Deeply Effecting First-Year Students' Thinking:

The Effects of Deep Approaches to Learning on Three Outcomes

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Abstract

The purpose of this study was to estimate the relationship between deep approaches to learning (DAL) and three cognitive outcomes. In particular, we sought to estimate the effects of four DAL measures, an overall DAL scale and its three sub-scales, on measures of students' critical thinking, need for cognition, and positive attitude toward literacy, controlling for many covariates and students' scores on the outcome measures prior to college. Results suggest that reflection is critical to helping students make developmental gains across all three outcome measures. Implications for researchers and practitioners are discussed.

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Put simply, students should become better thinkers as they proceed through college. They should leave their institutions inclined to learn more and ready to take up the intellectual challenges imbedded in their lives. This is evident in even a cursory examination of the 21st century collegiate learning outcomes articulated by the Association of American Colleges and Universities (AAC&U, 2007) and those found in innumerable other documents from previous eras that describe the best of what students should receive from a college experience. Yet, not all college students come out of their experiences equally equipped in these areas nor have they all made the same amount of progress. The findings from Arum and Roksa (2011) illustrate this point, but so too does a long line of research within the higher education literature (Pascarella & Terenzini, 2005).

To understand what makes for better learning and improved thinking, researchers have been investigating what are known as "deep" approaches to learning (DAL) for almost forty years. Deep approaches to learning focus on the substance of learning and its underlying meanings (Marton & Säljö, 1976), including seeking to grasp key concepts, understanding relationships, and transfering ideas from one circumstance to another (Beatie, Collins, & McInnes, 1997; Bowden & Marton, 1998). This contrasts with "surface" approaches where the focus is almost exclusively on the substance of information, where rote learning is predominant and the educational goals amount to avoiding failure (Biggs, 1989; Tagg, 2003).

Approaching learning deeply is important because students who use such approaches tend to earn higher grades, and retain, integrate, and transfer information at higher rates (Biggs 1988; Entwistle & Ramsden, 1983; Prosser & Millar, 1989; Ramsden, 2003; Whelan, 1988).

DAL are also associated with more enjoyment in learning, reading widely, drawing on a variety of resources, discussing ideas with others, reflecting on how individual pieces of information relate to larger constructs or patterns, and applying knowledge in real world situations (Biggs, 2003; Entwistle, 1981; Ramsden, 2003; Tagg, 2003).

While the evidence for DAL suggests a connection to valued college outcomes, the literature is lacking in two areas germane to our study. First, the range of outcomes examined in the literature about DAL is still fairly narrow. For example, few studies examine relationships between DAL and standardized measures of critical thinking or students' orientations toward thinking and learning. Second, much of the study of DAL has been done very locally, within classrooms or tied to particularly learning tasks. To complement the work that has already been done, researchers need to conduct larger-scale investigations that cover significant periods of time during college and examine outcomes that are less task or classroom specific.

Collegiate Thinking and Learning and Deep Approaches to Learning

In the following sub-sections, we discuss learning and our approach to its examination. Then, we define DAL, describe the measures of DAL on the National Survey of Student Engagement (NSSE), and discuss the connections between DAL and a variety of outcomes. Specifically, we pay particular attention to known relationships between NSSE's measures of DAL and outcomes and areas where relationships should be established or investigated further.

College Learning

What is learning? Underscoring most major ontological and epistemic assumptions about education and its purposes is the idea that learning is existent, measurable, and can change over time as a result of being exposed to and participating in certain educational experiences. Given these assumptions, many authors have articulated definitions of learning—each often offered

from a perspective consistent with the philosophical tenets of a given discipline (see Evans, Forney, & Guido-DiBrito, 1998). Rather than delve into or summarize definitions of learning into an articulated framework for understanding the outcomes examined in this study, we submit that college learning is an amalgam of many mutually-reinforcing forms, three of which were included in this study: critical thinking, need for cognition, and positive attitudes toward literacy (PATL).

Consistent among these forms is the idea that learning is a structural-developmental cognitive process, involving the interaction between the individual and the environment and the individual's ability to ascribe meaning to that interaction. From the early work of Perry (1968) and Piaget (1948), we see that individuals structure meaning by interacting with the environment – this dynamic forms the process individuals use to engage, evaluate, synthesize, and interpret information presented through environmental cues. With increased exposure to environmental cues comes change in individual processing—development of each cognitive form.

Theoretically, then, we assert that the mechanisms embedded within deep-learning approaches will engender movement in each of the three cognitive forms examined in this study: critical thinking, need for cognition, and PATL. Although we expect that certain mechanisms will help students make cognitive gains across these three forms, we also hypothesize that certain mechanisms may be more prevalent for one form than another—that is, one dimension of deep approaches may influence critical thinking to a greater degree than need for cognition, for example. As an exploratory study focusing on the relationship between DAL and three cognitive outcomes, we chose to use the same conceptual framework and analytic scheme for interrogating these relationships but leave room for the nuances reflecting each: DAL and critical thinking, DAL and need for cognition, and DAL and PATL, respectively.

Deep Approaches to Learning

Scholars distinguish between "approaches to learning" and the learning that results. What a student does, her or his study activities and behaviors, compose that student's approach to learning (e.g., Biggs, 1987, 2003; Ramsden, 2003). An approach leads to learning, but there are qualitative distinctions between approaches taken and in the quality of the learning that results. By definition, a deep approach leads to deeper learning and a surface approach leads to more surface learning.

In developing the distinctions between deep and surface approaches, researchers found that students who use a deep approach more often show a personal commitment to understand the material. They tend to use multiple strategies, such as reading widely, discussing ideas with others, pulling from multiple resources, reflecting on the learning process, and applying knowledge in real world situations (Biggs, 1987, 1989, 2003; Entwistle, 1981; Ramsden, 2003; Tagg, 2003). Integrating and synthesizing information with what one has learned previously also reflects a deep approach. Deep learners' ways of thinking and approaching new phenomena get updated through the learning process as they make efforts to see problems and issues from different perspectives (Ramsden, 2003; Tagg, 2003). Not surprisingly, students using "surface" approaches focus mostly on the substance of information and privilege memorization techniques over others (Biggs, 1989; Tagg, 2003). In using a surface approach, one is seeking to avoid failure, instead of understanding core concepts and seeing the relationships among them or figuring out how to apply information in new ways (Bowden & Marton, 1998).

When measured through questionnaires, researchers generally capture at least two types of approaches (deep and surface, or something analogous) by tapping the motivations and strategies that inform those approaches (Biggs, 1987; Entwistle & Ramsden, 1983; Ramsden &

Entwistle, 1981). Such instruments have been used widely on college students and updated periodically (Biggs, Kember & Leung, 2001; Entwistle & McCune, 2004; Gibbs, Habeshaw, & Habeshaw, 1989; Entwistle & Tait, 1994). Such instruments are most often administered with a focus on a course context or a particular learning task.

Deep Approaches to Learning as Measured by NSSE

NSSE is an annual survey of first-year and senior college students at baccalaureate degree-granting institutions. The NSSE questionnaire measures students' participation in educational experiences linked to important higher education outcomes (Chickering & Gamson, 1987; Kuh, 2001, 2003; Pascarella & Terenzini, 2005). Several NSSE items capture activities indicative of DAL even though this was not the stated intent of these items. A review of deep learning research and existing deep learning measures suggested a fairly strong connection between the content of previous measures of DAL and the NSSE items (Nelson Laird, Shoup, & Kuh, 2006). Items, such as the frequency with which students apply theories or concepts to practical problems or in new situations, assess challenging learning that requires deeper cognitive effort than memorization. Another item asks whether students examine the strengths and weaknesses of their views on a topic or issue. This probes the extent to which students reflect on their learning processes. There are also items about the extent to which students integrate and use information obtained from various sources.

Unlike other measures of DAL, the NSSE items attempt only to measure one's use of deep approaches rather than multiple types of approaches. Also, since NSSE items are aimed at students' experiences at an institution in a given year, the NSSE measure of DAL is best thought of as a general measure of DAL or an indicator of a student's preferred approach. This fits with

previous work that indicates that students have a general tendency to select one approach over another (Biggs, 1987; Entwistle, 1981; Ramsden, 2003).

Studies using this scale established an overall DAL scale and three sub-scales (higher-order, integrative, and reflective learning) with satisfactory internal validity and reliability (Nelson Laird et al., 2006, Nelson Laird, Shoup, Kuh, & Schwarz, 2008). In addition, the scales' validity has been supported by evidence showing positive relationships with student self-reported gains, grades, and satisfaction (Nelson Laird, Shoup, et al., 2008; Reason, Cox, McIntosh, & Terenzini, 2010). The positive relationship with grades is not surprising given prior research connecting DAL to outcomes, most of which focuses on grades as an indicator of academic achievement.

Deep Approaches to Learning and their Associated Outcomes

Research connecting DAL to outcomes is limited in two ways. First, there is an overwhelming focus on linking DAL to academic achievement, particularly grades. Second, studies generally target students in a small number of courses (often a single course) at a single institution. Still, the body of research suggests that DAL foster improved thinking and learning for students.

Early studies connected DAL and increased retention, integration, and transfer of information (Biggs 1988; Entwistle & Ramsden, 1983; Prosser & Millar, 1989; Whelan, 1988), which set the foundation for further work. Since then, many scholars established relationships between DAL and academic achievement. Though prior academic achievement is considered the primary predictor of current academic achievement, results show a positive relationship exists between DAL and achievement (e.g. Hall, Bolen, & Gupton, 1995; McKensie & Schweitzer, 2001; Zeegers, 2004; Zhang 2000). For example, a study of Australian students indicated that,

even though multiple factors contribute to learning outcomes, both deep and surface approaches had direct effects on overall GPA (Zeegers, 2004). In particular, DAL positively affected first- and third-year students' overall GPA, while surface approaches negatively affected students' GPA (and the effect was actually stronger in the 3rd year). Similarly, Zhang (2000) found use of DAL positively associated with higher GPAs controlling for US students' self-rated analytic, creative, and practical abilities. Other studies show that altering teaching practices can lead to increased use of DAL and consequently improved grades (Gow, Kember, & Cooper, 1994; Meyer, Parsons, & Dunne, 1990; Woods, Hrymak, & Wright, 2000).

Similarly, adoption of DAL was positively associated with exam and portfolio grades (Lonka, Keikkil, Lindblom-Ylanne, & Maury, 1997; Vermunt, 1992; Vermunt & Vermetten, 2004). Students who took a deep approach also failed and withdrew from a course less often (Rowell, Dawson, & Pollard, 1993) and were more likely to achieve higher GPAs and earn more credits per year (Tynjälä, Salminen, Sutela, Nuutinen, & Pitkänen, 2005).

In many studies that utilize grades as an outcome, the assumption is that students' grades reflect deeper understanding, greater critical thought, and other outcomes. Particularly in some of the course-specific studies, this may well be the case, but across courses, we are dubious about the use of GPA as a proxy for important thinking and learning outcomes. In the current study, we focus on three particular thinking and learning outcomes: critical thinking, need for cognition, and PATL.

Critical Thinking. While a positive relationship between DAL and critical thinking is regularly assumed, only a small number of studies empirically investigated the connection between DAL and critical thinking. For example, Chapman (2001) found that the adoption of teaching methods that favored DAL led to improved higher-order and critical thinking skills

among students in an introductory biology course. While such results are encouraging, two studies that examined the relationship between NSSE's DAL scale and standardized tests of critical thinking skills found no relationship (Nelson Laird, Garver, Niskode-Dossett, & Banks, 2008; Reason et al., 2010), though Nelson Laird and colleagues did find a positive relationship between DAL and reflective judgment (for students with strong high school GPAs) and critical thinking dispositions.

Need for Cognition. It has been noted that use of DAL is associated with the enjoyment of learning and at least one study has established a positive relationship between DAL and students' need for cognition (Evans, Kirby, & Fabrigar, 2003), which is defined as the "tendency to engage in and enjoy effortful cognitive activity" (Cacioppo, Petty, Feinstein, & Jarvis, 1996, p. 197). However, that study only looked at the correlations between the two and not the development of need for cognition over time.

Positive Attitudes toward Literacy. PATL is a concept that covers students' enjoyment of such literacy activities as reading poetry and literature, reading scientific and historical material, and expressing ideas in writing (Bray, Pascarella, & Pierson, 2004). Scholars suggest that DAL are positively associated with reading widely and enjoying the learning process (Biggs, 2003; Ramsden, 2003; Tagg, 2003), which implies a connection to PATL, though a direct empirical link has not been established.

Purpose

The purpose of this study was to estimate the relationship between DAL and three dimensions of cognitive development. In particular, we sought to estimate the effects of four DAL measures, an overall DAL scale and its three sub-scales, on measures of students' critical

thinking skills, inclination to inquire, and orientation toward literacy controlling for many covariates and students' scores on the outcome measures prior to college.

This study is an explicit examination of thinking and learning within the first college year connecting students general use of DAL, as measured by the National Survey of Student Engagement (NSSE) (Nelson Laird et al., 2006; Nelson Laird, Shoup et al., 2008), with the Critical Thinking Test from the Collegiate Assessment of Academic Proficiency (CAAP) (American College Testing Program [ACT], 1991), the Need for Cognition Scale (NCS) (Cacioppo et al., 1996), and the PATL scale (Bray et al., 2004). As such, this study is both an assessment of the impact of the first year of college as well as a test of the relationships between NSSE's DAL scale and sub-scales and the three outcome measures.

Conceptual Framework

Biggs (2003), in his 3-P model, suggests that Student Factors and the Teaching Context (both a part of Presage) lead to students' choice of Learning-Focused Activities (the Process; e.g., DAL), which in turn affects the Learning Outcomes (the Products). This model encouraged our inclusion of student background characteristics (e.g., gender, race, parental education, academic ability), learning environment characteristics (e.g., courses taken), and learning process indicators such as approaches to learning. While the Biggs model is not substantially different from other models of college impact (e.g., Astin, 1977, 1993; Pascarella, 1985), it highlights how aspects of students' background and the college context influence students' choices of learning approaches, something central to our study that is not emphasized in the other models.

Consistent with previous research on our dependent measures and DAL, our *presage* variables included a host of covariates, including race, gender, parental education, precollege ACT score or equivalent, secondary school involvement, academic motivation, and precollege

measures of each dependent variable. For *process* variables, we included a measure of course-taking patterns, the number of courses taken in humanities, the social sciences, education, and business. This allowed us to capture the amount of exposure students' had to fields inclined toward DAL (Nelson Laird, Shoup, et al., 2008). For a sample of first-year students, like ours, measures of course-taking were preferred over capturing major, because many students in the sample had yet to declare a major. In addition, with our focus on first-year students, trying to capture finer distinctions in course taking patterns was difficult without creating highly skewed variables (i.e., many students take zero courses in certain areas). Our other process variables were the variables measuring DAL. Our *product* variables were three measures of cognitive development: critical thinking, need for cognition, and PATL.

Methods

Samples

Institutional Sample. The participants in the study consisted of incoming first-year students at 19 four- and two-year colleges and universities located in 11 different states in the Northeast, Southeast, Midwest, or Pacific Coast regions of the United States. The 19 institutions were selected from more than 60 colleges and universities that responded to a national invitation to participate in the Wabash National Study of Liberal Arts Education (WNSLAE), a longitudinal investigation funded by the Center of Inquiry in the Liberal Arts at Wabash College aimed at understanding the effects of liberal arts colleges and liberal arts experiences on the cognitive and personal outcomes theoretically associated with a liberal arts education. The institutions were selected to represent differences in college and universities nationwide on a variety of characteristics including institutional type and control, size, location, and patterns of

student residence. However, liberal arts colleges were purposefully over-represented because the study's focus on the impacts of liberal arts colleges and liberal arts experiences.

The selection process produced a sample of institutions with a wide range of academic selectivity, from some of the most selective institutions in the country to some that were essentially open admissions. Undergraduate enrollments also varied considerably, from institutions with entering classes between 3,000 and 6,000, to institutions with entering classes between 250 and 500. According to the 2007 Carnegie Classification of Institutions, 3 of the participating institutions were considered research universities, 3 were regional universities that did not grant the doctorate, 2 were two-year community colleges, and 11 were liberal arts colleges.

Student Sample. The individuals in the sample were first-year, full-time undergraduate students participating in the WNSLAE at each of the 19 institutions in the study. At each institution students were selected in either of two ways. First, for larger institutions, the sample was selected randomly from the incoming first-year class at each institution. The only exception to this was at the largest participating institution in the study, where the sample was selected randomly from the incoming class in the College of Arts and Sciences. Second, for a number of the smallest institutions in the study—all liberal arts colleges—the sample was the entire incoming first-year class. The students in the sample were invited to participate in a national longitudinal study examining how a college education affects students, with the goal of improving the undergraduate experience. They were informed that they would receive a monetary stipend for their participation in each data collection, and were also assured in writing that any information they provided would be kept in the strictest confidence and never become part of their institutional records.

Data Collection

Initial Data Collection. The initial data collection was conducted in the early fall of 2006 with 4,501 students from the 19 institutions. This first data collection lasted between 90-100 minutes and students were paid a stipend of $50 each for their participation. The data collected included a WNSLAE precollege survey that sought information on student demographic characteristics, family background, high school experiences, political orientation, educational degree plans, and the like. Students also completed a series of instruments that measured dimensions of cognitive and personal development theoretically associated with a liberal arts education, including a measure of critical thinking skills, a measure of inclination to inquire, and a measure of orientation toward involvement in literacy activities. These three instruments are described in greater detail in the Dependent Variables section below. Due to instrument length and concerns about the use of student time during the assessment, not all students in the sample completed the measure of critical thinking skills. Rather, at each institution, it was randomly assigned to half of the student study participants, while the other random half of the sample completed a different instrument of almost identical length. All students in the sample at each institution completed the measures of inclination to inquire and orientation toward literacy activities.

Follow-Up Data Collection. The follow-up data collection was conducted in spring 2007. This data collection took about two hours and participating students were paid an additional stipend of $50 each. Two types of data were collected. The first was based on questionnaire instruments that collected extensive information on students' experience of college. Two complementary instruments were used: NSSE and the WNSLAE Student Experiences Survey (WSES). However, for the purposes of this study, we focus on information

provided by the NSSE. The second type of data collected consisted of follow-up (or posttest) measures of the instruments measuring dimensions of cognitive and personal development that were first completed in the initial data collection. All students completed the NSSE and WSES prior to completing the follow-up instruments assessing cognitive and personal development. Both the initial and follow-up data collections were administered and conducted by ACT (formerly the American College Testing Program).

Of the original sample of 4,501 students who participated in the fall 2006 testing, 3,081 participated in the spring 2007 follow-up data collection, for a response rate of 68.5%. These 3,081 students represented 16.2% of the total population of incoming first-year students at the 19 participating institutions. To provide at least some adjustment for potential response bias by sex, race, academic ability, and institution in the sample of students, a weighting algorithm was developed. Using information provided by each institution on sex, race, and ACT score (or appropriate SAT equivalent or COMPASS score equivalent for community college students), follow-up participants were weighted up to each institution's first-year undergraduate population by sex (male or female), race (Caucasian, African American/Black, Hispanic/Latino, Asian/Pacific Islander, or other), and ACT (or equivalent score) quartile. While applying weights in this manner has the effect of making the overall sample more similar to the population from which it was drawn, it cannot totally adjust for non-response bias.

Dependent Variables

The study had three dependent variables: a measure of critical thinking skills, a measure of inclination to inquire, and a measure of orientation toward involvement in literacy activities. To measure critical thinking skills we used the Critical Thinking Test (CTT) from the Collegiate Assessment of Academic Proficiency (CAAP) developed by ACT. The CAAP CTT is a 40-

minute, 32-item instrument designed to measure a student's ability to clarify, analyze, evaluate, and extend arguments. The test consists of four passages in a variety of formats (e.g., case studies, debates, dialogues, experimental results, statistical arguments, editorials.). Each passage contains a series of arguments that support a general conclusion and a set of multiple-choice test items. The internal consistency reliability for the CTT ranges between .81 and .82 (ACT, 1991). It correlates .75 with the Watson-Glaser Critical Thinking Appraisal (Pascarella, Bohr, Nora, & Terenzini, 1995).

Need for cognition, which refers to the engagement in and enjoyment of effortful thinking, was measured with the 18-item Need for Cognition Scale (NCS). Those who have a high need for cognition "tend to seek, acquire, think about, reflect back on information to make sense of stimuli, relationships, and events in the world" (Cacioppo et al., 1996, p. 198). In contrast, those with low need for cognition are more likely to rely on others, such as celebrities and experts, cognitive heuristics, or social comparison processes to provide or make sense of their world. The reliability of the NCS ranges from .83 to .91 in samples of undergraduate students (Cacioppo, et al., 1996). With samples of undergraduates the NCS has been positively associated with the tendency to generate complex attributions for human behavior, high levels of verbal ability, engagement in evaluative responding, one's desire to maximize information gained rather than maintain one's perceived reality (Cacioppo et al., 1996) and college grades (Elias & Loomis, 2002). The NCS is negatively linked with authoritarianism, need for closure, personal need for structure, the tendency to respond to information reception tasks with anxiety, and chronic concern regarding self-presentation (Cacioppo et al., 1996).

Finally, orientation toward involvement in literacy activities was measured with the six-item Positive Attitude Toward Literacy Scale (PATL). The PATL assesses a student's

enjoyment of such literacy activities as reading poetry and literature, reading scientific and historical material, and expressing ideas in writing, and has an internal consistency reliability of .71. The PATL score at entrance to college correlated .36 with three-year cumulative scores on a measure of library use during college, .48 with the cumulative number of unassigned books read during three years of college, and .26 with a measure of reading comprehension administered after three years of college (Bray et al., 2004).

Independent Variables

The independent variables in the study were four scales developed by Nelson Laird and colleagues (Nelson Laird et al., 2006; Nelson Laird, Shoup, et al., 2008) to measure deep approaches to learning. The scales are based on NSSE items completed by the student sample in spring 2007. Three of the four scales are termed: Higher-Order Learning, Integrative Learning, and Reflective Learning. According to Nelson Laird, Shoup et al. (2008), the four-item 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 consists of five items and 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). Reflective Learning is a three-item scale that asks "how often students examined the strengths and weaknesses of their own views and learned something that changed their understanding" (p. 477). Nelson Laird and his colleagues have also developed an Overall DAL Scale that yields a score based on all 12 items. We present the specific items constituting each of the three deep learning subscales and the overall scale in Table 1

Control Variables/Covariates

A particular methodological strength of the Wabash National Study of Liberal Arts Education is that it is longitudinal in nature. This permitted us to introduce a wide range of statistical controls, not only for student background and precollege traits and experiences, but also for other experiences during the first year of college.

In specifying our regression models we were guided by a number of longitudinal conceptual models for studying the impact of college on students (e.g., Astin, 1977, 1993; Pascarella, 1985). These longitudinal models argue that to validly understand the net impact of any specific college experience one must take into account at least three additional sets of variables: the background characteristics with which the student begins postsecondary education, the institutional context (if the data are multi-institutional), and other college experiences that might influence or co-vary with the particular experience in question. The student pre-college variables in our study included: demographics, such as race, sex, and parental education; a pre-college measure of each of the three outcome variables and a measure of tested pre-college academic preparation; and measures of involvement/engagement in secondary school and pre-college academic motivation. Many of the pre-college variables had significant correlations, either with the dependent measures, and/or with the deep learning scales. For example, the pre-college measures of critical thinking, need for cognition, and positive attitude toward literacy correlated .796, .741, and .742, respectively, with the end-of-first-year scores on the three measures. The pre-college measure of need for cognition had correlations with the four deep learning scales that ranged between .256 and .382, while the precollege positive attitude toward literacy score correlated from .163 to .327 with the deep learning scales.

Finally, the measure of academic motivation (described below) had correlations with the deep learning scales ranging from .23 to .31.

To take into account institutional context, we created dummy variables (i.e., coded 1 or 0) to represent the four types of institutions attended by the WNS sample: liberal arts colleges, research universities, regional institutions, and community colleges. Finally, we also took into account the influence of other first year college experiences which we hypothesized might shape a student's opportunity for engagement in deep learning experiences, or confound the link between deep learning experiences and the three first year outcomes. These included: living on- or off-campus, work responsibilities, and the type of first year coursework taken.

Our control variables/covariates, and their operational definitions were as follows:

- A parallel precollege measure of each of the three outcome measures: critical thinking, need for cognition, and positive attitude toward literacy (described above).
- Tested precollege academic preparation. This was the student's actual ACT score, SAT equivalent score, or COMPASS equivalent score for community college students, provided by each participating institution.
- Sex (coded as 1 = Male, 0 = Female).
- Race (coded as 1 = White, 0 = non-White).
- Average parental education. This was computed as the average of the respondent's parents' education provided that the student provided a response for at least one parent. The 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 of other 2-year degree, 6 = Bachelors or other 4-year degree, 7 = Masters, 8 = Law, 9 = Doctorate).

- High school involvement. This was a seven-item scale with an internal consistency reliability of .58 that measured involvement during high school. Examples of constituent items include: "During your last year in high school, how often did you study with a friend?" "During your last year in high school, how often did you talk with teachers outside of class?" "During your last year in high school, how often did you participate in extracurricular activities?" Response options were "very often," "often," "occasionally," "rarely," or "never." Scores on the scale were obtained during the initial data collection in fall 2006.
- Precollege academic motivation. This was an eight-item, Likert-type scale in which respondents were asked to indicate the extent to which they agree or disagree ("strongly agree," "agree," "not sure," "disagree," "strongly disagree") with statements about their academic motivation. These statements included: a willingness to work hard to learn material even if it doesn't lead to a higher grade, the importance of getting good grades, reading more for a class than required, enjoyment of academic challenge, and the importance of academic experiences in college. The internal consistency reliability for the scale is .69, and scores on the scale were obtained during the initial data collection in fall 2006.
- Hours per week during the first year of college one worked both on and off campus. There were eight response options from "zero" to "more than 30 hours."
- Lived in campus housing (coded 1) versus elsewhere (coded 0) during the first year of college.

- The liberal arts emphasis of one's first year coursework. [Operationalized as the total number of courses during the first year of college taken in traditional liberal arts areas: "Fine Arts, Humanities, and Languages" (e.g., art, music, philosophy, religion, history); "Mathematics/Statistics/Computer Science"; "Natural Sciences" (e.g., chemistry, physics); and "Social Science" (e.g., anthropology, economics, psychology, political science, sociology)]
- Institutional type. This was operationally defined as three dummy variables representing attendance at a research university, regional university, or community college (each coded 1), with attendance at a liberal arts college always coded 0.

Information on work responsibilities, place of residence, and first-year coursework was obtained during the follow-up data collection in spring 2007.

Data Analyses

Our analyses were conducted in two stages. First, we estimated the relationship between the DAL scales and the three outcome measures using correlations. These analyses were based on the zero-order correlations between the DAL scales and both the precollege and end-of-first-year scores for critical thinking, need for cognition, and PATL, as well as the partial correlations between the deep learning scales and end-of-first-year outcome scores controlling for the precollege scores. These analyses were intended to be preliminary and so did not take into account the nested (students within institutions) nature of the data. This likely led to underestimated standard errors (Raudenbush & Bryk, 2001). As a result, we used a more stringent alpha level ($p < .01$) to indicate statistical significance.

The second stage of analysis contained two waves of modeling. In the first wave we regressed end-of-first-year (spring 2007) scores for each dependent measure (i.e., the CAAP

CTT, NCS, and PATL) on the DAL scales and all control variables described above. Separate analyses were done, first with an equation including the Overall DAL Scale, and subsequently with an equation including the three DAL sub-scales (Higher-Order Learning, Integrative Learning and Reflective Learning). In the second wave of stage two, we sought to determine if the estimated effects of the deep learning scales on the three dependent measures were general or conditional. We added cross-products consisting of sex, precollege score on each dependent measure, and tested precollege academic preparation on the one hand and the deep learning scales on the other, to the general effects equations specified above. We then tested the sets of cross-products for statistical significance to determine the presence of conditional effects based on sex, pre-college dependent variable scores, and precollege academic preparation.

In the stage two analyses, we standardized all continuous variables so that model parameter estimates could be interpreted as effect sizes. We also adjusted for the clustered or nested nature of our data. The "clustered" nature of our data results from the fact that the individuals in our sample were not drawn from a random individual sample but a sample in which their postsecondary institution was the primary sampling unit. Because students within a school are more similar than across schools, the error terms from the prediction model are correlated, which violates one of the assumptions of Ordinary Least Squares regression and results in underestimated standard errors (Ethington, 1997; Raudenbush & Bryk, 2001). We accounted for the nested nature of the data by using appropriate statistical techniques that adjust for this clustering (Groves et al., 2004). Specifically, we employed the regression option (svy) in the STATA software package that adjusts standard errors in coefficient estimates for the clustering effect. Complete data on all variables was available for 1,451 students in the analysis

of the CAAP CTT, and 3,010 students in the analyses of NCS and PATL. All analyses are based on weighted sample estimates adjusted to the actual sample size for correct standard errors.

Limitations

This study has several limitations. Because we studied students nested within institutions, we restricted the number of covariates included in the analytic models. For example, we reduced the number of process variables included in the model, coded race into two discrete categories, and used a limited number course-taking measured due to the limits on our degrees of freedom.

The NSSE measure of DAL contains fewer items (only 12) than other such measures and does not tap other types of learning approaches (Biggs et al., 2001; Entwistle & McCune, 2004). It may be that a finer tuned measure or including a measure of another approach (e.g., surface) would result is modified findings. Future research should consider whether a more robust measure or measures of deep approaches to learning would show stronger relationships even with controls, particularly for critical thinking.

Also, our sample consisted of only first-year students. This meant that certain covariates of interest, particularly year in school and depth or major, did not vary or were much less meaningful. In addition, we tested these students at only two time points; we cannot speak to stability of change scores over time. Future research, including studies using more years of WNSLAE data, should address these limitations.

Including community college students as part of our longitudinal sample presents some potential limitations. The institutional mission of community colleges differs from those at other types of colleges (Cohen & Brawer, 2003; Grubb, 1996) and this difference can make it problematic to include students enrolled at community colleges with four-year college students in studies of college impact. However, many first-year students at community colleges

experience cognitive changes that are quite similar in direction and magnitude to those of their four-year college counterparts (Pascarella, 1999; Pascarella & Terenzini, 2005). Further, too often community college students are ignored in research on college impact. As a result, we opted to include community college students in our sample and control for student clustering and precollege ACT or equivalent. Future researchers may want to specifically investigate DAL and cognitive outcomes at community colleges because of their embedded and distinctive educational practices.

Finally, since the focus of this study was on the individual-level effects of DAL on three cognitive outcomes, we chose not to model institutional-level effects but simply account for the clustered nature of the sampling design. We believe examining institutional-level effects is an area for further research, but studies need to ensure enough statistical power for examining Level-2 variables.

Results

Table 2 summarizes the descriptive statistics for all variables used in the analyses. The two different samples were quite similar in characteristics and, for all dependent measures, the overall averages changed very little over the course of the first year. Table 3 summarizes the results of our first stage analyses. As Table 3 indicates, the zero-order correlations between the DAL scales and both the precollege and end-of-first-year CAAP CTT scores were, at most, modest in magnitude (ranging from .045 to .183). The zero-order correlations between Higher-Order Learning and the critical thinking scores were near zero and not significant($p > .05$). The zero-order correlations between the DAL scales and the two other measures were modest (.163, $p < .001$) to relatively large (.414, $p < .001$). Across all measures, there was a clear trend for the associations between DAL and the three cognitive outcomes to be stronger at the end of the first

year of college than the associations between DAL and the precollege scores. Indeed, even controlling for precollege scores, the partial correlations between each of the DAL scales and end-of-first-year NCS and PATL scores were all statistically significant, if somewhat modest in magnitude (ranging from .086 to .211, $p < .001$). For CAAP CTT, only Reflective Learning was significantly associated with end of first-year scores controlling for pre-college scores and the size of the effect was small (.073, $p < .01$), though, given the strong relationships between the pre-college and end-of-first-year measures, even a small relationship is notable. Among the sub-scales, Reflective Learning also had the strongest relationship with NCS (.196, $p < .001$), but it was not much higher than the coefficient for Integrative Learning (.180, $p < .001$) and actually a little bit less than that for the overall DAL scale (.211, $p < .001$). The strongest relationship for PATL was with Integrative Learning (.185). These findings show that DAL were related to three important college outcomes even after controlling for pre-college scores, but do not determine the unique effects of the DAL measures controlling for a set of pre-college and college experience measures.

Table 4 shows the results of the general effects regression estimates. Columns 1, 3, and 5 show the estimated effects on each dependent measure for the models that included the Overall DAL Scale. As Table 4 indicates, Overall DAL had no significant effect on Critical Thinking, but had modest and statistically reliable, positive effects on both NCS and PATL that persisted even in the presence of controls for a wide range of potential confounding influences – including precollege academic preparation and precollege scores on each dependent measure. In each model, the precollege scores for the dependent measures were the largest predictors by far (.558 to .671, $p < .001$). For CAAP CTT, precollege academic preparation was the second largest

predictor (.277, $p < .001$). For NCS and PATL, the Overall DAL Scale was the second largest predictor in the models (.150 and .127, respectively, $p < .001$).

Columns 2, 4, and 6 in Table 4 summarize the estimated effects on the dependent measures for the models containing the three deep learning sub-scales. As expected, the effects of the control variables stayed largely the same. Higher-Order Learning had no significant unique influence on any outcome. However, even with statistical adjustments made for the entire list of control variables, Reflective Learning had statistically reliable and positive links to all three outcomes (ranging from .060 to .096, with $p < .05$ for the smallest and $p < .001$ for the other two) and Integrative learning had similarly modest positive links with both NCS and PATL (.073 and .113, respectively, $p < .001$).

Our analyses to detect the presence of conditional effects were all non-significant. None of the sets of cross-product terms were associated with a statistically significant increase in the explained variance for any of the three dependent measures. Thus, the estimated unique effects of the DAL scales on first-year CAAP CCT scores, NCS, and PATL summarized in Table 4 appear to be essentially similar in magnitude for men and women, for students with different pre-college scores on each end-of-first year outcome, and for students with different levels of tested precollege academic preparation.

Discussion

As institutions become increasingly scrutinized for their focus on learning or lack thereof (Arum & Roksa, 2011), educators may need to respond by adopting more rigorous approaches to the study and practice of higher education, especially in the context of teaching and learning. This study takes a small but important step towards this end, as we attempted to uncover specific learning approaches and their influences on three outcomes related to cognitive development:

critical thinking, need for cognition, and PATL. Consistent with previous efforts, our findings suggest that cognitive development is as nuanced as the approaches taken to spur it.

That cognitive developmental trajectories varied based on the form examined was expected given the theoretical essence of each and its relationship with DAL. As the DAL literature makes clear (Biggs, 2003; Ramsden, 2003), it is one's approach to a learning task that effects how and how well one learns. Though our measures of DAL likely tap a general or preferred approach, it is important to remember that they are indicative of the approaches taken in relation to the learning tasks of college. We know from classroom studies (e.g., Chapman, 2001), when the learning task is designed to promote critical thinking skill development and DAL are emphasized, critical thinking skills are gained. Our results and those of others (Nelson Laird, Garver et al., 2008; Reason et al., 2010), which show a lack of connection between overall DAL and critical thinking skills among a general college population, suggest that college students may not be facing tasks that encourage the kind of critical thinking skills tapped by tests such as the CAAP CTT. So, if such skills are important, faculty members and others at colleges and universities need to start creating more tasks that require these skills and emphasizing a deep approach to learning those skills.

Like the overall DAL scale, integrative approaches to learning shared a significant relationship with need for cognition and PATL but not with critical thinking. Perhaps, the cognitive effort needed to integrate information from varied perspectives relies more heavily on the enjoyment rather than the critical nature of learning. Perhaps the affective dimension of learning shared by students with higher needs for cognition and more PATL serves as part of an internal motivation needed to examine truth claims from a variety of perspectives, a hallmark of someone adopting an integrative approach to learning. Alternatively, these results could be an

artifact of measurement similarities among the three scales; unlike the critical thinking measure, the integrative learning, need for cognition, and positive attitude toward literacy scales were all assessed using face-valid, Likert-type scales. Clearly, future research is needed to further illuminate the relationship between integrative learning and cognitive development.

Not only are the differences among cognitive forms of interest, but so are the similarities. It appears as though reflection is a critical component to helping students make developmental gains in the forms of cognition examined for this study. Although varying in degree of influence, more frequent reflection activities engendered movement across all three learning dimensions, including critical thinking, need for cognition, and PATL. Theoretically, this finding is no surprise given that reflection has been a central component of learning since the beginning of discourse concerning the philosophy of education (Smith, 2001). Exemplifying this point and connecting directed reflection to cognitive gains, John Dewey (1916) notes: "Without initiation into the scientific spirit one is not in possession of the best tools humanity has so far devised for effectively directed reflection. [Without these, one] fails to understand the full meaning of knowledge" (p. 223).

Another similarity is notable for the lack of significance found between higher-order learning and each cognitive form. Although higher-order learning has a significant relationship with end-of-first-year NCS and PATL scores even when controlling for the pre-college measures of those outcomes (see Table 3), the unique effect of higher-order learning is near zero in each full model. Given the existence of unique effects for integrative and reflective learning on two and three of the outcomes, respectively, this suggests that the variance higher-order learning could potentially explain in the outcomes is explained by other variables, most likely the other two DAL sub-scales. Rather than suggesting that higher-order learning is not important, this

pattern of findings suggests that emphasizing higher-order learning alone would be unwise. Faculty should be looking for ways to tie higher-order learning activities to integrative and reflective experiences, something the literature on reflective teaching has emphasized as far back as Dewey (Rodgers, 2002) and something AAC&U (2007) has been pushing recently with their emphasis on integrative learning.

An additional similarity is that the effects of DAL on each cognitive form were not conditional on other variables in the models. In other words, the effects of DAL were largely the same for first-year students of different racial/ethnic backgrounds, genders, levels of academic preparation, and so on. This differs from some evidence that suggests that better prepared students benefit more from DAL (Nelson Laird, Garver et al., 2008). The differences in the studies point to interesting questions that need more investigation. Nelson Laird, Garver et al.'s study was cross-sectional, done on a fairly small sample of students largely from two campuses, looked at different outcomes, and included first-year students through seniors. Our study was longitudinal, done on a much larger sample and 19 campuses, but was limited to first-year students. Do the conditional effects appear with only certain outcomes (e.g., reflective judgment and critical thinking dispositions) and not others (e.g., critical thinking skills and need for cognition)? Do the conditional effects largely appear after the first year? Or, are the findings from Nelson Laird, Garver et al. limited to their more specific sample? An affirmative answer to this latter question would suggest the need to better understand the characteristics of the contexts that matter. Reason et al. (2010) showed that average DAL scores at the institutional level did not explain variation in average critical thinking scores or averages on three self-reported gains. Future analyses with WNSLAE data can help to answer some of these questions, but we encourage other researchers to look into this as well.

One simple yet consistent finding in our study is that the means for CAAP CTT, NCS, and PATL barely changed from the beginning of the first year to the end. In other words, according to our measures, the average student's critical thinking skills, engagement and enjoyment of effortful thinking, and enjoyment of various literacy activities did not change as a result of their first year of college. Such results are not uncommon in college impact research (Pascarella & Terenzini, 2005), but remind us that colleges and universities, their faculties and students can do better.

Implications

If we expect to observe cognitive gains over the course of the first-year in school, we should also expect educators to create developmentally-appropriate learning environments for first-year students. Educators need to be trained in student learning and development theory, with particular attention to how first-year students can be appropriately challenged and supported (see Sanford, 1967) as they make the transition from high school to college. Too often the curricular experiences of first-year students emphasize the latter at expense of the former, with educators more interested in using class time to put students at ease than in putting them to work, academically-speaking (see Engberg & Mayhew, 2007).

To make the cognitive gains suggested by this study, educators of first-year students need to enact practices that more frequently encourage students to examine the strengths and weaknesses of their own views, and to a lesser degree, integrate ideas from various sources, including diverse perspectives in their academic work. In short, first-year students make cognitive gains when asked to engage meta-cognitive processes, including reflecting on themselves and integrate diverging perspectives into a formative, working epistemology. Teaching college educators how to enact such practices that then spur the processes responsible

for helping students make cognitive gains remains a challenge, as few graduate programs require courses on learning, student development, or effective pedagogy. Expecting students to learn from faculty who have not been adequately trained to teach remains a ubiquitous problem in American higher education and one underscored by findings from this study.

Conclusion

The results of this study suggest that DAL have important effects on first-year students' need for cognition and positive attitudes toward a range of literacy activities. We also showed that reflective learning had a small effect on critical thinking skills. Though small, this effect should not be over trivialized because it was found after controlling for pre-college scores on the outcome and pre-college academic ability. Further, we showed that among first-year students, the effects of DAL did not vary significantly by student groups or academic ability. Though these findings are important, there is room to improve the development of critical thinking skills, need for cognition, and PATL in the first year. Such improvement will likely require designing more effective learning tasks and the deliberate connection of those tasks to DAL.

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Table 1
NSSE DAL Scales andComponent Items[a]

Scales/Items
Higher-Order Learning(alphas = .82,.75)[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
Integrative Learning (alphas = .72, .67)[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.)
Reflective Learning (alphas = .81, .76)[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
Overall DAL Scale(alphas =.72, .82) [b]
Includes all 12 items in the scales above

[a]Source: Nelson Laird, Shoup, et al. (2008).
[b]First alpha reliability is from Nelson Laird, Shoup, et al. (2008) second alpha reliability is based on the WNSLAE sample.
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.

Table 2
Descriptive Statistics for All Variables

	Analyses			
	CAAP CTT (N = 1,451)		NCS and PATL (N = 3,010)	
Variable	M	SD	M	SD
Precollege CAAP CTT	62.41	5.29		
Precollege NCS			3.40	0.62
Precollege PATL			3.21	0.76
Male	0.47	0.50	0.45	0.49
Caucasian	0.82	0.38	0.82	0.38
Parental education	15.14	2.15	15.22	2.20
Tested precollege academic preparation	24.78	4.91	24.91	4.84
Secondary school involvement	3.57	0.67	3.62	0.61
Academic motivation	3.51	0.56	3.52	0.56
Attends a research university	0.35	0.48	0.35	0.48
Attends a regional institution	0.24	0.43	0.25	0.43
Attends a community college	0.17	0.38	0.15	0.36
Lives on campus	0.72	0.44	0.75	0.42
Hours of on- and off-campus work	7.57	10.22	7.05	9.53
Liberal arts emphasis of coursework	6.15	2.20	6.25	2.18
Overall DAL scale	59.32	15.50	59.46	15.54
Higher-order learning	68.95	20.07	68.43	20.11
Integrative learning	52.97	16.56	53.45	17.08
Reflective learning	57.04	22.46	57.60	22.39
End-of-first-year CAAP CTT	62.63	5.80		
End-of-first-year NCS			3.39	0.62
End-of-first-year PATL			3.15	0.82

Table 3
Correlations Between DAL Scales and Three Cognitive Outcomes[a]

Cognitive Outcome/Correlation	Higher-Order Learning	Integrative Learning	Reflective Learning	Overall DAL Scale
CAAP CTT				
Correlation with precollege score	.050	.093***	.175***	.126***
Correlation with end-of-first-year score	.045	.103***	.183***	.131***
Partial correlation with end-of-first-year score, controlling for precollege score	.009	.018	.073**	.051
NCS				
Correlation with precollege score	.256***	.318***	.349***	.382***
Correlation with end-of-first-year score	.271***	.350***	.382***	.414***
Partial correlation with end-of-first-year score, controlling for precollege score	.125***	.180***	.196***	.211***
PATL				
Correlation with precollege score	.163***	.303***	.327***	.327***
Correlation with end-of-first-year score	.178***	.343***	.346***	.359***
Partial correlation with end-of-first-year score, controlling for precollege score	.086***	.185***	.163***	.184***

[a]Precollege/end-of-first-year correlations were .796, .741 and .742, respectively, for CAAP CCT, NCS, and PATL.
**p < .01, ***p < .001

Table 4

Estimated General Effects of Deep Learning Scales on End-of-First-Year Critical Thinking, Need for Cognition, and Positive Attitude Toward Literacy (Standard Errors in Parentheses)

	CAAP CTT		NCS		PATL	
Predictor	(1)	(2)	(3)	(4)	(5)	(6)
Precollege CAAP CTT	.558***	.550***				
	(.032)	(.032)				
Precollege NCS			.605***	.599***		
			(.029)	(.027)		
Precollege PATL					.671***	.658***
					(.026)	(.025)
Male	-.100*	-.100*	.018	.017	-.082**	-.089**
	(.047)	(.046)	(.044)	(.034)	(.023)	(.026)
Caucasian	.039	.046	.025	.026	-.057	-.059
	(.044)	(.044)	(.045)	(.045)	(.042)	(.041)
Parental education	.019	.019	.014	.013	.022	.020
	(.019)	(.018)	(.016)	(.017)	(.015)	(.016)
Tested precollege	.277***	.275***	.109***	.108***	.079***	.082***
academic preparation	(.046)	(.045)	(.024)	(.024)	(.017)	(.017)
Secondary school	.012	.010	-.003	-.003	-.027	-.030
involvement	(.039)	(.039)	(.019)	(.020)	(.017)	(.016)
Academic motivation	-.001	.000	.056**	.059	.030	.032*
	(.016)	(.017)	(.015)	(.014)	(.016)	(.015)
Attends a research	.033	.043	-.074*	-.071*	-.110**	-.105**
university	(.063)	(.067)	(.032)	(.032)	(.034)	(.033)
Attends a regional	-.103*	-.106	-.047	-.050	-.070*	-.069
institution	(.051)	(.052)	(.047)	(.045)	(.034)	(.036)
Attends a community	-.202	-.203	.172*	.165	-.147	-.149
college	(.150)	(.149)	(.081)	(.082)	(.120)	(.114)
Lives on campus	-.156*	-.154*	.033	.036	-.083	-.083
	(.068)	(.071)	(.046)	(.050)	(.161)	(.158)
Hours of on- and off-	-.046	-.048	-.025	-.024	.004	.008
campus work	(.036)	(.036)	(.024)	(.024)	(.013)	(.012)
Liberal arts emphasis of	.019	.020	.028*	.028*	.023	.024
coursework	(.029)	(.029)	(.013)	(.013)	(.022)	(.023)
Overall DAL scale	.028		.150***		.127***	
	(.023)		(.036)		(.033)	
Higher-order learning		-.027		.023		-.019
		(.028)		(.056)		(.028)
Integrative learning		.007		.073**		.113***
		(.027)		(.025)		(.029)
Reflective learning		.060*		.096***		.069***
		(.026)		(.015)		(.014)
R^2	.706***	.708***	.589***	.591***	.577***	.581***

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

Note. Except where noted, columns contain regression coefficients with standard errors in parentheses.