off-campus employment, academic major, and co-curricular involvement had small effects with NFC. These results supported the previous literatures and the guiding theoretical framework of this study.

Regarding the study variables, integrative learning had the highest (medium) effect at $.347$ ($p < .001$) with NFC, reflective learning had a medium effect ($r = .34$, $p < .001$), and higher-order learning had a small effect $r = .242$, $p < .001$). In addition, integrative learning and reflective learning correlated with each other ($r = .501$, $p < .001$) and integrative learning correlated with higher-order learning at $.462$ ($p < .001$). In Table 7 the presence of multicollinearity is further examined. Allison (1999) suggested that variance inflation factors greater than 2.5 were considered problematic. The results shown in Table 7 indicate that multicollinearity was not a problem in this study.

Section 3: The results of the main effects model

The decision to select student characteristics and precollege experiences in this study was made based on the prior literature, the college impact research, and students' learning research. To distinguish the differences in NFC due to students' background and precollege experiences, control measures were introduced into the precollege model. In addition, the pretest measure of NFC as a covariate provided the estimated impact of all variables on the end-of-the fourth year of NFC as well as the actual gains of NFC over four years. Including the pretest measures not only allowed for an estimate of the net effect of the independent variables on the dependent variable but also allowed for an estimate of the effects of the independent variables on the actual gains students made from freshman year to senior year (Pascarella, Wolniak, & Blaich, 2003). Thus, the standardized coefficients in this study indicated a one standard deviation increase in the deep approaches to learning based on the posttest measure of NFC. This can also be interpreted as the actual gains in NFC.

In the general effects model, variables are grouped into blocks based on the guiding model to understand the direct effects of student background characteristics and precollege experiences, institutional contexts, and college experiences on NFC, as well as the indirect effects mediated by deep approaches to learning. Using an ordinary least squares regression provided the advantage, especially useful in multi-institution longitudinal studies, of conducting a path analytical causal model to show the direct and indirect paths to the dependent variables. The independent variables can be introduced in the model as follows: student backgrounds, college characteristics, and college experiences (Astin, 2009). In this section, the main effects of Blocks 1, 2, and 3 will be reported before presenting the effects of deep approaches to learning in Block 4.

Block 1: Student background/precollege experiences.

As shown in Table 8, although precollege measures of NFC, precollege total academic preparation, parents' educational attainment, race, gender, precollege academic motivation, and secondary school engagement were correlated with NFC, the precollege measure of NFC, precollege total academic preparation, and gender were statistically significant predictors of the development of NFC. These results partially supported previous studies.

The pretest measure of NFC had a substantial positive effect on end-of-fourth-year NFC ($B = .538, p < .001$). This result was expected because the precollege measure of NFC should account for the substantial proportion of the variance in end-of fourth-year NFC. Consistent with the previous findings that NFC was related to ACT score (Cacioppo et al., 1996), this result also indicated that precollege total academic preparation—operationally defined as ACT score—had a positive effect on end-of-fourth-year NFC ($B = .118, p < .001$). Unexpectedly, the male gender had a significant positive effect on NFC ($B = .0455, p < .01$). This was surprising because the effect of the gender factor had been previously shown as neutral on NFC-SF (Sadowski, 1993).

Block 2: Institutional contexts.

The inclusion of institutional types increased by a total R^2 of .378 ($p < .001$), representing a .008 increase in the variance of end-of-fourth-year NFC explained by student backgrounds and precollege experiences. Compared to students in liberal arts colleges, data from research university students showed a greater decline in NFC ($B = -.108, p < .001$). However, the fact that institutional type was only significant in Block 2 and Block 3 may be due to suppressor effects, in that deep approaches to learning mediated the effect of institutional type. It is possible that enhancing deep approaches to learning in larger institutions (versus in small liberal arts colleges) is more difficult.

Block 3: Academic and non-academic college experiences.

The academic and non-academic college experiences block included participation in first year assessment, on-campus residency, the total amount of on- and-off campus employment, major academic disciplines, co-curricular involvement, and teaching clarity and organization. The statistics on this block resulted in an R^2 of .40 ($p < .001$), which increased by .022 in the variance explained by Block 2. Among both academic and non-academic experiences, as the level of teaching clarity and organization increased, end-of-the fourth-year NFC increased by a .150 standard deviation ($p < .001$) when holding all other variables constant. This finding implies that teaching clarity and organization can foster cognitive development and feelings of enjoyment, which result in the development of NFC.

Block 4: Deep approaches to learning.

Adding the deep approaches to learning block into the regression resulted in an R^2 of .459 ($p < .01$), which increased by an additional .058% variance explained by Block 3. In the regression, the variable measuring higher-order learning showed a statistically significant increase—.071 standard deviations ($p < .01$)—related to the development of end-of-fourth-year NFC when holding all other variables constant. Similarly, one standard deviation increase in reflective learning experiences significantly increased NFC by a .127 standard deviation; one standard deviation increase in integrative learning experiences increased NFC by .143 standard deviations when holding all other variables constant. The three deep approaches to learning subscales, therefore, significantly contributed to the development of end-of-the fourth year NFC.

Section 4: The results of each of the conditional terms

This study was also designed to investigate whether the effects of deep approaches to learning on the development of end-of-fourth-year NFC were conditional based on race, gender, ACT (or equivalent) scores, and precollege measures of NFC. Despite the fact that the general model did not reveal any effects of race on the development of end-of-fourth-year NFC, race was still included to investigate whether the net effects of deep approaches to learning on NFC are general or conditional.

In Table 9, the results of the analysis for conditional effects based on sex, race, ACT (or equivalent) scores, and precollege levels of NFC are shown. All the individual cross-product terms failed to reject the null hypothesis at $p < .01$. The values of the adjusted Wald test for all cross-product terms were close to zero, which indicated that the cross-product terms did not increase any explained variance. This suggested that the effects of the use of deep approaches to learning on the development of NFC over four years did not differ for men and women, for White students and non-White students, for students with different levels of tested academic preparation, or for different levels of precollege measures of NFC when participants attended a postsecondary institution.

Summary

The statistical results of this study illustrate the importance of student's background characteristics, institutional type, college experiences, and the use of deep approaches to learning over four years; each of these factors had a significant impact on the development of NFC. The findings also indicated that precollege measures of NFC, ACT (or equivalent) scores, sex, attendance at research universities (versus liberal arts colleges), and teaching clarity and organization had significant effects on the development of NFC over four years. After taking

student's background characteristics, institutional type, and college experiences as covariates, data from the higher-order learning subscale, the integrative learning subscale, and the reflective learning subscale significantly contributed to students' development of NFC over four years. Interestingly, the effect of institutional type on NFC disappeared (in Block 4) after three deep approaches to learning subscales were introduced into the model. However, the conditional effects of the use of deep approaches to learning did not differ based on sex, race, ACT (or equivalent) scores, and precollege measures of NFC.

In Chapter V, a further discussion and interpretation of the findings is provided, as well as the theoretical and practical implications of this research. Suggestions for future research and final conclusions of the study are also discussed in Chapter V.

Table 6. Correlation Matrix for All variables Included in this study

	1	2	3	4	5	6	7	8	9
1. Need for cognition (Fourth Year)	1								
2. Need for cognition (Precollege)	0.588***	1							
3. Precollege Tested Academic Preparation	0.313***	0.320***	1						
4. Parents' Educational Attainment	0.127***	0.125***	0.332***	1					
5. Race (White=1)	0.133***	0.095***	0.297***	0.263***	1				
6. Gender (Male=1)	0.065**	-0.015	0.074**	0.035	-0.001	1			
7. Academic Motivation (First Year)	0.286***	0.504***	0.045*	-0.033	-0.057*	-0.074**	1		
8. Secondary School Involvement	0.116***	0.172***	0.073**	0.032	0.02	-0.242***	0.346***	1	
9. Student Completed Spring of First Year Survey	-0.004	-0.003	0.147***	0.082**	0.134***	-0.077**	0.038	0.103***	1
10. Attends a regional institution	-0.109***	-0.117***	-0.405***	-0.264***	-0.23***	-0.046*	-0.047*	-0.098***	-0.191***
11. Attends a research university	-0.031	-0.012	0.355***	0.22***	0.107***	0.041	-0.022	0.094***	0.176***
12. Lives on campus	0.143***	0.175***	0.14***	0.036	0.016	0.004	0.148***	0.057*	-0.013
13. Hours of on-and off-campus work	-0.051*	-0.053*	-0.24***	-0.239***	-0.103***	-0.125***	0.001	0.065**	-0.048*
14. Humanities, Fine Arts, or Social Science Major	0.030	-0.017	0.049*	0.031	-0.027	0.004	-0.082**	-0.016	0.025
15. Stem Major	0.097***	0.135***	0.121***	0.009	0.034	0.094***	0.156***	-0.007	-0.009
16. Co-Curricular Involvement	0.067*	0.071**	-0.004	0.043	0.057*	0.074**	0.001	0.096***	-0.009
17. Teaching clarity and organization	0.247***	0.115***	0.217***	0.08**	0.146***	-0.001	0.068**	0.121***	0.052*
18. Higher-order learning	0.242***	0.132***	-0.017	0.026	-0.022	-0.056*	0.169***	0.140***	-0.029
19. Reflective learning	0.340***	0.237***	0.044	0.059**	-0.065**	-0.061**	0.120***	0.147***	-0.018
20. Integrative learning	0.347***	0.222***	-0.014	0.005	-0.045	-0.096***	0.191***	0.233***	-0.045

Table 6—continued.

	10	11	12	13	14	15	16	17	18	19	20
10. Attends a regional institution	1										
11. Attend a research university	-0.575***	1									
12. Lives on campus	-0.147***	-0.225***	1								
13. Hours of on-and off-campus work	0.166***	-0.113***	-0.086**	1							
14. Humanities, Fine Arts, or Social Science Major	-0.089	-0.01	-0.006	-0.001	1						
15. Stem Major	-0.017	0.03	0.096***	-0.066*	-0.642***	1					
16. Co-Curricular Involvement	-0.072**	-0.047*	0.05*	-0.07*	0.045	0.002	1				
17. Teaching clarity and organization	-0.137***	-0.026	0.107***	-0.05*	0.09***	-0.018	-0.017	1			
18. Higher-order learning	-0.047*	-0.07**	0.026	-0.013	-0.01	-0.005	0.101***	0.177***	1		
19. Reflective learning	-0.04	-0.076**	0.064**	0.039*	0.118***	-0.083**	0.065**	0.173***	0.314***	1	
20. Integrative learning	-0.027	-0.166***	0.106***	0.06**	0.124***	-0.115***	0.159***	0.247***	0.462***	0.501***	1

*p<.05, **p<.01, ***p<.001

Table 7. Variance Inflation Factors

Variable	VIF	1/VIF
Need for cognition (Precollege)	1.66	0.602
Precollege Tested Academic Preparation	1.69	0.592
Parents' Educational Attainment	1.24	0.806
Race (White=1)	1.21	0.826
Gender (Male=1)	1.11	0.901
Academic Motivation (First Year)	1.60	0.625
Secondary School Involvement	1.30	0.769
Student Completed Spring of First Year Survey	1.08	0.926
Attends a regional institution	1.93	0.518
Attends a research university	2.02	0.495
Lives on campus	1.27	0.787
Hours of on-and off-campus work	1.13	0.885
Humanities, Fine Arts, or Social Science Major	1.82	0.549
Stem Major	1.87	0.535
Co-Curricular Involvement	1.08	0.926
Teaching clarity and organization	1.18	0.847
Higher-order learning	1.33	0.752
Reflective learning	1.41	0.709
Integrative learning	1.74	0.575
Mean VIF	1.46	

Table 8. Estimated Effect of Deep Approaches to Learning on End-of –Fourth-Year Need for Cognition

Predictors	Block 1	Block 2	Block 3	Block 4
	Student Background Characteristics	Institutional Context	College Experiences	Deep Approaches to Learning
	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)
Precollege need for cognition	.538** (.037)	.521** (.037)	.515** (.036)	.458* (.038)
Precollege total academic preparation	.118** (.004)	.147** (.004)	.119** (.004)	.134* (.004)
Parents' educational attainment	.006 (.008)	.015 (.008)	.020 (.008)	.004 (.008)
White	.0455 (.041)	.041 (.041)	.032 (.040)	.062 (.040)
Male	.072* (.033)	.074* (.033)	.068* (.032)	.080* (.031)
Precollege academic motivation	.008 (.037)	.009 (.038)	.009 (.037)	-.001 (.036)
Secondary school engagement	.028 (.037)	.036 (.037)	.018 (.036)	-.021 (.036)
Attended regional institution		-.031 (.044)	-.008 (.047)	.026 (.045)
Attended research university		-.108** (.031)	-.074* (.033)	-.025 (.034)
Participated in end-of-first year assessment			-.018 (.044)	-.007 (.041)
Lived on campus			-.005 (.033)	.003 (.032)

Table 8 (continued)

	Block 1	Block 2	Block 3	Block 4
	Student Background Characteristics	Institutional Context	College Experiences	Deep Approaches to Learning
Predictors	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)	Standardized coefficient (Standard error)
On-and-off campus work			.023 (.002)	.012 (.002)
Humanities, fine arts, or social science major			.044 (.043)	.035 (.040)
Stem major			.039 (.051)	.062 (.050)
Co-curricular involvement			.020 (.010)	-.009 (.010)
Teaching clarity and organization			.150** (.022)	.090* (.023)
Higher-order learning				.071* (.094)
Reflective learning				.127* (.084)
Integrative learning				.143* (.119)
R ² total model	.370**	.378**	.40**	.459**

CHAPTER V

CONCLUSION AND IMPLICATIONS

Despite policy makers and higher education researchers advocating for teaching the skill of lifelong learning as an essential learning outcome, no prior rigorous research has investigated the effects of the use of deep approaches to learning on the development of lifelong learning over four years. This study showed the effect of deep approaches to learning on gains in end-of-fourth-year NFC after accounting for the precollege measure of NFC, students' background characteristics, and college experiences. With the increasing demand for accountability in developing students' capacity for lifelong learning as an essential graduate outcome in postsecondary education, these results filled major gaps in the student learning strategies literature. Furthermore, these results indicated whether the effects of deep approaches to learning on NFC were general or conditional based on the precollege measures of NFC, sex, race, and ACT (or equivalent) scores. In addition to being the first study to establish the causal relationship between deep approaches to learning and NFC by using a rigorous methodological analysis with a multiple-institution design, this research also corroborates the importance of deep approaches to learning on cognitive development.

To address the research questions, I analyzed the data from the 2006 cohort of WNSLAE, which is comprised of students' background characteristics, academic and non-academic college experiences, and college outcomes. The analytical samples included 1,914 undergraduates from 17 institutions, including liberal arts colleges, research universities, and regional universities. Because the study was designed to investigate the effects of the use of deep approaches to learning on end-of-the-fourth year NFC, Pascarella's (1985) general model for assessing change was used as the study's theoretical guide. Using a pretest-posttest longitudinal design with a set

of statistical covariates, ordinary least squares regressions were conducted to examine the net effects of deep approaches to learning on the development of NFC.

Discussion of Findings

Research Question 1: What are the effects of student background characteristics, precollege experiences, academic college experiences, and non-academic college experiences on end-of-fourth-year NFC?

Student background characteristics

The findings from this study partially support the prior studies that explored the relationship between student background characteristics/experiences and students' inclination for inquiry. Once the precollege measure of NFC was controlled, a few student background characteristics, institutional type, and college experiences had a significant impact on end-of-fourth-year NFC. Consistent with prior studies (Cacioppo et al., 1996), the ACT (or equivalent) score was a significant predictor in all of the blocks, a confirmation that NFC is related to ability indexes. One possible explanation is that an individual with high intelligence tends to engage in and enjoy thinking. Also, despite the fact that a prior researcher found that the 18-item NFC (short form) was gender neutral (Sadowski, 1993), my results indicated that being male as an undergraduate had a significant effect on NFC compared to being female. One possible explanation might be that the precollege measure of NFC for males was lower than for females.

Institutional types

The institutional context in which college students act and think can influence students' NFC change, based on not only how students respond to the environment actively, but also

according to the nature of the environmental stimulus (Pascarella & Terenzini, 2005). Astin, Pascarella, and Biggs adopted this concept in their models, which I used as the theoretical basis for this research. My results clearly illustrate that students who attended to liberal arts colleges were much likely to enhance the development of NFC over the four years than students who attended to research universities (Block 2 and Block 3). Other research has shown that students attending liberal arts colleges had greater development of end-of-first-year NFC than students at research universities (Nelson Laird et al., 2011). One possible explanation for this finding is that professors at liberal arts colleges provide learning experiences based on vetted good practices in undergraduate education more often than professors at research universities (Pascarella et al., 2004). However, when deep approaches to learning were added to the equation (Block 4), the effects of attending a research university were reduced to non-significance. In other words, the indirect effect of liberal arts colleges on NFC was mediated through the use of deep approaches to learning. As such, the greater use of deep approaches to learning might be expected to have a positive effect on students at research universities.

College experiences

Among the college experience variables, only the teaching clarity and organization variable had a positive significant impact on the increase in NFC over four years. The findings in this research indicate that students who are exposed to effective teaching behaviors tend to have higher gains in NFC. In other words, effective instructional behavior enhanced students' desires to engage in effortful cognitive activities. This result supports a prior study's findings that effective teaching behaviors activate students' cognitive processes (Perry, 1991), which has also been empirically demonstrated based on the relationship between effective teaching and NFC among first-year undergraduates (Mayhew et al., 2008).

Research Question 2: What are the net effects of deep approaches to learning on end-of-fourth-year NFC?

The results of this research suggest that, even in the presence of a precollege measure of NFC, student background characteristics/precollege experiences, college experiences, higher-order learning, integrative learning, and reflective learning influenced the development of NFC over four years.

Higher-order learning

Higher-order learning had a significant and positive effect on the development of NFC. A prior study did not find any significant relationship between end-of-first-year NFC and higher-order learning; the researchers of the prior study consequently suggested that the major contribution to end-of-first-year NFC came from integrative and reflective learning (Nelson Laird et al., 2011). However, the results of the current study provide strong evidence of the importance of higher-order learning to the growth of NFC over four years. Cacioppo et al. (1996) asserted that individuals with high NFC tended to expend effort on information acquisition, reasoning, and problem solving to handle various dilemmas. Students who master analyzing, synthesizing, and applying might show more enjoyment during learning activities, and would probably use those skills to cope with predicaments in their life, which would result in improvements in NFC.

Integrative learning

The results of this study provide strong evidence of the importance of integrative approaches to learning in the development of NFC. This finding supports the concept originally proposed by Cohen et al. (1955) that NFC has “a need to structure relevant situations in meaningful, integrative ways (p. 291). As Cacioppo et al. (1996) indicated, individuals with high

NFC tend to actively acquire and think about information to make sense of relationships and events. In addition, several scholars have found that students who adopted deep approaches to learning tended to show positive feelings (Biggs & Tang, 2011; Ramsden, 1992; Tagg, 2003). Thus, students' enjoyment in learning is enhanced when they engage in learning activities in which information from various sources and diverse perspectives is part of the task.

Another possible explanation for this finding may be that individuals with high NFC are more likely to engage in the complex cognitive work needed to resolve inconsistencies in information than individuals with low NFC (Cacioppo et al., 1996). Engaging in integrative learning significantly increased the development of end-of-fourth-year NFC. This is the first study to estimate the effects of integrative learning on gains in NFC over four years. Researchers at the Association of American Colleges and Universities (2007) listed integrative learning as one of the essential college outcomes, noting that integrative learning contributed to lifelong learning and expanded students' capacity to face rapidly changing environments.

Reflective approaches to learning

Reflective approaches to learning were also found to increase the development of NFC over four years. This supports prior research results in which reflection was the essential component of learning and led to gains in cognitive development (Nelson Laird et al., 2011; Phan, 2007; Phan, 2011). Recent research had similar results on the effect of reflective approaches to learning on critical thinking, NFC, and an orientation toward involvement in literacy activities (Nelson Laird et al., 2011). As Cacioppo et al. (1996) stated, individuals with high NFC tend to think about information thoughtfully, reflect back on information, and consider all sides of an issue. Dewey (1933) indicated that reflection "involves active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that

support it and the further consequences to which it leads” (p. 9). Therefore, students who adopt reflective approaches to learning are concerned with the consequences of ideas and the possibility of using them for problem solving, which helps students make developmental gains in NFC.

Research Question 3: Are the net effects of deep approaches to learning on NFC conditional or general?

No evidence was found in this study to indicate that the effects of deep approaches to learning varied by gender, race, ACT score (or equivalent), or precollege measure of NFC. To detect the presence of conditional effects, the cross-product terms were introduced to the general effect model separately. However, each of the individual cross-product terms were neither significantly increases in the explained variance nor statistically significant. This is consistent with the prior study by Nelson Laird et al. (2011), who found that the effects of deep approaches to learning tended to be similar in magnitude for men and women, for White and non-White students, for different levels of tested academic preparation, and for different levels of the precollege measure of NFC among first-year undergraduates. The data from the current study provides strong evidence that deep approaches to learning enhance the growth of NFC regardless of the students’ precollege background.

Implications

The findings of this study hold several important implications for educators, policy makers, and researchers in higher education. Despite the fact that lifelong learning has been identified as an essential graduate outcome and an important mission of higher education institutions in the United States and Europe, few studies have attempted to provide rigorous

evidence and operationalize the concept among undergraduates. This study is the first to provide a theoretically derived and empirically validated measure as a practical strategy for enhancing lifelong learning over four years.

This research provides evidence to confirm that the theoretical construct of NFC can change over four years of college. The findings from this study suggest that student' NFC can develop over four years of college and that change can be influenced by deep approaches to learning. Moreover, the evidence confirms that NFC can be changed in educational settings that design for cognitive development, feelings of enjoyment, and deep approaches to learning (Cacioppo et al., 1996). Identified as an essential graduate outcome within the twenty-first century by AAC&U, the capacity for lifelong learning has a significant influence on the ability to face the characteristics of rapid and continuous change (Knapper and Cropley, 2000). Though American postsecondary education has had limited effects on student learning (Arum and Roksa, 2010), deep approaches to learning are a powerful and practical method for students to develop their inclinations toward inquiry and lifelong learning. A current challenge for higher education faculty is to focus on improving instruction to encourage the adoption of deep approaches to learning.

The findings provide higher education leaders with more incentives to ensure developmentally appropriate learning environments for undergraduates. In order to improve undergraduate education, higher education institutions need to develop a campus culture that fosters student success (Kuh, Kinzie, Schuh, & Whitt, 2010). Though it is not easy to foster a culture of learning, effective leadership is one of the essential ways to ensure "student success becomes an institutional priority" (Kuh, Kinzie, Schuh, & Whitt, 2010, p.270). Leaders of higher education institutions are in a unique position to shape a campus culture and prioritize the

institutional goals in decision-making (Arum & Roksa, 2010). As such, higher education leaders should invest additional funding and resources to shape appropriate learning environment for students. The challenge, however, is to re-orient the faculty and leaders of higher education institutions toward focusing on teaching and student learning rather than on research (Knapper & Cropley, 2000).

The findings provide empirical evidence that rigorous and effective instruction significantly enhances students' NFC over the four years of college. Though faculty and administrators rarely focus on how to improve instruction and demonstrate gains in student learning in current college cultures, Arum and Roksa (2010) concluded that academically rigorous instruction was related to the academic performance requiring critical thinking, complex reasoning, and written communication. Similarly, Pascarella and Terenzini (2005) indicated that effective teaching has an effect on students' general cognitive skills and intellectual development. Scholars have demonstrated that the quality of teaching is not only associated with deep approaches to learning (Crawford, Godon, Nicholas, & Prosser, 1998; Diseth et al., 2006; Diseth, 2007b; Entwistle, 2009; Entwistle & Tait, 1990; Karagiannopoulou & Christodoulides, 2005; Lawless & Richardson, 2002), but also has an effect on academic achievement and qualitative learning outcomes (Lizzio et al., 2002). The findings reinforce the importance of effective teaching emphasized within college impact research. As a result, providing college educators with effective pedagogy theory will not only allow undergraduates to expand their development of NFC, but also encourage the adoption of deep approaches to learning.

The findings of this study indicate that students who adopt higher-order learning will significantly increase their end-of-fourth-year NFC. Engaging in higher-order learning—defined as analyzing the basic components of ideas, experiences, or theories, and synthesizing

information and experiences into new, more complex interpretations—significantly increases the development of NFC. From an information-processing perspective of student knowledge, higher-order learning emphasizes the organization of knowledge into a cognitive structure that is created by students in the process of learning. This cognitive structure then guides future perceptions and learning (Pintrich, 1988). To develop the capacity for lifelong learning, Pintrich (1988) suggested that students must organize and elaborate on information in a meaningful way to be able use the knowledge gained. As a result, higher-order approaches to learning can be thought of as developing students' skill in building their cognitive structures that, in turn, will foster their capacity for lifelong learning.

Higher education researchers and educators should be encouraged by the significant effect of integrative approaches to learning on the inclination toward learning. Leskes and Miller (2006) stated that “powerful learning occurs when the problems posed are unscripted, drawn from the outside world, without simple answers, and are sufficiently broad to require information from multiple areas of knowledge” (p. 18). Integrative learning activities that force students to synthesize information from various sources and make connections between theory and daily-life experiences can develop habits of mind that prepare them to make informed judgments in our globalized and highly technical societies.

Despite the fact that some professors at higher educational institutions have created opportunities for more integrative learning activities, for example incorporating learning communities, interdisciplinary studies, and portfolios into their pedagogy, these innovations only benefit a small number of undergraduates (Huber, 2004). Teaching clarity, organization, and innovative assessment approaches can contribute to the greater use of deep approaches to

learning in more classrooms. However, developing effective teaching methods, innovative assessments, and innovative curriculum designs are a time-consuming tasks for educators.

The results of this study indicate that reflective approaches to learning—defined as the encouragement to learn and evaluate the strengths and weaknesses of an argument from different perspectives and to learn something that changes one’s understanding—significantly increase students’ inclination to commit to lifelong learning over four years. Sternberg and Grigorenko (2002) suggested that “given the amazing rapid rate of development today. . .colleges and universities are obliged to develop flexibility in their students. The rapid accumulation of knowledge may render much of the knowledge students acquire in college obsolete, but it will never render obsolete the facility they acquire in coping with a novel environment” (Sternberg & Grigorenko, 2002, p. 49). A college environment should not only challenge students’ boundaries, but also help them understand points of view other than their own (Sternberg & Grigorenko, 2002). Experiencing reflective approaches to learning allows students to cultivate an ability to critique information they are learning in a thoughtful manner and to see the world from different perspectives.

The findings of this study support the use of the deep approaches to learning scales at an institutional level to stimulate dialogue about teaching and learning practices and emphasize the need for deep approaches to learning among educators. Even though lifelong learning has been recognized as an important undergraduate outcome in many areas of the world, the lack of an approach to institute practices that support this outcome is often a challenge for educators.

The Relationship of the Results to Theory

The conceptual framework of this study was based on student background characteristics, precollege experiences, institutional types, college academic experiences, and deep approaches to learning that could theoretically foster the development of NFC over four years. Besides being the first study to establish the causal relationship between deep approaches to learning and end-of-fourth-year NFC, the results of this study also demonstrate that engaging in deep approaches to learning produces enjoyment and positive feelings, and also fosters students' cognitive development. As Ramsden (1992) stated, deep approaches to learning involve engagement, challenge, and positive feelings of personal fulfillment and pleasure. Cacioppo et al. (1996) suggested that NFC is process oriented rather than outcome oriented. In response to King and Baxter Magolda's suggestion (2005) that researchers should pay attention to questions about process as well as to the content of student learning, a group of studies have demonstrated that deep approaches to learning enhanced students' cognitive development among first-year undergraduates (Mayhew et al., 2012; Nelson Laird et al., 2011). The process of learning helped students organize their knowledge into a cognitive structure that guided future perceptions and learning. As Biggs and Tang (2011) asserted, the acquisition of information cannot change the way we see the world, but the way effective learning helps structure information can lead to conceptual change.

Many researchers in student learning strategies put greater emphasis on the relationship between deep approaches to learning and academic achievement. However, the findings of this study demonstrated that the critical value of deep approaches to learning lies in enhancing cognitive development through conceptual change.

Directions for Future Research

Further research should include other types of learning approaches (e.g., a surface approach) to compare the effects on NFC. Although a body of studies have demonstrated the relationship between deep approaches to learning and high qualitative learning outcomes (Biggs, 1989; Entwistle, 1983; Marton & Säljö, 1976a; Ramsden, 1992; Trigwell, 1991; Tynjälä, 2005; Vermunt & Vermunt, 2004), some researchers found that the surface approaches to learning correlated with specific assessment formats (e.g., multiple choice question exams). Ramsden (1991) argued that deep approaches to learning were a *necessary* condition to achieve high quality outcomes, but were not a *sufficient* condition. Thus, further research should consider a finer-tuned measure—such as ASI or MSLQ—to investigate whether the effects of deep approaches to learning on NFC is mediated by different learning approaches.

Researchers should also consider other methods to investigate the reciprocal effects between NFC and deep approaches to learning. It may be that students with high NFC tend to adopt deep approaches to learning because they tend to engage in effortful cognitive activities. Cacioppo et al. (1996) argued that the concept of NFC emphasized process rather than outcomes, and they also asserted that individuals with high NFC expended more effort to acquire information, to reason, and to solve problems in their world. Future research on this topic should use structural equation modeling to understand whether there are potential reciprocal effects between NFC and deep approaches to learning.

Given the opportunity and resources for longitudinal research, future researchers should design a study to investigate which conditions and experiences in the various institution types contribute to students' NFC. A previous study showed that liberal arts college students had greater gains in end-of-first-year NFC than research university students, but it is still unclear what caused the difference. The effects of institutional types on NFC were diminished by the

deep approaches to learning in this study. It would also be helpful to investigate the impacts of deep approaches to learning on NFC among community college students. Community colleges have a different mission, a different student population, and different instructional methods (e.g., online-oriented instruction) than other types of colleges (Cohen & Brawer, 2009). A previous study showed that first-year community college students had greater gains in end-of-first-year NFC than first-year liberal arts college students (Nelson Laird et al., 2011).

Further research should be designed to include more specific information regarding total credits earned from the first year to the fourth year. It may be that students who earned more credits had greater NFC gains than students who earned fewer credits, because students with more credit hours have already benefited a great deal from academic and non-academic experiences. In this study, it was not possible to construct a useful variable to represent the total credits students earned from the first year to the fourth year. Including the total credits students earned would provide insight into how curricular experiences impacted students' development of NFC.

Conclusion

The increasingly compelling interest in lifelong learning in higher education is rooted in the challenges of a complex world and a demanding knowledge economy. When college students graduate and enter the world of fast-changing economic markets and societies that are in constant flux, they are required to continuously update their knowledge and skills. At the same time, the leaders of higher education institutions must respond to the increasing demand for accountability in regard to fostering the skills of lifelong learning in students by the time they graduate. Since the importance of lifelong learning has been identified, it has become part of the mission

statements of most higher education institutions. However, only a few studies have investigated how college experiences may influence lifelong learning, and none has examined how NFC can be increased through the use of deep approaches to learning.

This research was the first designed to investigate the effects of deep approaches to learning on end-of-fourth-year NFC using large-scale data. The findings from this study suggest that the use of deep approaches to learning—higher-order learning, integrative approaches to learning, and reflective approaches to learning—are particularly influential in the development of NFC over four years. Furthermore, the effects of deep approaches to learning on the development of NFC over four years does not differ for men and women, for White students and non-White students, for students with different levels of academic preparation, and for students with different levels of precollege NFC. By identifying the important role of NFC in deep learning, this study makes a contribution to the critical need for the leaders of higher education institutions to develop a holistic understanding of how to foster students' skills for lifelong learning.

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